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EXPERT VIEWS ON HURRICANE AND FLOOD PROTECTION AND WATER RESOURCES PLANNING FOR A REBUILT GULF COAST

(109–36)

HEARING

BEFORE THE

SUBCOMMITTEE ON
WATER RESOURCES AND ENVIRONMENT

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

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CONTENTS

TESTIMONY

	Page
Butler, Raymond, Executive Director, Gulf Intracoastal Canal Association	37
Coffee, Sidney, Executive Assistant to the Governor for Coastal Activities, Baton Rouge, Louisiana	11
Dalrymple, Robert A., Ph.D., P.E., Willard and Lillian Hackerman Professor of Civil Engineering, Johns Hopkins University, on behalf of the American Society of Civil Engineers	37
Dokka, Dr. Roy K., Fruehan Endowed Professor of Engineering, Director, Louisiana Spatial Reference Center and Center for Geoinformatics, Louisiana State University	37
Grumbles, Hon. Benjamin H., Assistant Administrator for Water, Environmental Protection Agency	11
Hoogland, Jan R., Director, Rijkswaterstaat, accompanied by Dale Morris	37
Reed, Dr. Denise J., Professor, Department of Geology and Geophysics, University of New Orleans	37
Strock, Lieutenant General Carl A., Chief of Engineers, U.S. Army Corps of Engineers	11
Walker, William W., Executive Director, Mississippi Department of Marine Resources	11
Woodley, Hon. John Paul, Jr., Assistant Secretary of the Army, Civil Works, U.S. Army Corps of Engineers	11

PREPARED STATEMENT SUBMITTED BY A MEMBER OF CONGRESS

Costello, Hon. Jerry F., of Illinois	76

PREPARED STATEMENTS SUBMITTED BY WITNESSES

Butler, Raymond	54
Coffee, Sidney	59
Dalrymple, Robert A	77
Dokka, Dr. Roy K.	87
Grumbles, Hon. Benjamin H.	100
Hoogland, Jan R.	119
Reed, Dr. Denise J.	133
Strock, Lieutenant General Carl A.	142
Walker, William W	146
Woodley, Hon. John Paul, Jr	154

ADDITIONS TO THE RECORD

Rounsavall, Mark, Director, Rural Community Assistance Program of the Community Resource Group, Inc., statement	163
Williams. S. Jeffress, U.S. Geological Survey, U.S. Department of the Interior, statement	170

EXPERT VIEWS ON HURRICANE AND FLOOD PROTECTION AND WATER RESOURCES PLANNING FOR A REBUILT GULF COAST

Thursday, October 20, 2005

HOUSE OF REPRESENTATIVES, COMMITTEE ON TRANSPORTATION AND, INFRASTRUCTURE, SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT, WASHINGTON, D.C.

The committee met, pursuant to call, at 10:00 a.m. in room 2167, Rayburn House Office Building, Hon. John J. Duncan [chairman of the committee] presiding.

Mr. DUNCAN. I want to welcome everyone to the second hearing, and I think a very, very important hearing in the Water Resources and Environment Subcommittee on the response to Hurricane Katrina.

On Tuesday, in a joint hearing with the Economic Development, Public Buildings and Emergency Management Subcommittee, we heard from Governor Blanco, Lieutenant Governor Landrieu and Mayor Nagin, as well as community and industry leaders, on their visions for rebuilding New Orleans. All of the witnesses eloquently expressed their strong desire to make New Orleans safe so its people will come back and its economy will revive.

To achieve this, Mayor Nagin said providing category 5 hurricane protection is one of his top priorities. However, both the Mayor and the Governor admitted that they do not yet have a rebuilding plan, and some neighborhoods may have to be relocated instead of rebuilt. In New Orleans and southern Louisiana, decisions about hurricane and flood protection cannot be made in isolation. These decisions must consider the need to protect people and property, maintain navigation, protect oil and gas infrastructure and sustain fisheries and wildlife habitat. Today's hearing focuses on these issues.

On the first panel, we will hear from the Corps of Engineers, the EPA and representatives from the State of Louisiana and the State of Mississippi. On the second panel, we will hear from engineering, geology, marsh restoration and navigation experts.

I hope these witnesses will be able to provide the Subcommittee with information on feasible options for providing hurricane protection for the Gulf Coast. This information will help guide the Committee's response to requests from the State of Louisiana and Mississippi and others for new authorizations.

The State of Louisiana is asking Congress to direct the Corps of Engineers to build category 5 hurricane protection for New Orleans and the entire coast of Louisiana at a total cost of about $18 billion. It probably would run higher than that. And to build the

State's coastal restoration plan at a total cost of $14 billion or even higher at full Federal expense and with no feasibility analysis.

The State also is asking Congress to authorize and appropriate all of this funding right now, as an emergency expense, on top of the $62 billion of emergency Katrina response funding that has already been appropriated. In fact, as everyone knows, some people have talked about spending as much as $250 billion overall for the problems caused by Hurricane Katrina. I don't believe that the Congress can or will appropriate anywhere close to that much money in response to this disaster.

This type of funding is just not going to happen, not because Congress does not want to help New Orleans and the State of Louisiana and the other areas affected, in fact, as I mentioned a couple of days ago, I think we saw the worst damage in the State of Mississippi. But I think this is not going to happen because it would be inconsistent with our responsibility to the taxpayers to ensure that these projects are in the Federal interest and technically feasible and economically justified.

Right now, we don't have enough information to make all these determinations. We can work with the Corps and the State to streamline the process, but we cannot abandon our responsibilities by authorizing a black box and letting other people decide how taxpayer dollars should be spent.

In fact, we do not even know why the Katrina storm surge breached the existing levees in New Orleans. I have also read articles that insurance companies have obligations anywhere from $20 billion to $100 billion and we need to make sure that they fulfill their obligations. Of course, they seem to be fudging as much as possible up to this point.

If the reason why these levees were breached, turns out to be weak soil conditions; that will radically change how the Corps can design and engineer hurricane protection. Building higher levees may not be technically feasible. The only feasible option for providing New Orleans with category 5 hurricane protection from storm surges coming from Lake Pontchartrain may be the barrier gates that Congress authorized in 1965. Construction of these gates was halted by various lawsuits through the 1960s and 1970s, about 20 years worth.

A very rough estimate of the cost of building the barriers at the mouth of Lake Pontchartrain and raising some levees to provide category 5 protection for the city of New Orleans from storm surges is about $5.5 billion and probably higher. This investment is probably justified under traditional cost benefit analysis. If not, it is probably justified because New Orleans is below sea level, increasing the risk of flooding and the consequences of the citizens' failure to evacuate.

I am not aware of any economic risk or consequence justification for providing category 5 hurricane protection along the entire coast of Louisiana. If there is a justification, we need to hear it and then apply the same standards nationwide. That is one of the considerations that we have to deal with because we are starting to get requests from all over the Nation because of the heightened levels of concern because of the Hurricanes Katrina and Rita.

For example, the city of Sacramento, California has almost twice as many people as New Orleans. Yet it has less flood protection than any other city in America. Cities like Houston, St. Louis and Miami are also at risk. We cannot treat citizens of these cities differently unless we have a policy reason that we can explain and justify to our constituents.

If Congress decides to build hurricane protection projects in Louisiana at full Federal expense with no justification and no feasibility studies, we must be prepared to do the same for thousands of miles of coastline across the Country, and that simply would not be possible. There is not enough money in the Federal Treasury to do everything that everyone wants us to do.

I have similar concerns about the request for full authorization of funding of the State's Coast 2050 plan. That plan is a framework for directing further study, but it is not a building plan. Restoring the coastal Louisiana marsh lands is very important, but before spending billions of taxpayer dollars, we have to make sure that the projects will work.

Geologists tell us that the Louisiana coastline is sinking. This may limit our ability to engineer a new coastline. We also need to make sure that adverse impacts on navigation and flood protection and oyster beds are held to a minimum. In addition, Congress may want to invest in marsh restoration in areas that will protect oil and gas infrastructure. Although this is used as a reason to justify spending on the Louisiana coastal restoration, the Corps plan and the State's plans were formulated as ecosystem restoration plans, not hurricane protection projects. We have no analysis that shows that the proposed projects will protect oil and gas infrastructure.

Finally, we need to work with the State of Louisiana on appropriate cost sharing. We understand that the economy of New Orleans and southern Louisiana has been devastated. That may be a reason to defer cost sharing in the near term.

Under current law, the Secretary of the Army may allow the non-Federal private sponsor to defer payment of the local cost sharing during project construction without accruing interest and may allow payment of the local share over a period of time up to 30 years with interest. Rather than waiving cost sharing, perhaps the Secretary of the Army should use this existing authority to ensure that Louisiana hurricane protection projects can proceed while the State's economy recovers, but without waiving all of the cost sharing rules and doing all of this work at total Federal expense.

There are a lot more issues that I hope and I know we will discuss with the witnesses, both today and in our hearing next week. But let me now apologize for the length of that statement and turn to the Ranking Member, Ms. Johnson, who will give her opening statement.

Ms. JOHNSON. Thank you very much, Mr. Chairman. Today's hearing is the second in a series of three hearings to examine the devastating effects of Hurricanes Katrina and Rita, how we might go about rebuilding and protecting the Gulf Coast communities and the Nation's hurricane damage and flood damage reduction programs.

On Tuesday, we heard from Governor Blanco, Mayor Nagin and others on their vision to a rebuilt New Orleans. Obviously, our re-

sponse will extend to the entire Gulf Coast. But the intensity of the human impact is so great in New Orleans that it serves as a good starting point for the examination.

Today we will hear from Federal and other witnesses concerning how we might actually go about rebuilding and protecting New Orleans and the Gulf Coast. If Tuesday represented the what, then today begins the how. Rebuilding the Gulf Coast will require thoughtful solutions, not unlike the massive efforts to address flooding of the Mississippi River in the last century.

However, we must be careful to avoid the mistakes and unintended consequences of that effort. For example, the very success of the flood protection project for the lower Mississippi valley continues to contribute to the loss of coastal wetlands that are crucial to protection from hurricanes.

As we heard in Tuesday's hearing, our State and local partners must make decisions on how and where to rebuild. Then we must join together to determine how best to provide sufficient protection from hurricanes and floods, so that the devastation we witnessed does not occur again. We must ensure that we do not repeat the shortcomings that contributed to the devastation. If we build levees, they must hold. If we build barriers, they must respect the environment and not threaten our communities. We must be sure that the poor are not denied the opportunity to return to the coast and are afforded protection at least as great as the affluent.

However, this effort is more than levees, flood walls, surge barriers, wetlands and barrier islands. It is about anticipating the needs of the communities. It is about making sure that the economic benefits of the rebuilding efforts accrue to local business interests. We must ensure that money spent in the coastal area stays in the coastal area and does not enhance the balance sheets of multi-national corporations.

Contracting must be transparent and available to local firms. As Mayor Nagin stated, rebuilding economic activity is central to rebuilding the area. Rebuilding is also about ensuring that the workers who return to the area are afforded the opportunity to earn a fair wage for a fair day's work and that all labor protections are provided. How can we tell a worker who lost his home and everything he has or she has that they can't have a job or if they are hired, they can be paid less than prevailing wages?

As we heard on Tuesday, the economy and therefore the people of the Gulf Coast can recover if given a hand up. It is our responsibility to provide that in a way that protects the people, the environment, the community and the culture that is an integral part of our one Nation.

Mr. Chairman, addressing the societal and infrastructure shortcomings that were laid bare by Hurricanes Katrina and Rita will be a monumental task. It will cost several billions of dollars, take many years and is likely to cause permanent change in the lives and lifestyles of the Gulf Coast region. We need to do our best to make sure that all the changes in the Gulf Coast region are positive.

I look forward to today's testimony and thank you again for calling the hearing.

Mr. DUNCAN. Thank you very much, Ms. Johnson. Mr. Gilchrest.

Mr. GILCHREST. Thank you, Mr. Chairman. I will just be very brief. I appreciate this hearing, the witnesses that you have called, your opening statement. What some of us are going to be looking for is understanding over the last literally maybe 250 years, certainly over the last 100 years, that we have re-engineered the ecological system of the mid-section of the United States and the Gulf of Mexico along coastal Louisiana, Mississippi, Alabama, Florida and Texas. We re-engineered sediment diversion, we have re-engineered marsh creation, we have re-engineered the barrier islands, shoreline protection, the hydrology, the vegetation. We have re-engineered that part of the world, totally re-engineered it.

So what we are going to have to do with 2050 and the Louisiana coastal restoration projects and all the other myriad of things that need to be done is to understand what we did and then try to piece that thing back together in an extraordinary, in what we have just heard, an enormous task ahead of us, which is going to cost billions of dollars.

I am not sure how many meteorologists, climatologists, hydrologists, wildlife biologists, wetland biologists, coastal barrier scientists were in on the first engineering project. But we sure need them on this engineering project, and we certainly know that the oil and gas industry needs to be protected, the people need to be protected. We don't want to give up the wildlife, the ecosystem, the magnificent place of this area of the United States. And there are some things we don't have any control over, so we have to factor that into the equation.

Right now, basically we have no control over climate change. We have no control over plate tectonics. We have no control over sea level rise. So I hope those factors are statistically factored into the modeling of how much we can restore the Gulf of Mexico, the Louisiana coast, over the next 50 years. And the Chairman mentioned the 2050 project. Along with that, we have CWPRA spending over the last decade or so, and then we have this LCA or LCR, whatever that is called on top of all of that. Then I understand that we can only save about 50 percent of the coastal area between now and 2050 with every effort at full throttle.

So Mr. Chairman, I appreciate the call of this hearing. And we want to be helpful, this Committee wants to be helpful. But we want to make sure that the number of people that are participating in this project is enough, we have enough scientific expertise to get our hands around this comprehensive, complicated issue.

Thank you, Mr. Chairman.

Mr. DUNCAN. Thank you, Mr. Gilchrest. Mr. Blumenauer.

Mr. BLUMENAUER. Thank you, Mr. Chairman.

I appreciate, again, in your opening statement, the way that you expressed the challenge. I apologize in advance: I have been working for the last five years in the flood insurance issue and there is a concurrent hearing going on dealing with fine tuning of that. I will be shuttling back and forth. But I wanted to be here to express my appreciation for what you and the Ranking Member have been focusing on, this series of hearings. As Ranking Member Johnson pointed out, you also have to consider the human dimension as well as the practical, and I think that is very important.

This is an issue that goes beyond the Gulf and recovery. We have been having these conversations with our friends in the Corps, on my part, for the last five or six years, and they are trying to look at the big picture. We have 70 percent of the American public that is at risk of one or more natural hazards, of which flooding is only the most common. But we have earthquakes, we have coastal erosion that is a national issue over the next 50 years. We are going to be seeing coastlines eroding.

And I appreciate the focus here on how we look at the big picture, how we look at the cost, how we use existing resources in the Corps, how we use the rebuilding process to learn from it, make the community stronger, and energize them economically if it is done right. And it is important that we as a Committee don't duck the hard answers to the difficult questions that we are asking and exploring.

This whole notion of cost effectiveness that was offered up with good intention actually may well have a perverse effect, because it really doesn't enable us to focus on the consequences of human loss of life and injury, and because of a narrow definition of cost effectiveness that invites local boosterism is natural.

It has actually promoted projects that probably put more people at risk, that create more problems over the long haul and are really difficult to get our hands around. We need to revisit this—and I will only say once about the principles and guidelines that after 25 years need to be updated. But these are things that we should capture so we don't put the Corps in the cross-fire.

I deeply appreciate all the previous members talking about the ecosystem and the big picture. Because if we don't get this right, we don't have enough money to buy concrete and to rebuild. We have to harness the forces of nature to solve the problems by the destructive forces of the nature that are visited upon us.

I do think that this can be a national model with the leadership that we are seeing from this Committee. We can establish principles that will save lives, will save the environment and will save the Treasury money. I deeply appreciate the way that you are structuring this common sense, thoughtful approach. I just hope that we as a Committee are willing to bite the bullet on some of these controversial solutions that are going to come out so that we empower people to do their job right.

Mr. DUNCAN. All right, thank you very much.

Dr. Boustany.

Mr. BOUSTANY. Chairman Duncan, I want to thank you for convening this hearing today. As Vice Chair of the Subcommittee, I applaud your leadership in holding this whole series of hearings examining the devastation that was caused by Hurricanes Katrina and Rita.

I think it is important as we go forward to look at the future implications for flood control, hurricane protection in the broad sense, just as my colleague just mentioned, looking at ecosystems and so forth.

But I have to say, and I think all of us would agree, that the top priority in rebuilding the great City of New Orleans will be providing a safe environment in which businesses can grow and return. Critical to that is going to be providing safety, because if we don't

do it, insurers will not return to this market, and we will see a completely failure economically. So protecting New Orleans from future flooding is really at the heart of the matter.

I know the Corps is well underway in its work to repair the levee system and the damage, and you have done a magnificent job under very adverse conditions, and I applaud your efforts. But this is only going to take us back to pre-Katrina levels, so we need to look and make sure that we can rebuild New Orleans safely and a safe levee system to prepare for future category 5 storms.

As the Subcommittee staff has recommended, and I have reviewed previous testimony going back to 1965, it has been pointed out that many options have been discussed for providing more extensive hurricane protection. All of these have consequences and tradeoffs, so we need to consider all of these very carefully. I personally believe we need to revisit the feasibility of the Lake Pontchartrain barrier plan that Congress initially authorized in 1965. We need to update this plan.

As we move forward, I do want to work with the Chairman to ensure that the Corps develops a comprehensive, peer-reviewed levee plan with an expedited and specified time frame, not only for the plan, but for the implementation. I agree, time is of the essence in this. And I believe those should be our guiding principles.

While much of the media post-Katrina was focused on the flooding in New Orleans, we cannot ignore the devastation inflicted upon the entire Gulf Coast. Hurricane Rita made landfall in my district. Cameron Parish was completely destroyed with massive flooding and hurricane force winds. Vermilion Parish, which is a parish that has extensive agricultural property—rice, sugar cane, cattle—had extensive flooding. Crops were destroyed by saltwater intrusion, homes were lifted from their foundations. We need to consider this area of the State as well.

The storm surge from Hurricane Rita impacted regions as far as 40 miles inland. Scientists estimate that storm surge in a hurricane is reduced by one to three feet for every two miles of coastal wetlands. This needs to be considered as we move forward.

Over 15,000 acres of Louisiana are lost each year to coastal erosion. United States Geological Survey estimates the State has lost about 1.22 million acres of coastal wetlands in the past 70 years, roughly the equivalent area to the State of Delaware.

I have worked closely with the Chairman and members of this Committee and staff as we drafted the 2005 Water Resources Development Act to include funding for a number of vital restoration projects in coastal Louisiana. I appreciate the Subcommittee's support on all of this.

I also want to say that much of this was focused in southeast Louisiana, and we can't neglect southwest Louisiana. Restoring Louisiana's coast is not just a public safety issue, it is not just a Louisiana issue, it is a key economic issue for all Americans. Eighty percent of our Nation's offshore oil and gas is produced off the Louisiana coast. Twenty-five percent of foreign and domestic oil used in this Country comes ashore through Louisiana ports.

In the little town of Henry in Vermilion Parish is a natural gas facility that accounts for 49 percent of natural gas production in this Country, but it is out of commission. Still out of commission.

If we don't get this up and running, we are going to see major spikes in natural gas prices.

More than 25 percent of our seafood that is consumed in the U.S. comes through Louisiana.

So I appreciate the Subcommittee holding this series of hearings. I appreciate Chairman Duncan's leadership on this. I look forward to working with the Chairman as we address a number of these issues, and I look forward to hearing all of your testimony. Thank you very much.

Mr. DUNCAN. Thank you very much, Dr. Boustany. You have been a very active member of this Subcommittee, and I appreciate your work as Vice Chairman. As we have mentioned before, there is no bill in the history of the Congress that potentially does more with regard to hurricane and flood protection and ecosystem restoration than does the Water Resources and Development Act, the WRDA bill that we have passed once again in the House. And the Senate needs to move on that, if they really want to help out in a very specific way. Because we have many sections of the WRDA bill that deal with a lot of the things that Dr. Boustany just mentioned.

Mr. Pascrell.

Mr. PASCRELL. Thank you, Mr. Chairman.

I want to thank you and Ranking Member Johnson for getting us together in this hearing today. Why do we need a national catastrophe to take care of parts of the infrastructure that Chairman Duncan has been talking about and many other people have been talking about for years? It is pretty mind-boggling. Why do we need a national catastrophe to expose the neglect of the poor and the neglect of our infrastructure?

So Water Resources and the Environment Subcommittee has not been listened to. And I think we need to understand that, and will it be any different tomorrow? So it has been four years since 9/11. It has been three years since we created the Homeland Security Department. The utter lack of preparation and pathetic emergency response we saw with Katrina is wholly unacceptable.

If I had the time, I would quote the words of Governor Bush of Florida yesterday who appeared before Homeland Security and what he thinks about the preparedness.

In every step of this catastrophe, the Federal response has been consistently and utterly behind the curve. The opportunity to show what the Federal Government can do for preparation and immediate response has passed us by, and millions have suffered because of that failure. It is imperative that this Committee and the agencies on this panel help ensure that for long term response the Federal Government will properly assist in the rebuilding of the Gulf Coast.

It is also imperative that this Committee continue to call attention to the larger issue of the need of infrastructure investments nationwide, not just in the Gulf. We can't control mother nature. Flood mitigation projects could have reduced the number of deaths and limited the economic devastation around the Gulf. That is either true or false, what I have just said. I want to repeat it, I want to emphasize it, because we are accessories to the crime. Flood

mitigation projects could have reduced the number of deaths and limited the economic devastation around the Gulf.

We can't be halfway on this. It is either right or wrong. I will stand corrected if you prove me wrong.

Cutting the Army Corp's budget is the favorite pastime of the Office of Management and Budget under administrations that are both Democratic and Republican. It is a favorite pastime. Do you know what it is like? It is like what happens in towns all across America when it comes time to tighten your belt, particularly in boards of education or cities. The first thing they do is cut the library's budget. Then they cut the sports recreation budget. So it is like an automatic knee jerk.

We are jerks, all right, for not understanding the significance of the Corps. And I tell you one thing, I don't think the Corps fought enough against those budget cuts. I was here, Duncan was here, Johnson—we were all here. A more robust highway and transit system could have done a better job, allowing movement of people out from the region and supplies into the region. In the coming months, we will need massive infrastructure investments to meet transportation and water resources needs, not only in New Orleans, but nationwide.

God help us if we take the little that the poor have left in that area so that we prioritize and move to other resources, so we cut off our nose to spite our face. God help us if we do that in the next four or five days in this House. Why don't we start with Medicaid? We can find a lot of money in Medicaid, put some more money into the Army Corps of Engineers. On the street, there is a name for that kind of stuff.

The question remains, will our priorities be affected by Katrina? Let us not only rebuild the Gulf, we are committed to that, we have heard enough commitments. But let's rebuild and upgrade the infrastructure throughout our Nation. As we know, devastation from natural or man-made disasters can happen any time. Our Nation's economic competitiveness and our citizens' quality of life depend on if we have learned our lesson and how we choose to respond.

Thank you again, Chairman. I think that hopefully somebody in leadership will be listening to you this time.

Mr. DUNCAN. Thank you very much, Mr. Pascrell. I always admire and respect your statements so much. With your experience as mayor of a major city, I think you understand some of these problems far better than most people in the Congress. I appreciate that.

Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman. Thanks for holding this hearing today and I appreciate very much this panel coming and giving us some insight on what is happening down in the Gulf Coast. I was down there a couple of weeks ago, I know it is a real challenge for not only that community, but for the whole United States.

Having said that, I represent South Carolina, which is also a hurricane-prone region. My good friend from Louisiana just stated about being proactive, and trying to help, at least lessen some of the storm damage. I know that our big issue, I represent about 160 miles of the coast, is beach renourishment. I certainly would hope,

Mr. Woodley, that you would not, and General Strock, would not give up on the fact that we really need to be proactive. Because it has been proven that those beaches that are renourished certainly have less damage when those storms coming. We can't prevent the storms from coming, but we can deal proactively in the process.

So thank you all for coming, and I am certainly anxious to listen to you.

Mr. DUNCAN. Thank you very much, Mr. Brown.

Probably the most active member of this Committee in regard to Hurricane Katrina and all the damage and all the problems that have resulted is Chairman Shuster, who I think was the first member of our Committee to go to the scene, possibly along with Congressman LoBiondo. At any rate, Chairman Shuster co-chaired the hearing with me on Tuesday, and we are certainly pleased to have him here with us now. Chairman Shuster.

Mr. SHUSTER. Thank you, Mr. Chairman. And thank all of you for being here today. This is an important hearing for a number of reasons, to find out what happened. I don't think we have determined why yet, I have heard some theories that maybe a barge hit, and the General and I spoke about that a little bit, but at that point, we weren't sure what happened.

As we move forward, what to do, do we build the levees back to withstand a category 3 or a category 5? The levees will stand, but will the houses that we are leaving there withstand a category 5? And questions about does it make sense to rebuild parts of the city, and we are going to rebuild, I am sure, the majority of New Orleans, but maybe there are sections that with your expert testimony here and moving forward, are there parts that maybe we shouldn't build. There are a lot of questions that I am looking forward to hearing the answers.

Again, I want to thank all of you for being here today and I look forward to hearing your testimony. Thank you.

Mr. DUNCAN. Thank you very much.

The first panel is a very distinguished panel, consisting of the Honorable John Paul Woodley, Jr., Assistant Secretary of the Army for Civil Works of the U.S. Army Corps of Engineers, who has been with us on several occasions. Also, in fact the first three witnesses, General Strock and Administrator Grumbles has been with us several times, too.

The second witness will be Lieutenant General Carl A. Strock, the Chief of Engineers of the U.S. Army Corps of Engineers. The third witness will be the Honorable Benjamin H. Grumbles, Assistant Administrator for Water of the Environmental Protection Agency. Then we have Ms. Sidney Coffee, the Executive Assistant to the Governor for Coastal Activities, from Baton Rouge. And finally, Dr. William W. Walker, who is the Executive Director of the Mississippi Department of Marine Resources, from Biloxi, Mississippi.

Thank you very much for being with us, and Secretary Woodley, you may begin your testimony. All full statements will be placed in the record. You are allowed to summarize and then we will get to the questions.

TESTIMONY OF THE HONORABLE JOHN PAUL WOODLEY, JR., ASSISTANT SECRETARY OF THE ARMY, CIVIL WORKS, U.S. ARMY CORPS OF ENGINEERS; LIEUTENANT GENERAL CARL A. STROCK, CHIEF OF ENGINEERS, U.S. ARMY CORPS OF ENGINEERS; HONORABLE BENJAMIN H. GRUMBLES, ASSISTANT ADMINISTRATOR FOR WATER, ENVIRONMENTAL PROTECTION AGENCY; SIDNEY COFFEE, EXECUTIVE ASSISTANT TO THE GOVERNOR FOR COASTAL ACTIVITIES, BATON ROUGE, LOUISIANA; WILLIAM W. WALKER, EXECUTIVE DIRECTOR, MISSISSIPPI DEPARTMENT OF MARINE RESOURCES

Mr. WOODLEY. Thank you, Mr. Chairman. I will be brief.

I am John Paul Woodley, Jr., Assistant Secretary of the Army for Civil Works. I am delighted to be here with the Committee again today, along with Lieutenant General Carl Strock, my colleague, the 51st Chief of Engineers.

The thorough analysis and much thoughtful consideration of alternatives and careful attention as to how best to integrate future protection objectives with one another and with the coastal wetlands ecosystem will guide future consideration and decision making in reconstruction of the Louisiana and Mississippi Gulf Coast. The President has pledged the support of the Corps of Engineers to work with the State, city and parish officials to make the flood damage reduction system better and these local officials will have a large part to play in the engineering decisions to come.

Our first and most urgent need is to assess the performance of the hurricane projects in place at the time of the Katrina and Rita storm events. We will use these findings to ensure that restoration plans for existing hurricane protection features are technically sound, will have efficacy and can be accomplished in a way that is environmentally acceptable.

Information developed by the forensic analysis and from performance assessments must be available in time to be integrated into the design, engineering and reconstruction of existing hurricane and flood protection features for New Orleans that are to be completed before the beginning of the next year's hurricane season. In this regard, the Corps is already very hard at work, having established an interagency performance evaluation task force to collect and assess information.

In addition, the Secretary of Defense has directed the Secretary of the Army to convene an independent, multi-disciplinary panel of acknowledged national and international experts from the public and private sectors and academia under the auspices of the National Academies of Science and the National Academy of Engineering, to evaluate the information collected and assess the performance of the hurricane protection systems in New Orleans and surrounding areas. The National Academies will report directly to me, and their study is expected to take approximately eight months to complete.

All reports, Mr. Chairman, generated by these panels, will be made available to this body and to the public, of course.

While the forensic analysis may recommend ways to improve the performance of the hurricane protection system at the currently authorized level of protection, more analysis and a broader range of considerations are required to determine the most efficient, effec-

tive and practical ways to increase the level of protection for this urban area. The President has pledged that Federal funds will cover a large measure of the costs of repairing public infrastructure in the disaster zones, from roads and bridges to schools and water systems. Certainly if called upon, the Corps of Engineers and the Army as a whole is ready to execute a broad array of engineering construction and contract management services.

We are especially mindful that the coastal wetlands ecosystem can provide a buffer against the impact of some storms. The coastal wetlands are the literal, figurative and conceptual foundation upon which future potential hurricane, flood protection and other development infrastructure must be integrated. The Administration is working with Congress and the State of Louisiana to develop appropriate generic authorizations for the Louisiana coastal area ecosystem protection and restoration program. They will expedite the approval process for projects and their implementation while providing greater flexibility in setting future priorities and increased opportunities for application of adaptive management decision making.

Such an integrated, programmatic approach to coastal wetlands protection and restoration is essential for efficiency and efficacy. The same approach should be considered in a process that allows for a holistic solution to challenges presented in New Orleans and coastal Louisiana.

Thank you, Mr. Chairman. That concludes my statement.

Mr. DUNCAN. Thank you very much, Secretary Woodley.

General Strock.

General STROCK. Mr. Chairman and members of the Committee, I am Lieutenant General Carl Strock. I am the Chief of Engineers and Commander of the U.S. Army Corps of Engineers.

I am honored to appear before the Committee today to testify on the potential role of the Corps of Engineers in the rebuilding of New Orleans. The people and the infrastructure of the Gulf Coast have suffered a catastrophe, and we also recognize that the national economy has been dramatically affected by this disaster. We and the rest of the Federal family are absolutely committed to doing everything we can to provide the needed assistance in setting the conditions for a full and rapid recovery.

We are continuing to execute our missions under the Federal Emergency Management Agency. New Orleans is essentially dry. We are working hard to provide interim protection for the remainder of the system and our goal is to restore to pre-Katrina levels of protection by the beginning of the next hurricane system next June. Navigation has largely been restored across the entire Gulf Coast to its pre-storm condition with great assistance from the U.S. Coast Guard, NOAA, State and industry partners.

We are currently mapping damage and collecting data for analysis of the performance of the system. We are doing this with our own engineering research and development center, with the National Science Foundation, with the American Society for Civil Engineers, and with an independent study by Louisiana State University. This analysis is to ensure that restoration is accomplished in the most technically sound, the most environmentally sustainable and the most economic manner.

In addition, at the direction of the Secretary of Defense, the Secretary of the Army has requested the National Academies to conduct a forensic analysis. This will include an independent peer review of the analysis performed by the Corps of Engineers and others. The purpose is to assess the performance of the system during the storm, to evaluate its performance and recovery from the storm, to identify any weaknesses in the system and then to recommend improvements. We expect this study should take about eight months to complete.

In his address to the Nation last month, the President committed to helping the citizens of the Gulf Coast rebuild their communities. The Corps is prepared to assist in that in many ways. We are replacing hundreds of public buildings in Mississippi, police and fire departments, city halls and other governmental buildings.

Yesterday I was in De Lisle, where I visited a middle and high school that had just opened after 15 days of effort by a Corps of Engineers team. Twelve hundred students are back at their desks now. This is critical, because it allows families to come home and it allows the children to continue their education, and it allows their parents the opportunity to focus on rebuilding their lives and livelihoods without worrying about their childrens' welfare.

The President also committed to rebuilding communities better and stronger than before the storm. Certainly local and State officials will have the lead in planning that effort. But the Corps will work with them to provide better and stronger flood and storm damage reduction systems to support their efforts.

The design of a stronger hurricane and flood protection system for New Orleans is an extremely complex task. We completed a reconnaissance study in 2002 and concluded there is a Federal interest in increased protection.

A feasibility study would normally now be necessary to consider the full suite of alternatives. We would anticipate this study would cost approximately $12 million, would normally be cost shared with a local sponsor, 50-50. We would obviously expedite the study. Even with expediting, we think this study may take from two to three years to complete, depending on negotiation of the cost sharing agreement and availability of Federal and non-Federal funding.

So I would like to close by echoing Mr. Woodley's comments and those of many of the panel members on the importance of coastal wetlands to hurricane protection. As we evaluate and possibly implement structural changes to the hurricane protection system in the New Orleans area, we must not lose sight of the important role that barrier islands and wetlands play in the Louisiana coastal area. While there is adequate justification for coastal wetlands restoration for a host of reasons, it is certain that these features will continue to provide a critical, natural component of the storm damage reduction system.

Again, I appreciate the opportunity to appear before the Committee. I want to assure you that we will remain focused on this important regional and national effort. Thank you, sir.

Mr. DUNCAN. Thank you very much, General Strock.

Administrator Grumbles.

Mr. GRUMBLES. Thank you, Mr. Chairman. It is my pleasure to appear before the Committee.

I know first-hand the passion and sincerity of the members of the Committee when it comes to the importance of investing in and sustaining the Nation's infrastructure. I am here on behalf of the U.S. EPA to talk about our role and responsibilities in the aftermath, as well as what we have done throughout since the hurricanes hit, and to focus on the water resources planning in a rebuilt Gulf Coast.

Mr. Chairman, the bottom line from an EPA perspective on this subject is that we must learn from and not lose sight of the importance of sustainability, sustainable infrastructure and also the importance of wetlands barriers and buffers. So that is the primary message from an EPA perspective, as we work with our partners at the State level and the local level and our partners at the Federal level, particularly the Army Corps of Engineers is to focus on and take advantage of this unique moment in history like never before to focus on sustainability, sustainable infrastructure, both man-made and natural infrastructure, the green infrastructure.

U.S. EPA was involved days before Hurricane Katrina actually hit land. There was pre-deployment and a coordinated effort with our colleagues, FEMA and other agencies, Federal, State and local. Mr. Chairman, the focus throughout this whole effort has been to approach this from a perspective of compassion, coordination and common sense. Compassion focused primarily on the emergency rescue at the initial stages of response. As we move into the recovery stage and the long term recovery stage, that is also where it really requires a great deal of common sense and coordination.

I would just say that EPA has various responsibilities under the Stafford Act, and in coordination with the Army Corps clearly, Army Corps is in the lead when it comes to ESF-#3, the Public Works and Engineering. We coordinate as well with FEMA on the ESF-#14, which is really the long term community recovery. But our particular lead area of focus is on hazardous materials response and spills, ESF-#10. The EPA has been extremely involved in monitoring the quality of floodwaters, monitoring the impacts on aquatic ecosystems, such as Lake Pontchartrain, coordinating with the Army Corps, with our State partners, not just in Louisiana but certainly Mississippi, Louisiana and Texas, to measure the impacts of these natural catastrophic events.

We have also been working with NOAA and other organizations at the State and local and Federal level, USGS, on monitoring fish tissue impacts, to measure the contaminants, status and trends of contaminants after these hurricanes.

Mr. Chairman, I would like to say that when it comes to drinking water and water infrastructure, one of the most important steps is to get an accurate and fair assessment of the damage. We know that when Hurricane Katrina hit, for instance, that there were over 700 facilities, drinking water facilities, that were impacted, many of them rendered completely inoperative. There were over 200, approximately 218 wastewater treatment facilities, including 6 from the State of Texas, that were rendered inoperable after Hurricane Rita as well as Katrina.

Though a lot of progress has been made over the last several weeks, it will take time, it will take money and it will take coordination. But a key aspect is to get an accurate assessment and then

to get in touch with the right people, to make sure that the energy is brought in to get the pumps operating again, that the necessary chemicals, chlorine and other are available, and that the technical know-how is available to get systems online and operational.

In New Orleans, in particular, for me November 15th is an extremely important date. That is the date that the East Bank Sewage Treatment Plant is expected to reach secondary treatment. On October 16th, they became operational with primary treatment. Secondary treatment under the Clean Water Act is required, and November 15th is the day for that. We are committed to providing every resource we can to help them meet that date.

The other thing I would like to touch on, Mr. Chairman, is the critically important component of wetlands buffers and barriers. Every member that I have heard from in this hearing and every witness so far has emphasized the importance of restoring those natural infrastructure components, restoring and protecting the wetlands. EPA is very proud of the efforts we played with the Army Corps and with other agencies in implementation of the Breaux Act, the Coastal Wetlands Protection Restoration Act. That is a very important authority to provide funding for projects to protect wetlands.

There is also the important component of barrier island restoration. I look forward to working in full partnership with the Army Corps to continue to advance this notion of beneficial use of dredged material. I think this is a great opportunity to really emphasize that point.

Last point, Mr. Chairman, is just simply the importance of working together to focus on ecosystem restoration as well as sustainable development. I know I am out of time, I just wanted to mention two things. One is a report that was done by CDC and U.S. EPA in the weeks after Hurricane Katrina hit. That report is available on our web site. It is an environmental health and habitability needs assessment. Its purpose was to lay out, with experts involved in the process, to layout 13 key environmental areas that should be looked at and be used as a blueprint to ensure that as people reoccupy New Orleans that the area is habitable. That is an important guideline for decisions, I think, and can be useful for local as well as Federal agencies.

The last point is that EPA and NOAA entered into a memorandum of agreement a year ago on smart growth, smart and sustainable development in coastal areas. We are committed to working with NOAA to follow through on that, not through regulation at the Federal top-down level, Mr. Chairman, but through providing technical assistance and resources to help in the local and State planning effort to avoid putting people in harm's way.

Thank you very much. I would be happy to answer questions at the end of the panel.

Mr. DUNCAN. Thank you, Administrator Grumbles.

Ms. Coffee.

Ms. COFFEE. Thank you, Mr. Chairman and members of the Committee, for allowing me to speak to you today. I serve as Executive Assistant to Governor Blanco for Coastal Activities.

Mr. Chairman, I would like to thank you for your interest in the New Orleans situation and surrounding region. I want each mem-

ber of this Committee to know that the people of Louisiana understand that recovery and future prosperity will take great tenacity and perseverance on our part. That said, all of us also realize the size of this catastrophe cannot be done, we can't go it alone. We are going to need assistance from our friends, our neighbors and our Government.

Along with this assistance comes obligation. We want to steward those generous resources as efficiently and effectively as possible and want to assure you that the State of Louisiana is committed to spending every dollar properly and to making the most of every dollar.

After years of predicting the scenario that would happen if the big one ever hit New Orleans, we find ourselves in the aftermath not only of Katrina but also of Rita in what is now a tragedy of such magnitude that its economic and social ripples will continue to impact the fabric of this Nation for many years to come.

We have known for decades that the dramatic land loss occurring in south Louisiana continues to directly impact the safety and sustainability of this region. We sounded the alarm repeatedly that the loss of Louisiana's coast, what is now recognized as America's wetland, is indeed an emergency and its restoration merits immediate attention, not just because of the inherent safety it provides our communities, but because it protects the Nation's number one port system, it safeguards our critical energy infrastructure, and it is home to a third of the fisheries in the lower 48 States, just to name three reasons.

This is an overwhelming challenge, but we know for certain that the citizens and businesses must feel safe that they are going to have a certain level of protection before they can return and reinvest in their communities and rebuild. In a meeting last week, New Orleans business leaders made it very clear that without increased hurricane protection, they could not return.

Therefore, we are seeking support for category 5 hurricane protection that integrates coastal restoration for region-wide, long term protection. Restoring our coastal wetlands is an integral part of this long term solution, incorporating water quality issues, reducing the dead zone and perhaps most importantly, reducing the storm surge.

It is true, scientists tell us that for every 2.7 miles of wetlands, storm surge height can be reduced by 1 foot. However, we continue to lose our wetlands at the rate of 24 square miles a year.

Hurricane protection must be done in concert with coastal restoration. They should not be separated. Water resource issues must continue to be addressed comprehensively and executed in a programmatic way, not piece-meal.

In light of the recent disasters, we have been asked if the LCA, I think someone mentioned LCR, it is the Louisiana Coastal Area plan that is now pending in WRDA, is still relevant. We think it is more important than ever. We are probably going to have to do a little project prioritization shifting, but the basics are there, and what was needed before is absolutely needed now.

We also at the same time have to consider the conditions that now exist out in the marsh. This is typical, any time you have a major storm event, especially of this magnitude, we have to under-

stand and assess what is out there and we are going to have to adapt our plans to follow. This is true all across our coast now, because basically every portion of our coast has been impacted.

Before you, you have a proposal that the State sent our delegation on September 8th in response to their request for recommendations on how to address the rebuilding. I want to just race through a few of the key concepts that we think are important.

That we should implement the program through a partnership between the State and the Corps through the Mississippi River Commission, supported by a working group of State and Federal agencies that includes scientists from the academic community, both in the State and out of the State, ensuring that sound science and engineering continues to lead the effort.

We have to accelerate construction of proposed hurricane protection projects to withstand category 5 storms, and we must repair existing hurricane protection and upgrade them to do the same.

In spite of continuing subsidence of the landscape and changing climate conditions, the engineering community assures us it can be accomplished if these issues are taken into consideration. I look forward to hearing what the Dutch say on that issue.

We must implement the comprehensive suite of coastal restoration measures recommended in the Coast 2050 plan and we do realize that is a blueprint, and the LCA, which came about basically because OMB asked us to scale back, to not address this comprehensively, and to scale back and deal with what was most immediately necessary, which we did. That is the LCA, which is what we consider the near term first steps of implementation.

It is critical that we streamline the implementation process and move immediately to design and construction. We can't simply initiate traditional feasibility studies that take a minimum of about five years on projects like these. By the Corps' own admission, it takes an average of 11 years from authorization to completion of a project. If you add the 5 years of pre-authorization to that, it would be 16 to 20 years before we have adequate hurricane protection from future storms. We simply don't have 20 storm seasons to wait.

We must have a sustained source of funding in the form of direct sharing of OCS revenues, I know you have heard this before, to protect and sustain our vital energy infrastructure to provide the hurricane protection we need and to restore our wetlands. Our cost estimates are about $32 billion to accomplish these things. It is a very reasonable investment, compared to the hundreds of billions of dollars in the losses caused by Katrina and Rita alone. Sharing the OCS revenues would simply allow production supported from Louisiana shores to be used to protected Louisiana shores, and we feel would have the last impact on Congressional budgets and appropriations.

We know this is a long term effort, especially the coastal restoration piece of this. That type of sustained revenue would help us pay our share.

Our predictions, tragically, now are reality. And time is definitely not on our side. The way we address the crisis cannot be business as usual. Surely the cost to the Nation of restoring our coastal lands and providing real safety has now been justified.

I can't emphasize enough how much the State of Louisiana values its longstanding partnership with the Corps of Engineers and our other Federal agencies working with us to save the coast. We recognize the role of this Committee in forging those partnerships, and we appreciate it very, very much.

We are committed to spending Federal funding wisely on cost effective projects that produce real results and meet environmental requirements. We are not asking for exemptions from NEPA or the Clean Water Act. But we do need a commitment from the Congress and the Administration that we all work much smarter and much, much faster.

In closing, I would like to remind you that this is no longer theoretical. It is very real. And real people have lost their lives, and hundreds of thousands more across the Gulf region have lost their homes, their livelihoods, their family pets, their photographs, their memories, if you will, everything. I sincerely ask you to keep the human aspect before you as you make your decisions.

When all is said and done, this is not just about numbers on a spreadsheet. It is about serving people just like you and me. It is about rebuilding their dreams and their aspirations. It is about Americans and their safety and their future. It is about the economic and human sustainability of our Country. Thank you.

Mr. DUNCAN. Thank you very much, Ms. Coffee. Certainly those of us who have been down there will testify that it is the worst devastation that we have ever seen. On the other hand, I think we will be amazed at how fast certain things come back, because we are talking about people's homes here. For instance, General Strock mentioning the high school that they have gotten back open now with 1,200 students already. Those types of reconstruction are going to be very important. There are also areas that are going to take years to recover.

But you are right, we do need some studies to make sure that we act accordingly. But on the other hand, we don't need years and years and years of studies. We have to have action, too.

Dr. Walker.

Mr. WALKER. Good morning. I'm Bill Walker, and I serve at the pleasure of Mississippi Governor Haley Barber as Executive Director of the Mississippi Department of Marine Resources.

Coastal Mississippi has been devastated by Hurricane Katrina. Our entire coastline found itself in the most damaging northeastern quadrant of this category 4 hurricane for 12 hours. While property damage caused by this catastrophic event is evident to anyone who has visited the area since the storm and seen first hand the swath of destruction along U.S. Highway 90 and inland for many blocks, the effect on coastal ecosystems and the renewable natural resources that depend upon them are less evident to the casual observer.

These resources, however, and Mississippi's ability to harvest and process them, have been devastated. Mississippi's commercial seafood industry produces an economic impact of about a billion dollars a year and employs some 17,000 people. Our recreational fishermen take some 1 million trips each year, with an economic impact of nearly $200 million. These drivers of coastal Mississippi's economy are presently out of operation and they must be restored.

Mississippi's oyster reefs produce some 400,000 sacks of oysters annually, with an economic impact of $100 million and an employment level of some 2,200 people. This industry has been brought to its knees by Katrina and it must be restored.

Mississippi's offshore barrier islands include Petit Bois, Horn, Ship and Cat Islands, the islands comprising the Federal Gulf Islands National Seashore. This island chain is located some 12 miles south of coastal Mississippi, and provides our natural first line of defense against hurricanes and other tropical storm systems.

Unfortunately, these natural barriers have suffered from a series of onslaughts, first from Hurricane Camille in 1969, then Hurricane Georges, then Hurricane Ivan, and finally Hurricane Katrina. Katrina alone destroyed over 2,000 acres on these four barrier islands. Deer Island, Mississippi's sole inshore barrier island, lost nearly 25 percent of its total 430 acres to Katrina.

But as important as the actual acres lost, the elevation of the remaining island footprints has been reduced to near sea level through almost complete destruction of all island dunes and at least 50 percent of all island vegetation. These damaged barrier islands are now in imminent danger of further catastrophic erosion without extensive and immediate beach, dune, vegetation and marsh restoration.

Should another hurricane hit our region now, our barrier islands would afford little if any protection to coastal Mississippi. These protective capacities must be restored. Coastal marshes, as has been mentioned by several of the speakers, also serve the Mississippi Gulf Coast by providing critical, essential habitat and also buffer the effect of coastal storm surges. The overall footprint of vegetative mainland coastal marshes remains similar to that before Katrina, but the elevation of these marshes, and particularly the upland areas immediately adjacent to them has been reduced significantly, making them and the landward areas which they protect extremely vulnerable to future hurricanes.

Other resources, such as the Mississippi offshore artificial reef system, submerged seagrass beds, our State's spotted sea trout hatchery, our emerging ecotourism industry, and numerous cultural and historical resources, have been drastically altered or destroyed by Hurricane Katrina. These losses are described in my submitted testimony and they must be restored.

Our restoration plan presents a two-phase approach. Phase 1 focuses on restoring Mississippi's natural storm defenses, flood control capacities and our coastal habitat functions to pre-Katrina levels. Our Governor has said that if all we accomplish through all the recovery efforts is to get back to where we were before Katrina, we will have failed. Mississippi also includes a Phase 2 restoration effort, which will return our storm protection capacity, our flood control capacity and our ecosystem function to pre-Hurricane Camille levels.

Both phases will also investigate non-natural defenses, such as breakwater seawalls and other mechanical storm surge diffusion approaches. The time frame for this plan is 15 to 20 years. We anticipate completing Phase 1 activities in the short term, one to five or so years, with Phase 2 efforts beginning in the near term and extending out some 20 years.

These restoration efforts will focus on improving flood control capacities by de-snagging and stream bed reconfiguring of coastal riverine systems and their tributaries, increasing our natural hurricane protection capabilities through extensive restoration of our offshore and nearshore islands and marshes, and the restoration of our environmentally important and economically critical coastal ecosystems and habitats.

We anticipate that with Federal assistance, coupled with State support and private sector participation, we will be able to ultimately restore Mississippi's capacity for hurricane protection, flood control and ecological function to pre-Hurricane Camille levels.

Now, more than ever, we need to partner. I am proud of the partnerships that the State of Mississippi has forged with our Federal friends at FEMA, with the Corps of Engineers and other agencies. I agree with statements earlier that we have today the opportunity to do things right, to provide a model, an example of how to respond in the face of crises like this. I am confident that if we partner together, we can be successful.

Thank you again for the opportunity to address you today.

Mr. DUNCAN. Thank you very much, Dr. Walker.

You may have heard in my opening statement where I said those of us who went down there saw the worst damage of all in Mississippi. The damage in New Orleans is horrible, and many of those homes will have to be destroyed. But most of those homes are still there, and some of them are in pretty good shape, many of them in good shape.

But we saw miles and miles and miles along the Mississippi coast land where blocks and blocks, several blocks of homes were just gone, totally. So it was really quite—it is more dramatic when you see it in person instead of just on a little TV screen.

I am going to go for first questions to Ms. Johnson and let my Ranking Member have the first questions here. Ms. Johnson.

Ms. JOHNSON. Thank you very much.

My first question is to Assistant Secretary Woodley and General Strock. What steps have you taken to be sure that the construction contracts for the rebuilding of the levees and any other hurricane related work that you might contract on behalf of Federal agencies is carried out by local contractors?

Mr. WOODLEY. Thank you for your question. I am going to ask the Chief of Engineers to respond.

General STROCK. Yes, ma'am. Earlier you mentioned the challenge of the various tradeoffs we have and what we face in response to a disaster is the need to bring in, in a very big way, massive support to begin things like debris removal and temporary housing. For that reason, we rely on advanced contract initiatives, where we compete in advance. We try to create opportunities for small businesses.

In the case of water, we have a small business firm delivering water to supply to the affected people.

After the crisis begins to pass, we can then rely on a more focused effort to bring local and small businesses into the effort. We are making that a very high priority.

In the interest of time, ma'am, I would like to submit all the statistics for the record. But I can assure you that it is a very, very

high priority for the Corps of Engineers. In addition to a focus on direct prime contracting, which is most important to the local economy, we do use the provisions of the Stafford Act, which require that the prime contractors give preference to local and small business. We require them to report on how they are doing.

I am very encouraged with the results we are getting from our prime contractors in utilization of particularly local and small business as subcontractors. So we are working it very hard.

Ms. JOHNSON. Thank you very much.

Assistant Secretary Woodley, you state that the Administration is working with Congress and the State of Louisiana to develop an appropriate generic authorization for the Louisiana coastal area ecosystem protection and restoration program. Who are you working with?

Mr. WOODLEY. We are working with the appropriate committees, this Committee and the appropriate committee on the Senate side to make sure that this type of authorization takes place within the context of the Water Resource Development Act.

Ms. JOHNSON. Has the Administration given up on enacting the water bill?

Mr. WOODLEY. No, indeed. We have not by any means given up on enacting the water bill.

Ms. JOHNSON. Do you know anything about the progress of it in the Senate?

Mr. WOODLEY. The progress in the Senate, the Senate is undertaking its constitutional responsibility in this regard.

[Laughter.]

Ms. JOHNSON. Thank you very much.

Mr. Grumbles, would you like to comment on that?

Mr. GRUMBLES. On Assistant Secretary Woodley's remark?

[Laughter.]

Ms. JOHNSON. Yes.

Mr. GRUMBLES. I don't know what the status of the legislation on the Senate side is.

Ms. JOHNSON. We know that your agency will be very busy in taking steps to help restore the flood protection to the pre-Katrina levels. I am not sure that is even adequate, to the pre-Katrina levels. But for the work to enhance protection to category 5, some have proposed waiving normal project development procedures, including waiving environmental laws. Do you support such call for those waivers?

Mr. GRUMBLES. I think there are some waivers that are being issued under the Clean Air Act. I think what is really required is first and foremost the responsibility of recovering and rebuilding communities and doing so consistent with the environmental laws. Common sense also needs to play an important role in that, and we need to take site by site, case by case instances into mind, provide flexibility but also accountability.

I know for instance, Congresswoman, with respect to some of the wastewater treatment plants, there is a real need to demonstrate discretion in terms of enforcement. You can't require or expect a facility to be meeting certain important requirements under an environmental law if the facility isn't even operable. So there is a need

for common sense and giving some time with milestones and accountability and tools to rebuild.

We are continuing to monitor and look for situations and to learn more about whether or not there are any other provisions or greater flexibility that is needed under the environmental laws.

Ms. JOHNSON. Thank you very much. My time has expired.

Mr. DUNCAN. All right, thank you very much.

Mr. Gilchrest.

Mr. GILCHREST. Thank you, Mr. Chairman.

Mr. Woodley and General Strock, as we go through and take a look at the kinds of things that need to be done to create the buffers, protect the infrastructure, it seems to me that a number of changes have to take place in the traditional engineering of the levees, the canals, the sediment diversion and those kinds of things.

So do you see, in your plan, 2050, LCA, the Breaux Act, all those things, do you see as you are going through to take a look at how to restore the buffers, the wetlands, the vegetation, sediment diversion, all those things, do you see a need to close any canals? I am asking in particular MRGO. Is there any status on that yet?

Mr. WOODLEY. Congressman, that type of decision would be one for the future. But the program that we have proposed in the chief's report for the Louisiana coastal area restoration has entered a very strong element of adaptive management that calls for the study and a scientific—

Mr. GILCHREST. That canal is a possibility?

Mr. WOODLEY. I would certainly say it is not by any means off the table.

Mr. GILCHREST. Ms. Coffee, is that one of your considerations? Some of the canals that may have to be closed to prevent another storm surge, is that in your thinking?

Ms. COFFEE. MRGO has always been in the mix. That is a very important issue to a lot of people, especially today. Yes, we want that canal environmentally restored, and we want the decision on it made sooner than later.

Mr. GILCHREST. You would like to see that canal closed, so the sediment would fill it in and it wouldn't be used any more for transportation purposes?

Ms. COFFEE. I don't know if the sediment will ever fill it in. It is huge. But yes, we would like to see it, if not closed, at least reduced to shallow draft or whatever. But I think that the modeling is going to have to show us that.

Also, the modeling has to be improved. We have to balance, what we are trying to do with MRGO is balance the needs of the Port of New Orleans with the environmental needs. As I said, we would like to get to the point that we can make that decision much sooner rather than later.

Mr. GILCHREST. In your consideration of protecting the lower Louisiana coast from a category 5 hurricane, do you envision, and if you can include in your thinking that your barrier plan to protect New Orleans, is there anywhere in your thinking that some communities may have to be relocated?

Ms. COFFEE. We have talked to year about this, and know that eventually these decisions have to be made. I think the decisions are, what has happened has possibly accelerated those types of de-

cisions. I want to stay very sensitive to the fact that these are peoples' homes, these are peoples' communities that they have lived in for generations and fished and all the rest.

But I think it's all a matter of protection. I think we have to look at insurance, are they going to still be protected by insurance, is FEMA going to offer flood insurance in certain ares, is the Congress willing to spend the money on certain pieces of that plan? I think that is what is ultimately going to dictate the choices.

Mr. GILCHREST. Yes, ma'am, very difficult human issues.

Ms. COFFEE. Very.

Mr. GILCHREST. Mr. Grumbles, we miss you up here. I'd like to go back to 1995 and do the Clean Water Act all over again.

Is there an estimate as to the amount of municipal trash that was generated as a result of Katrina based on the normal amount of municipal trash that Louisiana has to deal with?

Mr. GRUMBLES. Congressman, I don't have a specific number. I would say a couple of things. One is that EPA, not my office, but the Office of Solid Waste and Emergency Response has been spending a tremendous amount of time and attention on the debris issue and the demolition waste, and working with the Army Corps, which has a lead role in that area.

I think it is important that you are bringing up one of the greatest environmental challenges presenting in the Gulf, as the debris and the waste management. I know EPA is looking for ways to not only manage it appropriately and to help State and local authorities, but also to encourage recycling and re-use of uncontaminated waste.

But I commit to provide you and the Committee with some numbers or more specific data on that point.

Mr. GILCHREST. Thank you very much. My time is up. I would like to talk to Dr. Walker later about the differences between the Mississippi coast in ecological and geologic terms and the Louisiana coast and how the restoration projects might be different.

Mr. DUNCAN. Thank you very much. Mr. Pascrell.

Mr. PASCRELL. Yes, to the Assistant Secretary. I am concerned about the plan to clean up the wreckage caused by Katrina, especially in New Orleans. Because 22 million tons of garbage and debris are sitting in the city as we speak. The Corps tell us that it would take 3 and a half million large dump trucks to remove this destruction from the city. I know that the Corps has awarded billions in contracts to remove the waste.

In the Sunday Times, this past Sunday Times, the Corps commented that this process would take seven months. Yet the State argued it would take two years to clean up the debris. What seems more accurate to you, and can rebuilding really begin until this material is removed?

Mr. WOODLEY. I would have to ask the Chief to comment with respect to the timetable on it. I can tell you that our endeavor is to complete the work as quickly as possible, as soon as it can be done in a way that is environmentally responsible and appropriate and safe. The other part of your answer is that the ability to begin reconstruction will have to be gradually extended in cooperation with the State and local government on a neighborhood by neighborhood basis, and we are very sensitive to their priorities.

Let me ask General Strock to comment on the timetable.

General STROCK. Yes, sir, we normally speak in terms of cubic yards of debris. So I can't comment on the tonnage you cited there. But our estimate of the debris that the Corps of Engineers is charged with removing is about 44 million cubic yards across the coast. That is the four States involved here, and again, that is the mission that has been handed to the Corps. That does not include demolition debris, which we think might drive it up considerably, perhaps as much as 70 million cubic yards, if we have that mission in those same impacted counties and parishes.

Sir, to put it in context, Hurricane Andrew generated about 19 million cubic yards of debris. It took us 19 months to clear that away. In this case, so far on day 50 here, after Katrina, we have removed 13 million cubic yards. So we are well ahead of what would normally be expected after a catastrophe of this magnitude.

Now, at that rate, we certainly couldn't, there is not a linear relationship, because a lot of what we moved has been the easy stuff. Now we have to get into some sediments and contaminated materials that Mr. Grumbles talked about. It is a matter of setting priorities and ensuring that we are working with the locals so they get access to critical facilities and that sort of thing. Clearing rights of way, waiting for the private citizens to return and move their debris off their property onto the rights of way where we can pick it up, negotiating conditions for going into private property, which we must do after this circumstance.

Mr. PASCRELL. Is there a plan to do that, General?

General STROCK. To go on private property?

Mr. PASCRELL. Yes.

General STROCK. Yes, sir, there is. We have been given the authority to do that. It is very much like our roofing mission, we require a specific right of entry, signed by the landowner. It will be done in a very careful and respectful manner to make sure that we are not doing any unnecessary effort.

But clearly, as Mr. Duncan pointed out, in the coast of Mississippi, we cannot expect private landowners to be responsible for removing debris from their yards when that debris has traveled a quarter of a mile from the coast and it is their neighbor's house. So there clearly needs to be a little different way of thinking about debris removal in this circumstance.

But sir, I am convinced we are going to get this done, expeditiously and in a very environmentally sensitive way. For example, I flew over New Orleans yesterday and I saw a yard of thousands of white good, refrigerators, washing machines and those sorts of things, segregated and set aside for recycling. So we are very careful about how we do this.

Mr. PASCRELL. Thank you very much. I would like to ask, if I may, one question to the Assistant Administrator for Water and Environmental Protection, Mr. Grumbles. Has the State and city been working with you to assess environmentally dangerous materials in any of this debris, and have we analyzed the health impacts on people returning to their homes that are surrounded by this waste?

Mr. GRUMBLES. Congressman, I am going to give you a short answer and also commit to get back to you with more detail from

those who have been most involved in it, rather than me and the Water office. I know that we have been spending a considerable amount of time working with State and local officials and certainly the Army Corps, when it comes to debris, to try to get a sense of what it is, as well as to plan responsibly for how to manage it. Of course, providing information and tools and necessary precautions to people who are intent on getting back to their homes is also a very important component for us, the whole habitability issue, providing appropriate information so that local officials and the appropriate authorities can inform citizens as to what they should be doing is a high priority.

Mr. PASCRELL. Where is all this going, by the way? Where is all this material going to? When we move it, there is a tremendous amount of bacteria. We talked about this during the hurricane. Where is the material going? Where are you putting it, that's being removed? General?

General STROCK. Sir, vegetative debris, we reduce and use for mulch and try to recycle that as we can. White goods, as I mentioned, we try to recycle. We do try to minimize the use of landfills, although that will be necessary in many cases. It depends on the nature of the debris and if there are any hazards associated with it.

But we are trying to do dual-use things. For example, in Plaquemines Parish, we need burrow areas for levee construction. So working with the local parish, we are doing the permitting to convert those burrow areas into landfills and then refill them and somewhat restore the topography in that way. Many different ways to dispose of it.

Mr. PASCRELL. It seems to me that putting things in order before we get into the great debate as to what New Orleans and what folks living in New Orleans want New Orleans to look like, what will be built and what won't be built, we need to do everything we can to assure that the health of these people, who, many of them went back prematurely. We understand that. Many of us would probably have the same urge if given the same set of circumstances.

But that's critical. And I think the Congress needs to know what the timetable of that is, working with the State, and to assure people that they are going back into an environment that is not going make them sick, short term, long term. I think that is critical, don't you?

Mr. GRUMBLES. Most definitely. And I know from the Administrator's perspective, and from the Deputy Administrator's perspective, that is one of the highest priorities for the Agency and its mission, in carrying out our response to Katrina and Rita.

Mr. PASCRELL. Thank you very much.

General STROCK. Sir, if I could, another example of things we are trying to do is take highway debris, the concrete and so forth, the rubble of these destroyed structures, and take them offshore and build artificial reefs or perhaps barrier protection on the islands. So we are making every effort to re-use this debris in a beneficial way.

Mr. PASCRELL. Thank you.

Mr. DUNCAN. We have some votes starting up.

Dr. Walker, you heard Ms. Coffee use a figure of $32 billion in their request that they have made. You mentioned in your testimony that 60 percent of your shrimp industry was destroyed, that you have an oyster industry worth $100 million a year and so forth.

Has Mississippi come up with a figure comparable to what Ms. Coffee just mentioned for your needs and your infrastructure restoration needs?

Mr. WALKER. Mr. Chairman, Governor Barber has asked me to present to him some information and some dollar requests for coastal Mississippi. He has also asked the Mississippi Department of Environmental Quality to provide information on their needs, the Mississippi Department of Wildlife Issues and Parks and other State agencies. As you may expect, those numbers have gone through several revisions. They started relatively large and now they are shrinking, as they should.

I hate to step out and speak for what the Governor is going to do, but I will just simply say that it will be in the billions with a B level. It may be in the tens of billions. It won't be in the hundreds of billions, the request that comes from Mississippi.

Mr. DUNCAN. All right.

Ms. Coffee, it is my understanding that in the State of Louisiana of course, we have already spent billions on some of the FEMA emergency relief and people all over the Country have either contributed in cash or voluntary hours. I mentioned before that I don't think there is a police department, fire department, sheriff's department that didn't send people down there. So you have had billions of dollars worth of cash contributions or manhours that have been contributed.

Is the State requesting that this $32 billion be 100 percent Federal? Because that is what I was told. You said in your testimony when you first started out that you thought this should be a shared obligation between the State and the local people and so forth. What is your understanding?

Ms. COFFEE. I feel like there needs to be, we feel like there needs to be an infusion on the front end, obviously, to get things started, to get it jump started, especially when it comes to the hurricane protection. That is an immediate need, really, that is an immediate need.

With coastal restoration, we have always tied OCS revenue sharing with that, because we know that the coastal restoration piece, while we need an initial boost to go ahead and jump start some of these projects that we think are needed, in concert right here at the beginning, we know that the coastal restoration piece is a long term effort. If we have the OCS revenues we feel we rightly deserve, we can use those.

Our State has already passed, well, the constitutional amendment is coming up before the people, but we just passed overwhelmingly, in fact unanimously, in our last session the enabling legislation that would allow any OCS revenues that come to us, the first $600 million a year, which we thought would be on the outside, to be dedicated to coastal restoration and impacted infrastructure.

So our residents, we have been passing this type of legislation for years now. We are very committed to using this for its purpose.

Mr. DUNCAN. I have other questions, but we have to break for a vote here.

General Strock, let me just ask you very quickly, I understand that there is some concern that several or many of these levees have significant soil erosion underneath. What are you finding in that regard? And secondly, feeding off of, or building off of Mr. Pascrell's question, have you given any consideration to, I understand that a lot of this debris is wood and plant waste and possibly could be converted into ethanol or some other asset.

That is two different questions. Can you give us brief, quick answers to both of those?

General STROCK. Yes, sir, I can. Sir, as you know, we are in the midst of a data collection, and specifically where the 17th Street and London Avenue canals are concerned, we do think, the preliminary result of that is that the breaches in those levees were caused by a soil shift or an embankment shift. So the soil moved there, and we suspect that is because of foundation conditions. So as always, we have been concerned about the quality of soil and its ability to serve as part of the storm protection system.

Sir, on the recycling and ethanol, I was handed a paper when I was down there recently on a process that can be used to do that. It is quite expensive, a plant will take about $250 million to build and about eight months to do it. Of course, then it becomes an enduring asset to the community. But that is a possibility for recycling or disposal of this woody debris. We are not actively considering that or proposing that we do that, but that is certainly a possibility.

Mr. DUNCAN. Let me apologize to the panel and the next panel, but we have to go now and take a couple of votes. We will get back as soon as we can. Thank you very much.

[Recess.]

Mr. BOUSTANY. [Presiding] I would ask the panel to please take their seats so we can resume.

I have to apologize for Chairman Duncan's absence. Something came up, but I will be handling this hearing for the time being. Thank you for your patience. We appreciate it. We had a little interruption with the votes, and we will resume and hopefully have no further interruptions as we move forward.

We are going to resume where we left off. I have several questions I would like to ask. First of all, Secretary Woodley, Committee leadership recently sent you a letter regarding the ability of local cost sharing sponsors to pay for water resources projects following natural disasters such as what we have seen. Is the Corps amenable to using the authority under Section 103(k) of the Water Resources Development Act to allow non-Federal project sponsors to defer their payments for their share of the project?

Mr. WOODLEY. Mr. Chairman, that is certainly among the options that we will be exploring going forward. I believe that a fair case could be made that this is exactly the type of situation that that authority was designed to be used in. So going forward, we will explore that, and certainly as appropriate, as authorizations

are made, obviously the Committee will express its views to us as to how that should proceed.

But I would fully support using that authority in any case in which it was necessary and appropriate to ensure that infrastructure was created and the infrastructure necessary was constructed and that it was found to be in the best interest of the Nation as a whole.

Mr. BOUSTANY. I thank you for that answer.

General Strock, I was reviewing a lot of the old testimony from this Subcommittee, and in particular with regard to the proposed barrier plan that dates back to 1965, and my understanding was after Congress authorized this plan, it was actually in the process of being implemented and construction had begun in May of 1967. Following that, I think it was January 1st, 1970, the National Environmental Policy Act was enacted and put into place.

Subsequently, you went back and did an environmental impact statement, or the Corps did, and as a result, we had litigation. I think it was in 1977, in December, the courts issued an injunction halting that construction process. Obviously there is a plan in the process of being implemented. Is that plan something that is reasonable to work with as a starting point, or—I know technology has probably changed considerably. Do you think moving forward with a barrier type of plan as proposed in some form with modern technology, could it meet muster with regard to Environmental Policy Act?

General STROCK. Sir, I believe we would certainly need to consider the use of barriers. And I think in the next panel, you will hear from the Rijkswaterstaat of the Netherlands some views on the use of barriers and dikes. So it is certainly technically feasible to do that. And the concept, of course, is to take the storm surge off before it gets into Lake Pontchartrain. So we would certainly consider that as a potential feature in any future improvements of this system.

Mr. BOUSTANY. I thank you for that answer. Also, I know the Secretary of Defense, as you mentioned, has basically asked the Secretary of the Army to establish, get a National Academy of Sciences panel involved to look at how the levees performed. My understanding is that study is due in about eight months.

General STROCK. Yes, sir, that is correct. That is the request of the Secretary of the Army to the National Academies.

Mr. BOUSTANY. Will that have an impact on your planning process as you move forward? I know right now, probably most of your efforts are devoted to the reconstruction to pre-Katrina levels. But I am curious about the timing of this study and how it will play out with your future planning, depending on what we here in Congress do and so forth.

General STROCK. Sir, I think due to the complexity of the questions that need to be answered, that is a reasonable time. For example, just today I noted that it requires a 20 day waiting period simply to announce that a panel is convening before they can begin. That consumes over 20 percent of the time.

Mr. BOUSTANY. Sure.

General STROCK. So—not over 20 percent, that is wrong, but that consumes a good bit of time. So I think it is a reasonable time.

What we will do is, as that panel proceeds, if they can reach some interim conclusions, we will certainly take those and incorporate those into what we are doing to restore the existing system. If we find out they conclude there is some flaw in a design or construction or something, then we would incorporate that into our interim efforts to restore protection.

Obviously if we go to a different level of protection or find we need to do something significant, we use that.

We also are doing a parallel internal review of the same effort, which will be peer-reviewed by ASCE and further reviewed by the National Academies. As we reach conclusions there, we will incorporate that into our response to putting the system back together.

Mr. BOUSTANY. Thank you. One other question for you. Could you shed a little light on the relationship between the Corps and the local levee boards and how that has worked out, what deficiencies you see, what recommendations you may have as we move forward?

General STROCK. Sir, I can't comment on that personally. I think that is a better question for the district and division people on the ground. I can tell you, though, it is a symbiotic relationship. In most cases, they are the local sponsors. In some cases the State BOTD is the sponsor for some of our work.

But I can tell you that we work hand in glove with them. They have a vested interest in getting it done right. And ultimately, we turn it over to them for operations and maintenance, so they bear that responsibility. And in conjunction with that, we conduct annual inspections to ensure that they are being maintained in an adequate fashion.

Mr. BOUSTANY. And you are satisfied with that regime, whereby they handle maintenance, routine maintenance and so forth, under your watchful eye?

General STROCK. Yes, sir, I am.

Mr. BOUSTANY. Okay. That systems has worked well?

General STROCK. Yes, sir.

Mr. BOUSTANY. Okay, thank you.

Ms. Coffee, welcome, good to see you. You mentioned relevance of the LCA plan and mentioned that, yes, it is relevant and yet, we need shifting priorities. I know in my review, I look at the September 8th letter, I am familiar with what we have in WRDA and most of it is focused in the southeast part of the State. We have needs in the southwest part of Louisiana.

I was interested in knowing whether you have any further comment or any updates as to what Governor Blanco and the Administration feel should be necessary.

Ms. COFFEE. What I meant is that the LCA itself is still very much needed. What we have put forth in the LCA, my reference was that the storm hasn't changed, Katrina or Rita neither changed those needs. Yes, we are very well aware that the western part of the State is basically not included on an immediate level in the LCA, and that was due to the scaling back which was required and asking us to deal with the most critical areas, the most critical land loss.

But yes, and I am not saying for certain that the projects will be prioritized, but we are looking at it right now to see, well,

should we possibly start this before that or whatever. The western side of the State needs attention, definitely, especially after Rita. It has, as you know, a different set of circumstances. But yes, we need some work over there.

Mr. BOUSTANY. In reference to the southwestern part of the State, and it probably applies more further beyond that, when you look at the Gulf Intracoastal Waterway, that embankment has been considered spoil over the years by the Corps. My question is, should we rethink this now and look at some sort of levee under the jurisdiction of the Corps as we move forward. General Strock, you might want to comment on that.

General STROCK. Sir, I think we should certainly consider that. If as we analyze this with the State and this Committee and the Administration has felt that a component of more protection would be structural solutions of levees, then I think we should take advantage of those linear features that already exist and incorporate them into a system. In fact, we have done some of that already in some proposed projects in the area.

Mr. BOUSTANY. Okay. I appreciate the answer.

One final question for Ms. Coffee. The levee boards, do you have an idea of what type of resources they have available at this time as we look at mechanisms for funding?

Ms. COFFEE. I can't specifically answer that to the resources. I do know that the State itself has lost a third of its revenues.

Mr. BOUSTANY. Right, I am aware of that.

Ms. COFFEE. So when it comes to the levee protection, it is going to be very difficult for us to match that. That is needed immediately, and we have no money.

Mr. BOUSTANY. I appreciate your answer.

I will now defer to the Ranking Member, Ms. Johnson. She has been very patient here and probably has another round of questions.

Ms. JOHNSON. Thank you very much.

I know that this task is very daunting and certainly it is very frustrating to determine how to get started. I do have some concerns, and I applaud the Mayor for attempting to get back a tax base as quickly as he can. On the other hand, I am concerned that the hurricane season is really still on. The levees are still out.

I wonder if there has been some coordinated planning on that or some discussion, because it seems to me that the levees are going to have to be constructed a little differently, at least according to the October 8th New York Times article, that the levees that were constructed were done in soil that was not really appropriate to hold, that they needed to have been at least, the soil needed to be changed or at least a lot deeper to hold them.

What kinds of discussions or coordination or planning do you have in mind to be sure that when there is reconstruction, it is not a waste of money and it will do what it has been put there to be done, and that you coordinate with the Mayor, the local officials, State officials to be sure that this movement is in conjunction with the repair?

General STROCK. Ma'am, we are working very closely with Mayor Nagin on his decisions on what parts of the city can be reoccupied

and when. It has a lot to do with EPA and the hazards that might be faced by the citizens.

But it also has to do with the risks they face. There are two components of risk there. One, as you pointed out, is the condition of the levee system. We are concerned about that. We established the interim level prior to Rita, which was exceeded in the inner harbor area. We thought we would get a surge of about six feet from Rita. We got a surge of over eight feet, and we put protection into seven above sea level.

So right now, we have restored the level of protection at the breach sites to 10 feet of elevation, and we think we can certainly handle a surge associated with a storm that passes away from New Orleans. But again, they remain vulnerable to certainly any category of hurricane. So as they decide to reoccupy, obviously they have to make sure they have good, solid evacuation plans in those areas.

In terms of the areas that we had soil failure in, apparently we are fortunate in that in both of those canals we have bridges that transit the canals between the breach site and the lake. As we did prior to Rita, we can close those off with sheet pile, and that will protect those areas. That is good interim protection. So that is what we intend to do, until we can understand what needs to be done on a larger scale within those levees.

The other hazard the city faces is interior drainage. The big pump systems in New Orleans are not meant to fight floods, but to drain precipitation. Those are now back up to about 90 percent capacity, but we are well aware of those stations that are challenged, like the one in the Ninth Ward. We have auxiliary pumps and that sort of thing standing by.

But the Mayor is very well aware of what various levels of rainfall would result in terms of further flooding from precipitation. So we are working very closely with him to make sure that they make informed decisions on when to reoccupy.

Ms. JOHNSON. Thank you.

Mr. Grumbles, I know that the debris removal has not yet included the crud or whatever the dried stuff is now, and there is quite a bit of it. Has there been any testing on the content? Has there been decision as to what you do after you scrape it out?

Mr. GRUMBLES. Congresswoman, I know that I am going to have to get back to you with greater detail on this, because I haven't been the one primarily involved in the sediment. The Solid Waste and Emergency Response office has. I do know that we have done some testing of sediments.

The Agency has been monitoring for that, because just as you say, as the unwatering in the City of New Orleans has occurred, through the good efforts of a lot of folks, including the Corps, what you are left with is the residuals that may have greater health risks. That is why we have been focused on that as well in terms of the monitoring, to help inform decision makers on how best to manage that sediment.

But I am going to need to get back to you with more specifics on what we have found and the details of it.

Ms. JOHNSON. Thank you very much.

Mr. BOUSTANY. The Chair is now pleased to recognize the Subcommittee Chairman, Mr. Shuster. He is Chairman of the Public Buildings, Economic—it is a long one—Economic Development and Emergency Management.

Mr. SHUSTER. Thank you.

Again, welcome to all of you. Most of you, I guess the three on that side have been here many times. Welcome to you folks. Thanks for traveling from Mississippi and New Orleans.

The question I have first is for General Strock. We had a quick conversation, I think when we were out in the hall here about building up the levees and you conveyed to me that time, when you go up and make them higher, you also have to go wider. I wondered, do you have an idea at this time, have you been looking at design, if we go up and build the levees higher, how much ground will we take up? How many homes will be displaced if we do that?

General STROCK. Sir, I don't know if have specifics on that. That information may be available in the New Orleans district. That is certainly one of the considerations that we take as we plan how to do the flood protection. In fact, in many areas in metropolitan New Orleans, the decision was, there was a finite element of ground we were going to take up. For that reason, we came up with a combination of levees with a floodwall on top. That reduces the footprint.

The most effective form of flood protection is a levee.

Mr. SHUSTER. Which is there today, is what you are saying?

General STROCK. That is what is there today, and that is where we had the breaches in the 17th Street and London Avenue Canal.

Mr. SHUSTER. So it would be significantly wider if we go up to the category 5?

General STROCK. Yes, sir. Typically if you go up a foot of elevation, it requires about six feet of footprint to go up, based on our normal designs for levees.

Mr. SHUSTER. And how high would they have to go to resist or protect against category 5?

General STROCK. Sir, I am not sure about the storm surge associated with category 5. It is designed now to an 11.5 storm surge, and hence the walls are anywhere from 15 to 17 feet high, with a factor of safety and wave action.

I have heard the figure of 30 foot levees for category 5, but that depends on where you put them, and a lot of conditions and variables. But it is that sort of level of magnitude you are talking about, 25 to 30 foot levees really would take a category 5 storm surge.

Mr. SHUSTER. And what happened here was not the water coming in off the ocean, well, it was coming into Lake Pontchartrain, correct, and it was sort of the backwash out was what topped it?

General STROCK. Sir, we are still looking at that. The storm surge was actually caused by the wind and the change in barometric pressure associated with the storm. Perhaps Dr. Hoogland can talk more about that than I can.

The storm surge was really the cause of this, because the surge went up into Lake Pontchartrain, we have modeled this and we think we know what happened. We are still trying to gather the data.

One of the problems is that all the sensors were destroyed in the storm, so we really don't know exactly what happened. But there was clearly a very significant storm surge in Pontchartrain, and the challenge there is that once it gets into the lake, because of the narrow outlets, it stays there and it is rather like draining a bathtub with a straw, it just takes time to go down. So you had this elevated level of water, you had the dynamics of four hours of constant pounding and between those forces we had a breach in the levee and we couldn't contain it because the lake levels remained high.

Mr. SHUSTER. And if you build it to withstand a category 5 hurricane, you still can't put a guarantee that it could be a 5 plus, you are never certain, I guess you could build 100 foot high levees, you are not going to be able to guarantee that even at a 30 foot high wall that the surge may even go higher than that?

General STROCK. Sir, there is risk involved. We talk in terms of levels of protection in terms of years of events, 100 year, 200 year events. It is my understanding that the Dutch have gone to a 1 in 10,000 year event that they are protecting against. So those are pretty good odds.

I think it is technically feasible, but again, you have a lot of social things, you are talking about how much land it takes, how much cost it is and so forth. That is why I think we would have to consider something like the barriers, which would take the storm surge off, that would reduce the need for higher levees and gates and that sort of thing in the city.

Mr. SHUSTER. Looking at the City of New Orleans, it is a little above sea level in some places, but I think I have read as low as 12 feet below sea level, that adds to the problem, is that correct? In your view, are there parts that are below sea level that you would look at and say, well, maybe this isn't the best place to rebuild?

General STROCK. Sir, what that adds to, I think, the frequency of the storm is what it is. But the impact of the storm is magnified by where you sit in the city. So that is the real challenge there.

Land use and zoning and that sort of thing is up to the local authorities on whether and how to reoccupy. Of course, that will be influenced by things like flood plain mapping and whether FEMA is willing to insure, and whether the industry is willing to insure people who go into that kind of situation.

So it is not for us to say. What we will do then is create the technical, economic and environmental solutions, should they choose to operate in those areas in a way that protects them.

Mr. SHUSTER. When those levees were built, I have either read or was told the Corps wanted to put flood gates on or surge gates, and the locals decided at that point they didn't want to do that. Is that accurate?

General STROCK. Sir, it is a long and evolutionary process that started with the barricades as an outer barrier to stop it. Once that was ruled out, our suggestion was that flood gates across the canals would be appropriate, that we could close in an event. But the challenge with that is that when you close those gates, typically a hurricane has water as well. As they pump water out of the city

into those canals, then the water level, the water has nowhere to go.

So they were concerned about closing off those canals that could not be operated during hurricanes. Then we evolved to a solution of what we call parallel protection, that is armoring the sides of those canals to withstand the forces. We thought we had done that, and we will find out soon whether we did or not.

Mr. SHUSTER. Also, I saw an estimate of $5 billion, does that sound right, to build the levees up to 30 feet or to withstand a category 5?

General STROCK. Sir, I can't comment on the specifics of how we do that. The reconnaissance study that was completed in 2002 suggested that it is probably a $3 billion to $3.5 billion job to protect the parishes in New Orleans, the Lake Pontchartrain Hurricane Protection Study, to raise it to a category 5 level.

I think we have gone back and looked at that a bit now, and with some enhancements we think we would like to put in there if we get the opportunity, it may go higher than that. It is likely to go higher than that.

Mr. SHUSTER. When you do an estimate, do you just basically do it on what it costs to construct it, or do you factor in things like environmental challenges, you might have court challenges if you are going to move people and there are going to be people upset?

General STROCK. Sir, we don't factor in the potential for litigation. We assume we are going to do things right that will protect us from that.

But we certainly do, as we look at this, we look at national economic benefits, that is cost benefit ratio, what is being protected versus the cost of the protection. We look at regional economic development benefits, at least consider those. We look at environmental impacts and benefits. And then there other things, social and environmental justice and those kinds of things that we consider.

But the driver is the national economic development benefit, the cost benefit ratio, the value of the property being protected versus the cost to do that.

Mr. SHUSTER. And I heard six to one, does that sound right?

General STROCK. Six to one is a typical one. I believe that is the current cost benefit ratio of a category 5. I am not certain on that, but I think that is about right, yes, sir.

Mr. SHUSTER. Okay. Are there other things you can do besides building the levees up, if a decision is made not to build them to withstand a category 5, can you move houses out of the way and do retention ponds or storm drain runoff type facilities, or even a canal? Does that make sense?

General STROCK. Those sorts of things I think make a lot of sense in dealing with the post-event. For example, I think clearly the city needs to give some thought into bringing some of their electrical stations and pumping stations up above a flood level, because they are all down below the flood level now, because they were meant for interior drainage. So the city needs to consider those things, so they can deal with it after the fact.

Most of the newer pump stations in the city are up along the levee walls on the lake front and on the river front. The older

pump stations, which represent a tremendous investment in capital, are in the middle of the city. So I think they certainly need to look at measures like that to make the pumping stations less vulnerable to flooding, should it occur.

Again, I go back, I think, in terms of reducing the likelihood of a flood. You can either build higher and stronger around the city or you can build perhaps a layering of protection with perhaps something tied to barriers and that sort of thing to reduce the storm surge that would require lesser effort around the populated areas.

Mr. SHUSTER. So that is an option to do, if they decide not to go up?

General STROCK. Yes, sir, it is.

Mr. SHUSTER. You can do those types of things?

General STROCK. Yes, sir.

Mr. SHUSTER. I see my time has expired. So thank you very much, I appreciate it.

General STROCK. Thank you, Mr. Shuster.

Mr. BOUSTANY. The Chair now recognizes Mr. Boozman from Arkansas for five minutes.

Mr. BOOZMAN. Thank you very much. We appreciate you all being here.

As I go around my district, the people of Arkansas want to help and feel like we have a commitment. But I think there is great concern that this money be spent in an appropriate way. So very quickly, I'm interested in your input, and I have worked with all of you very closely, I have all the respect in the world. But this thing has to be done very transparently. In order to satisfy our citizens' concerns, to satisfy this Committee's concerns, and I think Congress' concern on both sides, I would like for you to reassure us publicly that you are going to make every effort to do that.

Then too, if you have any comments about perhaps any additional mechanisms that we need to put in place to assure Congress and to assure the public. Certainly we are going to have oversight, but to make this thing as transparent a process as it can be, and to ensure that the money that we allocate, especially in this time with so much going on, is spent as it should be spent.

General STROCK. Sir, I will start and then turn it over to the Secretary. First of all, in terms of transparency, there are many aspects of this. One of those is the forensic work we are doing right now to figure out what actually occurred. That must be absolutely transparent and very inclusive to make sure we have all points of view so that we really do understand what happened, so that we can build necessary enhancements back into the system.

We have ownership of that, so we are very interested in making sure that is an absolutely transparent process. I do know that there are some people who may be skeptical about our ability to investigate and analyze our own work. So I will turn it over to the Secretary, because in recognition of that, there is an effort that is above the Corps of Engineers in which we nest and contribute, but is overseen by others. I am not sure if that is the transparency you are talking about, but it is certainly one that is important to us.

Mr. WOODLEY. Yes, sir, Congressman, we have two aspects, as you mentioned, the first being the transparency and the public as-

surance necessary that we have gotten to the bottom of the breaches, the causes, and we understand what happened and why it happened with Hurricane Katrina and the way these works that were in place on August 28th functioned.

We are going to first of all operate a transparent process to determine that, then we are going to overlay on that another transparent process in which we get independent review from the National Academy of Sciences, the world's most respected independent scientific review body that we have at our disposal. So I have great confidence that at the end of that process, you and the Committee and the Congress and the American people and the Administration will all have the high level of confidence that we have vetted the process completely and we have a thorough understanding of what took place.

The second piece is the question of what is, what plans are going go be made and what plans are going to be laid going forward as we look to new dispensations on hurricane and storm protection for this region. Of course, you know that the Corps of Engineers process, the feasibility study process and the NEPA process that we go through for all of our projects is one of the most open processes in Government.

So we will certainly commit to using that process going forward and have all the reports and recommendations that are submitted and come forward after full public review, after review in the Chief's office and review in my office, and then submittal to the Committee, that everything that goes into our decision making process will be fully available to everyone. The same thing applies, I am sure, to the State and municipal authorities that are involved in these decision making processes.

Mr. BOOZMAN. Thank you very much. Thank you, Mr. Chairman.

Mr. BOUSTANY. I would ask the two gentlemen if they have any additional questions. We do have some time, if you would like. No? Okay.

That being the case, I want to thank this distinguished panel for being with us. This will conclude the questioning of the first panel, and we will start up with our second panel. Thank you very much, to all of you.

I would like to welcome the second panel to this hearing. We have a very distinguished panel here with us today. We have Dr. Robert Dalrymple, on behalf of the American Society of Civil Engineers. He is a professor of civil engineering at Johns Hopkins University in Baltimore.

We also have Dr. Denise Reed, Professor of the Department of Geology and Geophysics at the University of New Orleans in New Orleans, Louisiana. Welcome. I hope your home is okay.

We have Mr. Raymond Butler, Executive Director of the Gulf Intracoastal Canal Association, from Friendswood, Texas. Dr. Roy A. Dokka, Professor of Engineering, Director of the Louisiana Spatial Reference Center and Center for GeoInformatics at Louisiana State University in Baton Rouge. Mr. Jan Hoogland, Director of the Rijkswaterstaat in the Netherlands, accompanied by Mr. Dale Morris with the Dutch Embassy.

Welcome to all of you. We will start with the testimony from Dr. Dalrymple.

TESTIMONY OF ROBERT A. DALRYMPLE, PH.D., P.E., WILLARD AND LILLIAN HACKERMAN PROFESSOR OF CIVIL ENGINEERING, JOHNS HOPKINS UNIVERSITY; DENISE J. REED, PROFESSOR, DEPARTMENT OF GEOLOGY AND GEOPHYSICS, UNIVERSITY OF NEW ORLEANS; RAYMOND BUTLER, EXECUTIVE DIRECTOR, GULF INTRACOASTAL CANAL ASSOCIATION; ROY K. DOKKA, FRUEHAN ENDOWED PROFESSOR OF ENGINEERING, DIRECTOR, LOUISIANA SPATIAL REFERENCE CENTER AND CENTER FOR GEOINFORMATICS, LOUISIANA STATE UNIVERSITY; JAN R. HOOGLAND, DIRECTOR, RIJKSWATERSTAAT, ACCOMPANIED BY: DALE MORRIS

Mr. DALRYMPLE. Mr. Chairman and members of the Subcommittee, my name is Robert Dalrymple, and I am pleased to appear on behalf of the American Society of Civil Engineers as you examine hurricane and flood protection and water resource planning for a rebuilt Gulf Coast in the wake of Hurricane Katrina.

We commend you on taking the time to study the integration of hurricane, storm and flood protection, navigation and coastal ecosystem restoration while meeting local objectives for rebuilding New Orleans and the Gulf Coast. My career as an educator and engineer has been dedicated to coastal engineering, which is a field that deals with the complexities of engineering at the coastline, where waves and storms create large forces on structures, high water levels and coastal erosion.

The driving focus of coastal engineering research has been to develop an ability to predict the behavior of the shoreline over a short time scale, such as the duration of a major storm, to longer time scales, such as the response of a shoreline over 100 years to human intervention. We have come a long way toward that goal, but much work remains to be done.

The ASCE's paramount concern is for the safety, health and welfare of the public. We believe there is a tremendous opportunity to learn from the tragedy of New Orleans to prevent future loss of life and property.

After the storm, the American Society of Civil Engineers assembled several teams of experts to examine the failures of the New Orleans levee system, as well as to examine the shoreline damage along the Alabama and Mississippi coastline. I led a team of four coastal engineering experts, including two visitors from the Netherlands and Japan to look at the walls in New Orleans. Our New Orleans team of coastal engineers was joined by another ASCE team of geotechnical engineers and a team from the University of California at Berkeley. Our three teams were joined there by a team of U.S. Army Corps of Engineers from the Engineering Research and Development Center in Vicksburg, which provided considerable insight and logistic support.

We gathered information about the failure of the levees, including that data that would be lost during the process of levee repair and the passage of time. I have some overhead information.

The evidence that we looked for was evidence that was ephemeral, that would be lost in the process of levee repair, such evidence as high water lines, wave overtopping, and the evidence of foundation movement and failure. Based on the evidence that we gathered during that week, our joint teams knows in principle how the lev-

ees in New Orleans failed. The exact details, however, await additional analysis.

And as noted by the first panel, there is an interagency performance evaluation task force with NRC and the ASCE being put together.

In terms of development along the Nation's shoreline, for either commercial or residential purposes, it should be done in a sound manner. For residences, simple measures such as elevating buildings along the predicted coastal storm surges and adding hurricane clips to roofs are measures that have reduced the loss of life and property in hurricane-prone regions. Beach nourishment has proven to be effective for many coastal communities.

Since I do have the slides here, this is overtopping evidence on the industrial canal, just south of the big breach. You can see the barge that went through the wall. There were two breaches, one with the barge and one without. But you do see the trench at the foot of the wall. This is the 17th Street Canal, there is no evidence of overtopping here. I am standing in the breach area.

This is evidence of soil translation at the 17th Street Canal. You can see that there is a channeling fence in the middle of the picture that has been moved about 30 feet laterally by the walls being pushed landward.

Levees can provide protection from high water lines due to storm surge. However, they need to be designed to resist overtopping and to be well anchored. Restricting development in fragile environmental areas is another important tool. These and other coastal management practices should be provided to prevent unsafe coastal construction and the losses of beaches and wetlands that protect the upland.

We need to especially protect our Nation's wetlands, which are disappearing at an alarming rate. These vital natural areas, important for reducing the impact of storms by providing a buffer area, are also important biological assets.

The Mississippi River levee system, constructed to contain the river from flooding surrounding areas, is one of the several reasons for the rapid loss of land on the Louisiana shoreline, as it stops the natural sedimentation that flooding brings. Other reasons include oil and gas activity in the coastal area, naturally occurring subsidence and the rise in sea level.

The key to successfully restoring a sustainable ecosystem in the Louisiana coastal wetlands is to manage and use the natural forces that created the coastal area. We need to create and sustain wetlands and barrier islands by accumulating sediment and organic matter.

Moreover, we need to establish integrated watershed planning for the lower Mississippi River and the Mississippi Delta as a basis for any flood protection or coastal restoration program. This would require the inclusion of navigation, flood protection, hurricane protection and ecosystem restoration as integral parts of any infrastructure planning.

To better cope with natural disasters, we need to better understand them. Federal funding for research into hurricane waves and surge, tsunamis, coastal erosion and other costal natural disasters is very low, as documented in the 1999 National Research Council

report by the Marine Board. The Nation needs a sustained effort to improve the planning, design, construction, operation and maintenance of hurricane infrastructure systems that will mitigate the effects of natural hazards.

The Nation's flood protection infrastructure, as well as its inland waterway system, is in the same precarious state as much of the other civil infrastructure of the Country. The American Society of Civil Engineers, with its report card for America's infrastructure, has graded our navigable waterways a D minus this year, down from a D plus in the year 2001. Dams were given a grade of D. We need as a Nation to attend to these essential, life-protecting structures.

The ASCE believes that Congress should enact a national levee inspection and safety program that should be modeled on the successful national dam safety program to ensure that our levees are safe and effective.

Thank you, Mr. Chairman and members of the Subcommittee. That concludes my statement.

Mr. BOUSTANY. Thank you, Dr. Dalrymple.

Next we will go to Dr. Reed.

Ms. REED. Good morning, Mr. Chairman, members of the Committee. Thank you for the opportunity to be here today.

I am here today to discuss with you the interactions among ecosystem restoration, flood protection and other future water resources planning efforts for the area recently devastated by Hurricanes Katrina and Rita. Now more than ever, we need those things to work together.

I am going to emphasize just three points here this morning. First, I want to address how ecosystem restoration can assist with flood protection. Ecosystem restoration projects, particularly those in the future, that are placed and designed specifically to provide flood protection to adjacent communities, will only be effective in achieving that if they are robust and themselves stand up to storm damage.

Observations of coastal marshes east of New Orleans post-Hurricane Katrina show thankfully that most of the coastal wetlands came through unscathed and likely received an important input of sediment which will help keep them up above sea level rise in subsidence. I will come back to that issue in a moment.

However, marshes east of the city with more organic soils were physically torn apart by the storm surge and the waves. Importantly, though, some marshes close to the city which have been receiving river sediment as part of an existing restoration project remained intact, and six weeks after the storm, new growth of vegetation is already taking place.

Healing some of the damaged marshes will likely occur quickly if fresh water and nutrients from the river can be gotten into those areas. But firm marsh soils are going to be essential if these or any other restored marshes are going to withstand future storms and continue to contribute to flood protection.

Secondly, I want to address the effect of some flood protection measures on the coastal ecosystem. The barrier plan for Lake Pontchartrain and some other flood protection measures currently being considered for south Louisiana will change the dynamics of the

coastal ecosystem by altering water flows, even when there is no storm threat.

When the barrier plan was considered several years ago, it seems that salinity was the major concern. Some now suggest that that concern could be addressed by designing the structure appropriately to take that factor into account.

However, our 21st century understanding of how costal ecosystems work demands that we maintain the dynamic exchanges between the lakes and the bays and the marshes. This concept was fundamental to the widely accepted Coast 2050 plan for Louisiana restoration. To keep an ecosystem inside a barrier viable, let alone healthy, we must not limit these exchanges except during storms.

The planned Morganza to the Gulf hurricane protection project in Louisiana applies this principles. Future flood protection works that encompass coastal wetlands within their boundary can and should be similarly synergistic with the environment.

Lastly, I would like to address the issue of sustainability in the face of subsidence and sea level rise. The coastal wetlands of the northern Gulf Coast can survive sea level rise if we give them a fighting chance. Recent studies have measured high subsidence rates along roads and highways in the region. But thus far, these measurements have not been made in the coastal marshes. Coastal marshes are very resilient to rising sea level. They have the ability to build up soils in ways that roads and highways and levee crests that we build simply don't. That so many marshes still remain in coastal Louisiana despite these high rates of subsidence that we have measured in the late 20th century, that in itself is testament to their ability to survive, if conditions are favorable, if we give them a fighting chance.

Predictions of subsidence and sea level rise must be a really important part of our planning for restoration, for flood protection and for community rebuilding. But in and of themselves they do not mean that we should abandon this highly productive coastal ecosystem.

That concludes my remarks for the moment, Mr. Chairman. Thank you.

Mr. BOUSTANY. Thank you very much, Dr. Reed.

Mr. Butler, you are now recognized.

Mr. BUTLER. Thank you, sir.

Good afternoon. My name is Raymond Butler. I am the Executive Director of the Gulf Intracoastal Canal Association in Houston, Texas.

Mr. Chairman, members of the Committee, I would like to thank you for giving the Gulf Intracoastal Canal Association, GICA, this opportunity to provide our input into the vital questions of how Gulf Coast inland waters navigation might be affected by future hurricane protection options and how it has been affected by the recent storms.

Before I answer those questions, I would like to tell you a little bit more about our association. In August, GICA celebrated its 100th anniversary. Our 200 plus members are virtually a who's who of barge and towboat operators, cargo carriers, shippers, port authorities and waterways service organizations from Florida to Texas. Because of the local, regional and national significance of

the canal, GICA continues to exist as an organization advocating for proper stewardship of this vital resource.

As I am confident the Committee is already aware, barges move cargo more efficiently, cleanly, cheaply than any other competing surface mode of transportation. To give an example, a single tow pushing two tank barges, which is very common on the Gulf Intracoastal Waterway these days, can move 60,000 barrels of product. That same product would require 80 railroad tank cars or 300 large tank trucks to move on our highways and rail systems.

The products of the refineries, chemical plants along the Gulf Coast, grain, steel, coal, cement, agra-goods and other commodities that move by barge are vital to every American. If you eat, drive a car, turn on a light or use products containing plastic, I would contend you depend on the efficient operation of this waterway. The manufacturing facilities along the canal provide vital, high-paying jobs that sustain the Gulf Coast economy.

Overall, the GIWW fared very well in this last series of hurricanes that have battered the Gulf Coast. However, there are reasons for concern, lessons to be learned and actions that we need to take to ensure the future reliability of the waterways.

I have a vessel operations background. I was privileged to have worked with the Coast Guard command center and the Corps of Engineers very intimately in carrying out a coordinated, joint industry agency response to Hurricanes Ivan, Dennis, Katrina and Rita. I would like to share some of what I learned during some of those experiences with you today.

First, we must continue and strengthen the partnership between industry, the Corps of Engineers and the Coast Guard, which in my view was very critical to the rapid restoration of navigation along the entire GIWW, within six days after Hurricane Katrina and within four days after Rita. Secondly, we must focus on the critical importance of communications, recognizing the need to co-locate key industry and Government response personnel to the same location and provide those key personnel with a common operating picture of what is actually happening during our preparation and restoration efforts on a real-time basis.

Third, we must identify and pursue integrated response solutions that address the needs of navigation, flood control and the environment and allow us to simultaneously address all of these needs while assuring that the vital goods essential to our Nation's economy keep moving on the waterways.

Fourth, we must pursue wise planning mechanisms that avoid, wherever possible, placing residential and retail development in conflict with crucial navigation systems, while at the same time being sensitive to our environmental stewardship responsibilities.

Finally, we must stop under-investing in our Nation's inland waterway system and ensure on both the capital and operations and maintenance sides of the equation that this Nation will continue to have a world class inland waterway system.

Mr. Chairman, although I am not an expert on structural protection from hurricanes, I can tell you that we need to examine the damage our locks suffered as a result of the storms and ensure we protect these vital structures as best we can. We need adequate

spare parts, ready to deliver and fix whatever damage occurs right away.

I can tell you that efficient, low cost inland waterway transportation is vital to serving American consumers and keeping our coastal industries competitive in a global marketplace. Where structural remedies are required to assist in flood damage reduction, they must not impair the dependable, reliable and efficient navigation on which we all depend.

In closing, I would like to say that after spending many days with our Coast Guard and Corps of Engineers folks on a very personal level during our response to these devastating storms, I am in awe of the job that these folks did. In my view, one of the most important parts of that response was the spirit of partnership with industry that both of these agencies embraced during that process.

Thank you very much for the opportunity to be here and testify today.

Mr. BOUSTANY. We thank you, Mr. Butler.

We will now recognize Dr. Dokka.

Mr. DOKKA. Thank you, Mr. Chairman. I would like to thank the Committee for inviting me today, and I hope that my testimony will be of value to you.

You are looking for answers today, permit me to help you to try to understand a little bit better what the problem is. Ladies and gentlemen, a silent disaster of massive proportions is slowly drowning the Gulf Coast and making communities and critical infrastructure ever more vulnerable to hurricanes. Today, waters of the Gulf of Mexico are inundating the land, due to the slow rise of the world's oceans and more importantly, due to the rapid sinking of the land.

This sinking, or subsidence, is the downward movement of the land relative to a point of reference. The entire coast and adjoining areas from Mobile to the Mexican border is sinking. Louisiana's coast has sunk from between two and four feet since 1950. Subsidence occurs largely by natural processes, augmented locally by human activities. The natural processes are unrelenting and unstoppable, in contrast to human-induced components.

My written testimony outlines the causes, and I will use the remaining time to focus instead on how subsidence will directly impact immediate reconstruction efforts and future mitigation planning along the Gulf Coast.

Understanding subsidence today requires accurate measurement of what is happening today. Because sinking will continue into the future, it is critical for planning. My comments draw heavily from a report written Mr. Kurt Shinkle and myself and issued in 2004 by the National Oceanic and Atmospheric Administration of the Department of Commerce. This report, NOAA Technical Report 50, documents land movements that have occurred over the past 50 years, using the most precise and reliable data available.

Here are a few of the practical implications of modern subsidence. The vertical control system surveyors use to determine elevation, as well as the plan and build infrastructure, has been corrupted by subsidence. There are only 86 benchmarks in the entire State of Louisiana that are reliable today. A week ago it was zero.

Subsidence will render most of these reference points useless within a year or two.

Mississippi and south Texas have similar problems. Bad vertical control has bad consequences. The Corps of Engineers cannot at present build new or augment existing hurricane protection levees to proper elevations. The levees are as much as two feet lower than they were designed in some areas of south Louisiana. Subsidence has moved them over time.

NOAA National Hurricane Center cannot at present produce accurate storm surge models of the Gulf Coast, because land elevation inputs are incorrect. FEMA cannot make accurate flood insurance rate maps. Areas mapped as outside the flood zone may actually be in the flood zone.

State and Federal highways are being built below their desired design heights. They may not be able to serve as escape routes during storms and will likely degrade more quickly due to the elements. Consumers cannot get accurate elevations on home slabs for insurance purposes.

So what is the future? Well, because subsidence is unrelenting, it means increasing vulnerability to storm surge over time. If hurricanes of the magnitude of Katrina and Rita return 25 years from now, the area of effect and destruction will be much greater unless we prepare.

Much of coastal Louisiana sits between three feet and sea level, and by the end of this century, most areas will be at or below sea level. Modern subsidence has occurred at substantially higher rates and over larger areas than supposed by Federal and State agencies tasked to study this problem. Subsidence is observed far beyond the wetlands of the Mississippi River delta. In your district, sir, your area sunk something like five feet in the last several years.

The data do not support the widely held belief that the disease killing the coast can be addressed by just the wetlands-centric solutions. The real enemy is the Gulf of Mexico. Current plans to save the coast will likely improve the ecology, a laudable goal that stands on its own merits. But these efforts cannot build elevation in New Orleans, Houma or any places where people live and work in south Louisiana. Without elevation, our only hope is through the enhancement of our levee defenses. The reality is that without them, we must surrender the coast and retreat.

Let me close by focusing on two action items. The first deals with the design of a comprehensive levee system that can afford adequate protection today and over the design life of this system. To be viable, the design must account for our changing landscape, especially future subsidence. Furthermore, new protection walls will be needed to be built in southwest Louisiana, along the coast west of Morgan City to the Sabine River. There is none today.

Similarly effective designs need to be developed along the eastern edge of Lake Pontchartrain for storm surges that might arise from the north.

The second critical step is the rapid re-establishment of accurate vertical control in the region. If engineers say they need to built a category 5 flood protection wall to plus 23 feet, then the builders will have to be able to figure out where plus 20 feet is in the field. That is not possible today.

Congress needs to support acceleration of the national height modernization program currently underway by NOAA National Geodetic Survey. Builders and planners need accurate elevations now if we are to prevent future massive repeat mitigation.

Thank you for your attention. I will be happy to answer any questions afterwards.

Mr. BOUSTANY. Thank you very much, Dr. Dokka.

Mr. Hoogland, you are welcome to give your testimony now.

Mr. HOOGLAND. Mr. Chairman, distinguished members of the Committee, ladies and gentlemen. It is a great honor for me to be here to testify on the subject of flood protection in our country.

Let me tell you something about myself. I spent my entre career within the Netherlands Ministry of Public Works and Water Management, in a department called Rijkswaterstaat. That is comparable with the U.S. Army Corps of Engineers.

From 1981 until 1997, I was in charge of policy making of flood protection in my country. Mr. Chairman, I have submitted the formal written testimony called Flood Defense in the Netherlands: Lessons Learned from Dutch History, and I respectfully request that this be inserted in the records of your Committee.

First of all, I need to point out that all the water situation in the Netherlands is quite different from that in the United States. Almost 60 percent of our country is threatened by water, either by storm surges and/or by floods due to high discharges of rivers. Cities, such as Rotterdam, our main harbor and the world's second largest port, and Amsterdam, our capital, and our largest international airport are below sea level. We earn 70 percent of our gross national product and attract huge amounts of foreign investment in these flood-prone areas.

On top of that, millions of people live below sea level. Yet they feel safe and secure.

Hundreds of years ago, we established dedicated organizations whose sole purpose was to defend the country against flooding, from sea and rivers. On a local or county level, these are called water boards. And on a national level or federal level, it is my organization, Rijkswaterstaat.

My main message to your Committee, Mr. Chairman, is that we have learned and continue to learn from history, especially the history of flood disasters. Each flood disaster in the Netherlands, from the 13th century onward, has brought us new lessons to be learned for keeping our country habitable, liveable and attractive to citizens and business.

After the floods of 1953, in which nearly 2,000 people died, we designed our Deltaplan, primarily meant for the coastal areas. In this Deltaplan, we developed for the first time a comprehensive system of standards for designing dikes and barriers for the whole country. These government-endorsed standards assure the quality of our water defense system. All our dikes we rebuilt accordingly and the total length of our coastline was shortened by more than 700 kilometers as a result of closing estuaries with dams or storm surge barriers.

It took 50 years from idea to completion. In the interim, we incorporated new insights about morphological as well as ecological processes. For these reasons, the two last barriers constructed in

the end of the Deltaplan are partly open and moveable: the Easternscheldt Barrier, because of the fishery, sedimentation and the environment, and the Stormsurge Barrier in the Rotterdam Waterway because of shipping and sedimentation. These barriers are closed only in case of storm surges.

In the Netherlands, as in your country, cost is a factor. In total, over those 50 years, we invested about $15 billion in our Deltaplan in today's cost. Not an inconsequential cost, surely, but also a cost that is penny to the dollar compared to costs that we would have incurred had we not made that financial commitment.

Mr. Chairman, the Netherlands is threatened not only by sea but also by three of Europe's major rivers that empty into the North Sea via my country. In 1993 and 1995, the extreme discharges of the major rivers nearly overtopped our river dikes. Two hundred and fifty-thousand people and their livestock were evacuated. That event made clear again that we could not postpone upgrading the river dikes.

We then have learned that the water defense system includes not only technical solutions, it is not just building and maintaining dikes. Disasters can always happen, and therefore you need evacuation plans.

We also learned that it is always important to think about zoning. That is to say, legislating the areas to be reserved for urban development and for water. Our government designed this new policy in a document called More Room For Water, in which our spatial planning act, or land use act plays a pivotal role.

Now, if you were to ask me, what are the most important elements of our protection policy, I would say the following: know-how and organizational structure; standards and legislation; priorities and budget; and prevention and zoning. As to know-how, it clearly include technology, morphological and ecological knowledge, statistics and predictions. New developments, such as sea level risk and climate change, are important components.

To ensure that the development of this knowledge stays on the highest level, we have a department such as mine working at the national level as a respected partner in the international exchange of knowledge. My department, Rijkswaterstaat, by the way, has been around since 1798. Since yesterday, I found out that your Army Corps is just three years older.

[Laughter.]

Mr. HOOGLAND. On a local level, we have for 800 years one issue organizations called water boards. Their only task is water management, which includes flood protection. Water boards are public entities with their own election and tax system.

Now I come to standards and legislation. Our standards are accepted risk levels related to the design criteria of our dikes. Those standards are laid down in the flood defense act. For the economically most important and densely populated part of the country, we design our dikes and dunes to be sturdy enough to withstand a storm situation with a probability of 1 to 10,000 a year. That means that a Dutchman, if he should live 100 years, has a chance of 1 percent to witness such an event. For our parliament, these odds became the acceptable standards. For the less important

coastal areas, we calculate the probability of 1 to 4,000, and along the main rivers, 1 to 1,250.

Very essential is that every five years, the entire water defense system is assessed for compliance by local water boards. A summary of these assessments is submitted to the national parliament. In order to be able to make these assessments, it is essential to know what the hydraulic specifications belonging to the politically accepted standards are. In my department, Rijkswaterstaat publishes each five years, to these hydraulic specifications, in which we implement the latest knowledge of statistics, failure mechanisms of dikes, sea level rise and climate change.

A few words about priorities and budget. Since 1953, financing of renovating the dikes has been a national priority. All funds for rebuilding are allocated by the central government. Maintenance, financially and operationally, is totally controlled by the water boards, who in turn, tax the local population. Since the water boards have no other responsibility than water, other priorities never go to the detriment of the water defense system.

Finally, I get to the matter of prevention and zoning. The notion of zoning is fairly new in our approach. We need to answer questions such as whether we reserve space for urban development or whether we dedicate space exclusively for water. It is a tough issue, but an issue we cannot ignore.

Last but not least, it is important to realize that total safety does not exist, and therefore, it is essential to be prepared, for instance, by having evacuation plans. After all, members of the Committee, disasters do happen.

Thank you, Mr. Chairman.

Mr. BOUSTANY. Thank you for your perspective, Mr. Hoogland. We really appreciate it.

A quick question for you. In planning flood protection projects in the United States, we do economic analyses to determine the benefits of protecting infrastructure, and we compare that and look at the cost and do these cost benefit analyses. Do you do the same in your country?

Mr. HOOGLAND. In 1953, we had a delta committee which, a part of the delta committee was a cost benefit calculation. But we didn't do it afterwards in the new time, but it is a part of the policy in the Netherlands. But it is not the only part. Because the delta committee said the economic value you can calculate, but the cost of human life, it is incalculable. I am sorry for my language. Incalculable.

Mr. BOUSTANY. Your English is better than my Dutch.

[Laughter.]

Mr. BOUSTANY. Thank you for your answer.

One other question. The problem of subsidence that we have talked about here today, is that significant in your area? Do you see it there? Dr. Dokka mentioned benchmarks. Is coming up with benchmarks and a reference point, is it a problem or has it been a pretty consistent solution for you?

Mr. HOOGLAND. We have in the Netherlands an enormous subsidence of the land, especially in the western part of the country. When you look over the last 1,000 years, then we have a subsid-

ence of 5 meters. From that five meters, only one meter is sea level risk and four meters is soil subsidence.

So it is very important in our country to calculate and to measure. We have a system, geodetical system of measuring every, I think, three or five years the whole system, and to calculate the influence of that subsidence. We use fairly deep points to sterilize our level of measurements. But we have, I believe, 20 meters under the normal soil level, we have a layer that is permanent, without subsidence.

Mr. BOUSTANY. Thank you for that.

Dr. Dokka, you paint a very grim picture of what we face. Is it worthy of investment? Can New Orleans be salvaged? Should we move forward.

Mr. DOKKA. Absolutely. You can run the numbers for how much Louisiana's coast is worth. The cost benefit ratio is tremendous, from what I understand, from what the coast is worth and what it would cost to fix it.

It is also just too important not to be fixed. If people like $3 a gallon gasoline now, they are going to love the future if we do nothing.

But another important point is that this does not just affect the Louisiana coast. It affects the entire Gulf Coast and the folks in Texas have issues as well. But they are not quite as far along in discovering it.

Mr. BOUSTANY. How do we plan for subsidence? I am not an engineer, but I would be interested in hearing your insights on that.

Mr. DOKKA. Well, if I could predict things, I would be buying lottery tickets, frankly. But I think our best guess, our best way of making intelligent guesses, is to look at the most recent past and then try to project that into the future. If we want to understand how the entire coast works, you have to look at thousands of years of history. However, for trying to understand these problems right now, trying to make sure that our people are safe for the next 50 years, I think it makes sense to go back and look at the last 50 years.

However, predicting, one thing that we can't predict, how are people going to react to this. There are things we can do. The Dutch obviously live very well below sea level. People in New Orleans have done that as well. I think there are solutions, it is just a matter of beginning to understand what the problem actually is.

Mr. BOUSTANY. And the problem of reference points in Louisiana, it is a real problem. That is what I gather from your testimony.

Mr. DOKKA. The earth is dynamic. We have ways of fixing that. We have right now half of our plan to come up with a high-tech solution, essentially using a global positioning system, is halfway completed. The Corps is using these data right now to try to figure out exactly how to remedy the situation in New Orleans.

Mr. BOUSTANY. Thank you, Dr. Dokka.

At this time I am going to defer to the Ranking Member, Ms. Johnson, to ask questions.

Ms. JOHNSON. Thank you very much, Mr. Chairman. I don't have any questions. I will offer an apology to this panel for being out most of your testimony. I was listening part of the time, I was trying to solve a district problem with a visitor back there.

I thank you very much coming to spend your time, and I know that we will probably be in touch again before this is all over. Thanks.

Mr. BOUSTANY. I am pleased to recognize Mr. Gilchrest for five minutes.

Mr. GILCHREST. Thank you, Mr. Boustany.

I apologize, too, I was in a briefing about Iraq for the last hour or so. Fascinating, innovative perspectives on that situation.

But I wanted to, you know, we come in here and I didn't listen to you speak, I really apologize. But we have your testimony and I will take a look at it over the next couple of days.

I wanted to ask, first of all, I want to welcome Dr. Dalrymple, a fellow Marylander. Welcome to Washington.

Mr. DALRYMPLE. Thank you, sir.

Mr. GILCHREST. I wanted to ask Mr. Hoogland, you probably stated this already, but do you see the situation in the Netherlands similar to the situation in Louisiana and the Gulf of Mexico?

Mr. HOOGLAND. There is some similarity. But I think there is something, there are very big differences, too. We don't know hurricanes. We have floods from storm surges, and a storm surge is quite different from a hurricane. We have river floods, you have river floods as well.

But living below sea level and being protected by dikes, you call them levees, that is similar to our situation. So there are similarities, but there are big differences, too.

Mr. GILCHREST. The New York Times science section, maybe a month ago or so now, two months probably, had a fascinating article on your technology to keep Holland dry. Do you see similar technologies appropriate for New Orleans? I am not sure where you would put that. I mean, some of your technology would be appropriate for coastal Louisiana or New Orleans, or is the situation so different that some of those innovative technological pumps that you use would be appropriate?

Mr. HOOGLAND. I think so. I think there are possibilities. But the most important thing about what I tried to tell today was the political commitment of the system. Political commitment to the standards is essential in the Dutch system. Political commitment for the standards, political commitment for, we call it structural funding of budget and political commitment for assessments for compliance to the standards. That is essential in the political system in the Netherlands.

The next step, when it has been done, the next step is a step for technicians.

Mr. GILCHREST. What was the next step?

Mr. HOOGLAND. When you have political commitment for the standards, then technicians can transform those standards in several solutions. I heard this morning General Strock telling about the several solutions they have, they can present with their cost benefit effects, and with all the other effects.

But first of all, it was my message, there has to be political agreement for the standards you want to guarantee to your citizens. That is what we have done in the Netherlands. That is essential.

Mr. GILCHREST. My time is almost expired, and I wanted to get in another question. But thank you, that is well appreciated. It has an impact on our thinking.

Dr. Dokka, given all the proposals, whether it is 2050 or LSA or just the myriad of CWPRA programs that have been happening there that have apparently been pretty successful, do you see the policy which seems to me to be pretty urgent, because you could get another Wilma, Katrina, Rita, whatever, next season, and whatever you have done would be undone.

Can you tell us the process, the system that you would employ to restore coastal Louisiana in all the myriad of things that have been discussed here, to do it in a way that would be timely? We have heard you have to have the benefit to cost analysis, you have to have all these studies done and it is going to take five years, ten years, twenty years or whatever. Is the CWPRA model appropriate for us to fund larger sums of money to get some of these projects underway faster?

Mr. DOKKA. I am not an expert on these particular programs other than to say than, let's say, CWPRA, for instance, these are directed at the wetlands. But I think what I am saying here is that what is happening in the coast is happening everywhere. It is not just the wetlands. Most folks in Louisiana, contrary to popular belief, we do not live in the wetlands. We actually live on high ground.

So what we need to integrate into the dialogue at this particular point are ways that we can protect our people to the fact that the land is subsiding, the world's oceans are rising. They may rise much more quickly into the future. That is one of the difficult things about prediction.

But I think what needs to be done is, we need to add that additional component into that and then, as best we can, integrate all of these things together.

Mr. GILCHREST. Could I have just one more question?

Mr. BOUSTANY. I was going to say, Mr. Gilchrest, I'm feeling generous with time, knowing your interest in all this. So by all means.

Mr. GILCHREST. I just want to ask, when we hear, and then subsequent to that, when we say we can protect people against a category 5 hurricane, and we have heard that in a number of different places from a number of different people, and somebody just said here, and I think it might have been you, Dr. Dokka, this is a very dynamic ecological system.

How do you protect, and a category 5 hurricane I guess is down there right now. Can you protect lower Louisiana and New Orleans from a category 5 hurricane?

Mr. DOKKA. The short answer is, I think you can. I think the question is, can you afford it. The same issues, in the United States, if you go through and look at most of the major cities, people live in risk. Either you are living next to an active volcano that is going to blow up in our lifetimes, or there is going to be a major earthquake in Los Angeles, San Francisco, Seattle. I can go down the list. These are risky places to live. However, this is where we live.

And we assume the risk, and we need to understand what that risk is. And engineering, the Corps of Engineers, have the tools to

do this. We cannot, as the member indicated before, we cannot plan for the unexpected.

Mr. GILCHREST. I think what I am trying to get at is, the Nation needs to be convinced that all of us should share in the risk of those folks who choose to live in coastal Louisiana. It is the Nation. Everybody is going to give money to the Red Cross. You have everybody that will go down under emergencies and save lives. There is no question that that type of compassion is out there.

The question, though, is, and I hear it in my district, and I hear it from other members in their districts, through town meetings and just meeting people, and that is why I asked the question about a category 5 hurricane. The Nation, I think, to some extent, needs to have some sense of certainty that the money that we have put in over the next couple of years and the money that it will take to sustain those areas, not just coastal Louisiana or Mississippi, my coastal district as well, North Carolina, Florida, the Nation needs to have some sense, because right now they are a little unsettled that we can do this in such a way that you can protect lives and property, it is sustainable and it is all reasonably affordable.

Mr. DOKKA. From the perspective of a scientist or engineer, we have the capabilities of doing these things. However, really, I think perhaps maybe where you would really like to go on that question is, what we have been doing up to this point has worked very well, to a point. We are discovering more and more about how this world works, and we are going to have to then step up, we are going to have to get better, we are going to have to understand the earth a lot better before we are going to be able to make the kind of certainty, you are asking me about certainty.

I think we can do this. It is just that we have to do things smarter.

Mr. GILCHREST. Thank you.

Mr. BOUSTANY. Thank you. I have a few more questions before we conclude the hearing.

First of all, Dr. Dalrymple, I was kind of intrigued when I saw the slides that you showed. In very close proximity to the levees were trees. Does this pose a risk to the levees, particularly those which are earthen?

Mr. DALRYMPLE. I think they can. I don't know that it was a problem there. The trees are fairly well back from the levees. But there are indeed trees in peoples' back yards and so forth. I think the problem is if you get roots growing through the levees, it poses a problem. But I think this is something that they look for.

Mr. BOUSTANY. Thank you. I know you mentioned engineering constraints, especially with regard to the prediction of subsidence. Obviously, my earlier questions were kind of pointed in that direction, and trying to predict it and so forth. It seems to me to be a very challenging problem from an engineering standpoint.

Mr. DALRYMPLE. I believe it is. The New Orleans district does in fact repair the levees on a routine basis, that is, add more elevation to the levees as they subside.

Mr. BOUSTANY. Does the elevation, as you add more elevation, you are adding weight, and I guess it is a calculation problem to sort of maintain some sort of equilibrium?

Mr. DALRYMPLE. Right.

Mr. BOUSTANY. Dr. Reed, your comments about the dynamic nature of our wetlands and the interaction with storms and so forth was interesting. Having lived down in southwest Louisiana, I certainly have seen it directly and experienced that sort of dynamic state.

Can you comment on the salt intrusion and what effect it has on wetlands after a major storm surge like this? I certainly saw devastated farm land and marsh, it looked like it had been burned over by the salt. What is the long lasting effect with replenishing a marsh after this type of event?

Ms. REED. That is a very good question. When we look at these marshes immediately after the storm, they look brown, they look dead. We found a number of experimental studies, this is the kind of thing that scientists can look at in laboratories where you take plants in, you flood them as if there would be a storm and they return to normal conditions and see what happens.

The good news is that much of that fresh vegetation in the fresh marsh areas, as long as the storm surge drains away fairly quickly and doesn't stay there for a long time, and as long as there is a return to fairly normal hydrologic conditions, the salinity goes back the way it was, perhaps there is some rainfall and the winter season, as we might normally have. Then many of those plants will come back during the spring. So experimental studies really show that, and I think we start to see that on the ground, too.

The problem comes, and this may indeed be more of a problem in southwestern Louisiana, where we had hydrologic barriers across the landscape, for one reason or another. Sometimes they are roads or sometimes they are duck ponds, frankly. The water stays in there longer, a bit like the City of New Orleans. It just doesn't drain out when there is a levee around very effectively. That saltwater, particularly in your district where it is very close to the Gulf of Mexico and you get very high salinity waters coming in, if that water stays there too long, then we could have a problem.

The thing is to return it to normal hydrology as quickly as possible. And we have to think about what we want those areas to be and really whether or not having fresh marsh or the expectation of fresh marsh very close to the coast as we have there is viable in the long term. Or we can plan for systems to allow us to get that water out quicker, and then the marsh will stand a good chance.

Mr. BOUSTANY. Thank you. Can our coastal marsh erosion ever be reversed, or are we going to be content with just slowing down this process?

Ms. REED. That is a very good question. I was part of the Coast 2050 team when we sat down essentially with a blank sheet of paper and worked out what we would want to do for the coast. Even with the very ambitious plans laid out there, when we think about the state that our coast is in already, how degraded it is and how that degradation is expected to continue, even those very ambitious plans laid out in the 2050 plan didn't really bring much back of what we had lost.

As you know from the report, the idea was to kind of stem the tide, if you like. What will happen, however, is there will be different things in different areas. That kind of evaluation of how

much you gain versus how much you lose, if you do it on the whole coast basis, then you can't get it back.

But effectively when you do restoration, you don't do the same thing in every area, you don't apply the same tool in every area. So in some areas we really do stand a chance of growing marsh back. In other areas, it is really a matter of managing the system and trying to slow the loss as much as can, just because the process is different. And as it seems like you know, your district is one of those ares where actually bringing marsh back with natural processes is very difficult.

However, we do have other approaches, and we can mechanically move sediment around in systems. So if we want to bring marshes back in southwestern Louisiana, then we just need a different kind of approach.

Mr. BOUSTANY. Do you have an estimate of what we have lost permanently, particularly in southeast Louisiana, in terms of barrier islands and also land mass? Or is it too soon to know what we are going to end up with?

Ms. REED. Well, it's really too soon to know. You have probably seen some of these comparisons of satellite imagery being in some of the media that have been produced. It is important to recognize firstly that some of the marshes can come back. As I noted in my remarks, some of the marshes close to the city are already growing back really very well, and many others were unscathed. So we have to wait for next growing season really to see what the situation in the marshes is.

On the barrier islands, we know from previous storms, we know from Ivan, we know from Georges, we know from Andrew, that they always look worse immediately after the storm. Actually that sand recovery process is really very effective. It is limited by how much sand we have in the system. For barrier islands, going out there immediately with a dredge is not the best thing. Rather, you should wait and see how those natural healing processes proceed.

So we can't tell yet, I'm afraid.

Mr. BOUSTANY. I am going to wrap up here, but one question, one line of inquiry to Mr. Butler. Can fresh water and sediment be drawn off the Mississippi River in order to provide for marsh restoration without impacting navigation? Do you have thoughts on that?

Mr. BUTLER. Mr. Chairman, yes, I would tell you that first off, I am not a hydrologist. I know we have had a lot of discussion along those lines. I think it is something that is really worthwhile discussing, and it has a lot of real possibilities. I think we could probably do that and not impact navigation significantly.

Mr. BOUSTANY. I know with respect to the Gulf Intracoastal Waterway, we had a challenge with regard to the locks, you know, whether to keep them open or closed, facilitate drainage or create currents for navigation. It was an ongoing problem. We managed to solve it by coming up with a timetable, and you had mentioned something along those lines, so I appreciate your thoughts on that. Something we can perhaps further work on, as well.

I want to thank all of you for your testimony. It has been very informative. The questions that we have asked you have answered

very forthrightly and we really appreciate it. Thank you. We will conclude the hearing.

[Whereupon, at 1:42 p.m., the subcommittee was adjourned.]

Testimony of Raymond Butler
Executive Director, Gulf Intracoastal Canal Association
October 20, 2005

Mr. Chairman, members of the Committee, thank you for giving the Gulf Intracoastal Canal Association (GICA) an opportunity to provide its input into the vital questions of how Gulf Coast inland waterways navigation might be affected by future hurricane protection options and how it has been affected by the recent storms.

Before I answer those questions, I would like to tell you a bit more about our association. In August, GICA celebrated its 100th anniversary. Its 200 plus members are a who's who of barge and towboat operators, cargo shippers, port authorities and waterways service organizations from Florida to Texas.

GICA was formed by visionary leaders from across the Gulf Coast, who recognized the economic value of an inland canal connecting all the ports, large and small, along the Gulf Coast. As visionary as they were, they did not even begin to recognize the contribution this canal would be making to our economy 100 years later. Their early estimates were that the canal would move 5 million tons of cargo a year. Congress approved the project on that basis. As the canal was under construction, one of my predecessors was bold enough to predict it might someday move 10 million tons a year. Ladies and gentleman, that canal, which is little changed from its initial design, now carries some 120 million tons of cargo a year and has plenty of capacity left to meet the growing transportation needs of this nation. Barges move cargo more efficiently, cleanly and cheaply than any competing surface mode. To give you an example, a single towboat pushing two tank barges, which is common on the Gulf Intracoastal Waterway (GIWW), can move 60,000 barrels of product. That same product would require 80 railroad tank cars or 300 large tank trucks to move. Every day, thousands of barges move vital commodities that would otherwise have to be loaded in tens of thousands of additional trucks on our already crowded highways to get to their destinations.

In my view, it was not random chance that concentrated the nation's refining and petrochemical industries along the Gulf Coast. These facilities depend upon one another for feedstocks and other products. They constantly move large quantities of a multitude of products between facilities. More often than not, barges provide the most efficient means for them to do so. Barges also carry their final products to customers throughout the inland waterway system, from Minneapolis to Chicago to Pittsburgh and points in between.

The products of these refineries and chemical plants are vital to every American. If you drive a car, turn on a light, eat or use products containing plastic, you depend on these plants and refineries. These facilities also provide vital high paying jobs that sustain the Gulf Coast economy. Reliable, efficient and low cost waterways transportation keeps costs down and allows our Gulf Coast facilities to remain competitive in an increasingly tough global marketplace. Gulf Coast industries depend on the waterways. We all

depend on them. So, in reality, our entire nation depends on the Gulf Intracoastal Waterway and its tributaries. A significant disruption to the GIWW would be a disruption to the national economy. It could be devastating to particular areas. For example, the gasoline supplies for the Florida panhandle and the Rio Grande Valley are delivered mainly by the GIWW. They quickly feel the effects of any disruptions. It is because of the local, regional and national importance of the canal that GICA continues to exist as an organization, advocating for proper stewardship of this vital resource.

Overall, the GIWW fared well in the series of hurricanes that have battered the Gulf over the past year. The GIWW served its navigation role well while other modes of transportation along the Coast remained crippled. However, there are reasons for concern, lessons to be learned and actions to be taken to ensure the future reliability of the canal.

First of all, GICA has learned that our industries and their customers, especially gasoline and diesel end users, need the earliest possible resumption of navigation following a storm. We must start taking action before a storm hits to be ready to resume operations quickly after the storm. For that reason, industry pre-positions personnel and equipment to be used in the restoration effort before a storm strikes. We have developed partnerships with the U.S. Army Corps of Engineers and the U.S. Coast Guard. Our people work side by side with them during and after the storm. I have been privileged to be present in the Coast Guard Command posts for Ivan, Dennis, Katrina and Rita serving as the liaison between the Coast Guard and inland navigation interestsfor response purposes. During the hours after storm passage, when the Coast Guard and its boats and aircraft are rightly focused on lifesaving and public safety missions, our member's vessels are in the waterway, often with Coast Guard and/or Corps representatives on board, conducting sonar sweeps for debris and shoaling, noting discrepancies in navigation buoys and looking for other waterways problems. These same vessels and personnel, using sophisticated mapping and positioning equipment, can actually set temporary buoys under the direction of Coast Guard personnel at a time when no Coast Guard assets are available for this service or when Coast Guard resources are tied up on other reaches of the waterway. Within 6 days following Katrina and 4 days following Rita, shallow draft navigability had been restored along the entire Gulf Intracoastal Waterway. Without the government, GICA and industry partnership, navigation would have been delayed for a much longer period of time.

Another thing we have learned is that communications are vital. We must do a better job of ensuring that the Coast Guard, Corps and industry are working with the same information at the same time. In the crisis mode, before, during, and immediately after the storm, key personnel from each group should be in the same place, coordinating preparations for the storm, the resumption of navigation afterward, and, where needed, waterborne relief efforts. Following Katrina, the Coast Guard and Corps had separate headquarters in Mobile for the areas east of New Orleans. The Coast Guard in New Orleans moved to Alexandria, Louisiana and the Corps in New Orleans moved to Vicksburg. This is an issue that will be addressed in after action reviews and from my

informal discussions with the Corps and Coast Guard, I believe they share our commitment to the idea of co-locating personnel to coordinate efforts.

We have also learned once again that hurricanes do not respect artificial lines between Corps Districts or Coast Guard sectors. Gulf Intracoastal Waterway Response efforts after these storms had to be coordinated across three Corps of Engineer Districts each reporting to three independent divisions. Information needs to be coordinated among field offices and between the field level, regional, and headquarters levels. The most effective tactic used in the entire navigation response effort was the scheduling of daily conference calls which included key Corps, Coast Guard and industry stakeholders. We saw situations where decisions were being made at one agency on the basis of old data from another agency. For example, at one point after Rita, the Corps felt there was no need to open a lock for navigation because the Coast Guard daily situation report from that morning stated that the waterway segment leading up to it was closed. Unfortunately, the Corps was unaware that, within an hour after the situation report was issued, the local Coast Guard Captain of the Port reopened that segment of waterway, Even though eight hours had passed, the updated information had not made its way to all the people who needed it to make the right decisions. What we need is a "Common Operating Picture." I'm told this is a concept already used in the military that allows every player at every level of command to graphically see what is going on and where it is happening on a real time basis. We should have a common operating picture for navigation, accessible to government and industry, that will tell us whether certain reaches of the waterways are open or closed, whether locks are functional, whether draw bridges are working, where there are obstructions, downed power lines, buoys off station and the like. The idea is that anybody with the "need to know" can look at a map on their computer, find the information they need, and get the same answer at the same time. Such a system would allow users to determine the source and time of the information if they need to follow up or make a correction.

Perhaps the greatest cause for concern from a navigational perspective came after Rita in the area east of Lake Charles, between the Calcasieu and the Leland Bowman locks on the Gulf Intracoastal Waterway. The fields and marshes in this area were flooded by the storm surge and needed to be drained. At the same time, the refining and petrochemical industries were hard hit by Katrina and had seen almost a week of disrupted deliveries during the repositioning of marine equipment in preparation for Rita. In particular, gasoline supplies were extremely stressed by evacuation-related demand. Some of the plants that were still operating were in danger of shutting down if they could not get barges to their docks. Others needed barges to resume operations. This was a developing crisis of national proportions. You probably remember that the President made a public appeal for the nation to conserve fuel to avert a crisis.

Against this backdrop, we were told by the Corps that the lock gates at Calcasieu and Leland Bowman would be kept open and would not be operated to pass marine traffic until the water receded, which they said could be for days or weeks. This meant that the only waterway connection between Lake Charles, Louisiana and points east was essentially severed. Gasoline and other products could not be delivered between Texas

and New Orleans or any other ports on the Mississippi River or points east, nor could materials move the other way. The refineries and chemical plants told us that this could not be allowed to happen. The issue was elevated within the Corps and, rightfully so, a decision was made that navigation had to continue. Fortunately, we were able to clear the backlog and keep traffic moving, but there were still significant restrictions placed on navigation. Had we not seen a reduction in barge movements that was probably a result of some of the refineries and plants restarting operations slowly, we could have seen a huge barge backlog develop at these locks.

In normal times, the customers using barge transportation can tolerate some transportation delays without significant adverse effects. Hurricanes are not normal times and when the system is already stressed by shutdowns and excessive demand induced by a hurricane, additional navigational delays could become the straw that breaks the camel's back and, potentially, brings down facilities. So, what do we do? I believe we need an integrated solution that addresses the needs of navigation, flood control and the environment in a manner that allows us to simultaneously address all these issues. We need a means of draining flooded basins other than by using the navigation locks needed to keep vital goods essential to our nation's economy moving on the waterways. This could come in the form of floodgates or other by other means that could allow for greater drainage while at the same time letting tows get safely through. In exploring the cost-benefit ratios for these measures, we need to ensure our economic models properly account for the value they would provide in a crisis.

We must take a holistic approach to environmental stewardship. We must recognize the clear environmental benefits of waterways transportation. As we take steps to protect and restore the wetlands of Louisiana and elsewhere, we must do so in a way that will not impair the efficiency of this vital mode of transportation. In Europe, many in the environmental community have been calling for increasing the use of barges as a way to get cargo off of crowded roadways and railroads. Again, our existing waterways have the capacity to meet a lot of the projected future transportation demand of our nation.

As we rebuild our coastal communities, we must be sensitive to the need to keep a reasonable separation between residential and retail development and the waterways. We do not allow people to build on the shoulders of our freeways. We should not allow them to locate structures that concentrate members of the public on the edges of our navigational channels. Through wise planning, we can have commercial development, environmental protection and navigation in the same areas, but safety must be paramount and navigability must be protected.

Some say our waterways are fragile. I say they are resilient. Our ability to spring back after two devastating hurricanes is proof. However, they are not indestrutible. For too long, we have been neglecting our waterways and the Gulf Intracoastal Waterway is no exception. We have been deferring maintenance and upgrades and if we continue to do so, we will see decreases in efficiency, unplanned shutdowns and possibly catastrophic economic consequences. We need to clear the deferred maintenance backlog. We need to have the spare parts and emergency backup systems that will allow the Corps to

quickly restore operations if we have another hurricane, a bad accident, a terrorist attack or simply a failure of a key lock component due to old age. We need to maintain project depths of our waterways through adequate funding for periodic dredging. In general, we know how often dredging will be required. There is no reason we should have to fight year after year for appropriations for basic maintenance and upkeep.

Where appropriate, we should invest in replacement structures where the existing facilities are simply unable to meet the need or where they can no longer be economically maintained to an appropriate level of reliability. I mentioned the situation at the Calcasieu and Leland Bowman locks. I believe we need a structural remedy there. In the meantime, we must have operational measures that will ensure continuity of navigation. We need to speed up the replacement of the Inner Harbor Navigation Canal Lock. This choke point is the key to the ports east of New Orleans along the Gulf Coast. It is vital to supplying gasoline to the Florida panhandle, especially in situations such as right now, when the Chevron refinery in Pascagoula is out of operation. The only alternative is Bayou Baptiste Collette. This route adds 24 hours to the trip and is not passable in bad weather. Had the Corps not reprogrammed money to dredge the Baptiste Collette this summer, it would not have been available as an alternate route when we were unable to use the Inner Harbor Navigation Canal following Katrina.

We must recognize that the Intracoastal Waterway is a system and every segment is essential. Draw bridges that cannot be operated following a storm or which are abandoned long before storm landfall cripple navigation and, in the time leading up to a storm, can leave the lives of mariners seeking shelter from the storm in severe peril. The Coast Guard must establish and enforce policies that require bridges to remain operable so long as it is safe for them to do so or be abandoned in the position open to navigation. Otherwise we may face loss of life, damage to equipment and the potential for a disastrous oil or chemical spill in the next Katrina or Rita.

In summary, although I am not an expert on structural protection from hurricanes, I can tell you that we need to examine the damage our locks suffered as a result of the storms and ensure we protect these vital structures as best we can. As mentioned before, we need adequate spare parts, ready to deliver, to fix whatever damage occurs. I can tell you that efficient, low cost inland waterway transportation is vital to serving American consumers and keeping our coastal industries competitive in the global marketplace. Where structural remedies are required to assist in flood damage reduction, they must not in any way impair the dependable, reliable and efficient navigation upon which we all depend.

Thank you for the opportunity to speak to you today. I would be happy to address any questions you may have.

Testimony of
Sidney Coffee, Executive Asst. to the Governor for Coastal Activities
For Governor Kathleen Babineaux Blanco

Subcommittee on Water Resources and Environment
Committee on Transportation and Infrastructure
U.S. House of Representatives

Thursday, October 20, 2005

Thank you, Mr. Chairman and Members of the Committee, for allowing me to speak before you today. I'm Sidney Coffee and I serve as Executive Assistant for Coastal Activities to Louisiana Governor Kathleen Blanco.

Mr. Chairman, I want to begin by thanking you for your interest in the future of New Orleans and the surrounding region. Additionally, I want each member of the committee to know that the people of Louisiana believe that recovery and future prosperity will require great tenacity and perseverance. That said, all Louisianans realize the size of this catastrophe ensures that we cannot go it alone; we will need assistance from our friends, neighbors and government.

Along with assistance comes an obligation: to steward those generous resources as efficiently and effectively as possible. In addition to working

with you to identify our most pressing needs, I want to assure you that the state of Louisiana is committed to making the most of every dollar.

After years of predicting the doomsday scenario that would occur if the "big one" ever hit New Orleans and the economic impacts it would have on the region and the nation, we find ourselves in the aftermath of not just Hurricane Katrina, but of Hurricane Rita as well, in what is now a tragedy of such magnitude that its economic and social ripples will continue to impact the very fabric of this nation for many years to come.

We have known for decades that the dramatic land loss occurring in south Louisiana continues to directly impact the safety and sustainability of the region. We've sounded the alarm repeatedly and very publicly, that the loss of Louisiana's coastal land – what is now recognized as America's Wetland – is indeed an emergency and that its restoration merits immediate attention -- not just because of the inherent safety it provides our communities, but because it protects the nation's number one port system, safeguards critical energy infrastructure, and is home to a third of the fisheries in the lower 48 states.

To bring back one of our nation's most historic and strategic cities and, indeed, an entire Gulf region, is an overwhelming challenge. However, as with efforts to rebuild after the Great Chicago Fire or the San Francisco earthquake, or Dresden, which better reflects the scale of our destruction, one thing is certain, citizens and businesses must be made to feel safe in their communities if they are to return and rebuild. In a meeting just last week, New Orleans business leaders made it clear they would not return to the city without increased protection.

We are seeking support for Category 5 hurricane protection that integrates coastal restoration for region-wide, long- term protection.

Restoring the wetlands is an integral part of this long-term solution, incorporating water quality issues, reduction of the dead zone and perhaps most importantly, reduction of storm surge. According to scientists, every 2.7 miles of wetlands reduce storm surge height by approximately one foot. However, we continue to lose 24 square miles of land each year, compounding our vulnerability.

Fortunately, one of the most critically important components of our recovery plan for a long-term solution to the region's battle with nature has been developed over the past several years and is ready for implementation.

Hurricane protection must be done in concert with coastal restoration; the two efforts must not be treated separately. As we've said in the past, all water resource issues must continue to be addressed comprehensively and must be executed programmatically, not as unrelated series of projects.

In light of the recent disasters, we've been asked if the Louisiana Coastal Area plan (the LCA) now pending before Congress is still relevant. In fact, we consider it even more important today than before the storms. We may need to shift some prioritization of projects, but the plan is not in conflict with what is still needed and the basics are in tact – barrier island restoration and shoreline protection and reintroduction of fresh water and sediment into the marshes from the Mississippi and Atchafalaya Rivers.

Of course, we have to consider the conditions that now exist and adapt our plans. Our delta system is dynamic and, as in the past, we must always adapt after storm events. For example, we may not know for a while the full

extent of the landscape changes – which areas experienced permanent loss and which will eventually recover.

You have before you (and attached to the written testimony) a proposal the State sent our delegation on September 8th in response to their request for recommendations on how to address our rebuilding needs. It includes some key concepts we feel are necessary as we go forward in integrating a comprehensive hurricane protection system with coastal restoration:

- We must implement the program through a partnership between the state of Louisiana and the Mississippi River Commission, supported by a working group of state and Federal agencies that includes scientists from the academic community, ensuring that sound science and engineering continues to lead the effort;
- We must accelerate construction of proposed hurricane protection projects to withstand Category 5 storms and we must repair and upgrade existing hurricane protection to do the same. In spite of continuing subsidence of the landscape and changing climate conditions, the engineering community assures us this can be accomplished. The main-line Mississippi River levee system was

designed to provide a very high standard of protection and that high standard must be applied now to hurricane protection;

- We must implement the comprehensive suite of coastal restoration measures recommended in the Coast 2050 Plan and the restoration planning under the LCA study. Coastal restoration will bolster and help sustain the protection of the levee system;
- It is critical that we streamline the implementation process and move immediately to design and construction in the shortest practical time. We cannot simply initiate traditional feasibility studies that usually take a minimum of five years to complete. By the Corps' own admission, it takes an average of 11 years from authorization to completion of a project. If you add five years of pre-authorization studies to this, it would be 16 to 20 years before we have adequate protection from future storms. We simply don't have 20 storm seasons to wait.
- And we must have a sustained source of funding in the form of direct sharing of OCS revenues to protect and sustain vital energy infrastructure, to provide hurricane protection, and to accomplish long-term coastal restoration.

> Our cost estimates are about $32 billion to accomplish this, but it is clear this is a very reasonable investment, compared to the hundreds of billions of dollars in losses caused by Katrina and Rita alone. Sharing OCS revenues would simply allow production supported from Louisiana's shores to be used to protect Louisiana's shores and would have the least impact on Congressional budgets and appropriations.

No one can deny that our predictions, tragically, are now reality. Time is definitely not on our side and the way we address this crisis cannot and must not be "business as usual" with lengthy project feasibility and cost/benefit analysis. Surely, the costs to the nation of restoring our coastal lands and providing real safety through adequate hurricane protection have now been justified.

I cannot overemphasize how much the state of Louisiana values its long-standing partnership with the Corps of Engineers and other Federal agencies working with us to save our strategic and invaluable coast. We recognize the role of this committee in forging and stewarding that partnership and appreciate it very, very much. We are committed to ensure that Federal

funding will be spent wisely – on projects that are cost-effective, will produce results, and which meet all environmental requirements. We are not asking for exemptions from NEPA or the Clean Water Act, but we do need a commitment from the Congress and the Administration to work smarter and much, much faster.

In closing, I'd like to remind you that this is no longer theoretical. This is real. Real people have lost their lives and hundreds of thousands more across the Gulf region – in Alabama, Mississippi, Louisiana and Texas – have lost their homes, their livelihoods, their family pets, their photographs and mementos of their past. They've lost everything.

I sincerely ask you to keep the human aspect before you as you make your decisions – that when all is said and done, this is not just about numbers on a spreadsheet, it's about serving people just like you and me – their families and their dreams and aspirations. It's about Americans and their safety and their future. It's about the economic and human sustainability of our country. Thank you.

####################

State of Louisiana

KATHLEEN BABINEAUX BLANCO
GOVERNOR

SCOTT A. ANGELLE
SECRETARY

JAMES R. HANCHEY
DEPUTY SECRETARY

DEPARTMENT OF NATURAL RESOURCES
OFFICE OF THE SECRETARY

September 8, 2005

Honorable Mary Landrieu
United States Senate
Washington, D.C. 20510

Honorable David Vitter
United States Senate
Washington, D.C. 20510

Dear Senators Landrieu and Vitter:

As you know, swift action is critically needed to address Hurricane Katrina's impacts on coastal communities and the regional and national economy. Our enclosed proposal calls for greatly accelerating efforts to reverse coastal land loss, and to protect population centers and infrastructure from category 5 hurricanes. We recognize that hurricane protection is not part of the primary mission of the Department of Natural Resources. As part of the State's coordinated response to Hurricane Katrina's impacts, we have collaborated closely with officials of the Louisiana Department of Transportation and Development and the Governor's Office of Coastal Activities in the preparation of the enclosed proposal. Both of those agencies have obviously been heavily involved in many other activities in response to this disaster.

Our proposal contains the following key components necessary for it to be successful.

- $32.2 billion in emergency appropriations for hurricane protection ($18.2 billion) and ecosystem restoration ($14 billion), including direct appropriations to the State. The amount we are requesting for hurricane protection is based on cost estimates provided by the Corps of Engineers (traditional Federal share only), which we subsequently modified to reflect a 100 percent Federal cost share.

- A sustained source of funding, in the form of direct sharing (50%) of revenue derived from Outer Continental Shelf oil and gas production, to protect and sustain vital infrastructure.

- Implementation of the projects through a partnership between the State and the Mississippi River Commission, supported by a working group from state and federal agencies.

- A much-streamlined project implementation process that includes explicit authority to proceed immediately to design and construction of the selected projects, following engineering analysis.

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PHONE (225) 342-4505 • FAX (225) 342-4313 • WEB http://www.dnr.state.la.us
AN EQUAL OPPORTUNITY EMPLOYER

- Clear opportunities and mechanisms for the state to utilize its technical capabilities.
- Acceleration of proposed hurricane protection projects, with design to withstand category 5 hurricanes.
- Repair and upgrade of existing hurricane protection projects to withstand category 5 hurricanes.
- Implementation of the comprehensive suite of coastal restoration measures recommended in the Federal/State Coast 2050 Plan and subsequent restoration planning under the Louisiana Coastal Area Study.

I trust that the above information will assist you and your staff in addressing the needs of the people of coastal Louisiana, the region, and the Nation, throughout the pending Emergency Appropriations Act process. We appreciate your continuing support, and that of the other members of the Louisiana Congressional delegation, in this important matter. Should you need additional assistance, please contact me at 225-342-4505.

Sincerely,

James R. Hanchey
Deputy Secretary

JRH:DWF/WKR:po

Enclosure

cc: Honorable Richard Baker
Honorable Charlie Melancon
Honorable William Jefferson
Honorable Charles Boustany, Jr.
Honorable Jim McCrery
Honorable Bobby Jindal
Honorable Rodney Alexander
Sidney Coffee, Governor's Office
Johnny Bradberry, LDOTD
Ed Preau, LDOTD
Scott A. Angelle, LDNR
Gerald M. Duszynski, LDNR

Estimates prepared for the Louisiana Department of Natural Resources
US Army Corps of Engineers Civil Works Projects
Response to Hurricane Katrina

	Amount needed to Recover and Protect against a Category 5 Hurricane
AUTHORIZED PROJECTS *	
New Orleans To Venice, LA (Hurricane Protection)	718,750,000
West Bank And Vicinity, New Orleans, LA	2,687,500,000
Lake Pontchartrain And Vicinity, LA (Hurricane Protection)	4,375,000,000
Southeast Louisiana, LA	1,125,000,000
Larose To Golden Meadow, LA (Hurricane Protection)	625,000,000
Grand Isle, LA	187,500,000
Inner Harbor Navigation Canal, LA	781,250,000
TOTAL CONSTRUCTION, GENERAL (CG)	**$10,500,000,000**
PRE-AUTHORIZATION STUDIES *	
Miss Riv & Tribs (MR&T)	
Alexandria to the Gulf, LA	5,000,000
Donaldsonville to the Gulf	8,600,000
Morganza to the Gulf, LA	1,630,000,000
Lower Atch. Barrier Plan, Atchafalaya Basin, LA	6,000,000,000
TOTAL MISSISSIPPI RIVER & TRIBUTARIES	**$7,643,600,000**
General Investigation (GI)	
Lake Pont. West Shore Protection	2,200,000
Lake Pont. North Shore Protection	10,000,000
Plaquemines Parish Urban Flood Control LA	4,800,000
St. Bernard Parish Urban Flood Control LA	4,400,000
St. Charles Parish Urban Flood Control LA	7,600,000
Louisiana Coastal Area, LA (GI,CONST)	14,000,000,000
TOTAL GI AND LCA	**$14,029,000,000**
GRAND TOTAL - ALL ACCOUNTS	**$32,172,600,000**

9/8/05

Emergency Supplemental Appropriations for Louisiana Coastal Restoration and Infrastructure Protection Projects In Response to Hurricane Katrina

Introduction

A major portion of Coastal Louisiana, home to nearly two million people, was recently devastated by Hurricane Katrina. It will be months before the full cost, in both human lives and dollars, are fully understood, but it is clear that swift action is required on many fronts to respond to the needs of the affected coastal communities and to mitigate impacts to the Nation's economy.

While we are faced with the immediate aftermath of an unprecedented natural disaster, we must recognize that the destruction has been made worse by the continuing, largely unaddressed crisis of coastal land loss and ecosystem degradation. In addition to immediate rescue and recovery operations, we must not lose sight of the larger needs to provide all necessary resources to protect our communities and infrastructure from the next major hurricane and to provide for the long-term sustainability of the coastal ecosystem. The three main missions in the coastal zone that the State must maintain focus on are hurricane protection, maintenance of the Nation's energy security, and ecosystem restoration. Thus, the ongoing State/Federal campaign to reverse coastal Louisiana's land loss crisis must be substantially accelerated, and linked with an expanded program of providing reliable protection of major population centers and critical infrastructure from the devastating impacts of category 5 hurricanes.

Coastal Louisiana is home to the nation's largest port complex by tonnage, as well as infrastructure that produces or transports nearly one-third of the nation's oil and gas supply. In addition, the coastal Louisiana ecosystem provides nationally important fish and wildlife habitat that supports the nation's second largest commercial fishery and over $1 billion per year in recreational fishing and hunting revenues. All of these activities are possible in Louisiana because of the close proximity of its skilled workforce to the Gulf of Mexico.

If the Nation is to continue to reap the benefits of the vast natural resources that are supported by the land and people of Louisiana, a commitment must be made now to invest in protecting this rich area. The wetlands and barrier islands/shorelines of coastal Louisiana provide coastal communities with the first line of defense against storm surge. As land has continued to subside and erode — currently at a rate of approximately 25 square miles per year— the ability of the landscape to slow the advance of catastrophic storm surges has been severely diminished. This land loss crisis is compounded by predictions that due to global climate change, the frequency of major storms (category 3 and above) will increase in the future because of higher sea-surface temperatures. It is impossible to separate the need to protect the coastal communities and infrastructure from the need to protect investments in oil and gas infrastructure as well as other natural resources such as wildlife and fisheries. Therefore, any hurricane protection effort must integrate improvements to and construction of traditional structures such as levees with restoration and sustainability of the natural ecosystem.

Required Action
In response to the 1927 Mississippi River flood, Congress authorized the U. S. Army Corps of Engineers (USACE) to provide flood protection for the Lower Mississippi River Valley at 100% Federal expense. More recently, the Congress appropriated over $18.5 billion to assist in infrastructure repairs in Iraq. In both of these situations, work was authorized and funded even though the final details of the required work were not clearly understood; the Nation simply made a choice to provide the necessary resources to begin work, and a long-term commitment to see the mission through. Our current situation requires this type of commitment from the Nation.

The needs of the State of Louisiana to protect its population centers and critical infrastructure are diverse and distributed throughout the coastal zone. While the catastrophe in Southeast Louisiana has already occurred, it is important to remember that similar disasters are likely in other areas of coastal Louisiana if action is not taken to improve hurricane protection in these areas. Major population centers remain unprotected from storms of any magnitude, and critical oil and gas infrastructure remains at risk. The consequences of long-term disruption of the supplies of oil and gas on the national economy are unacceptable. We now must make the commitment to take all necessary actions to protect the infrastructure and workforce, that provide these products and services that keep the economy running, from future devastation such as we are currently experiencing in southeast Louisiana.

A much-streamlined implementation process is critically needed in order minimize delay in addressing this catastrophe and its potential recurrence. This process should make full use of the expertise and capabilities of federal, state, and local governments. Implementation of projects should be through a partnership between the State of Louisiana and the Mississippi River Commission. The partnership should be supported by a working group from state and federal agencies with relevant missions in order to facilitate reviews and issue resolution so that the design and construction processes are not delayed. Any bill to address this issue should provide explicit authority to proceed immediately to design and construction of the selected projects once engineering analysis is completed (i.e., feasibility study is not required) and provide clear opportunities and mechanisms for the State of Louisiana to utilize its technical capabilities for these purposes. Clear mechanisms must also be put in place to ensure that projects are based on sound scientific and technical knowledge.

Potential Critical Infrastructure Projects
Over 26% of the nation's natural gas and crude oil supplies are produced in, processed in, or travels through coastal Louisiana. Nearly 34% of the nation's natural gas supply, and over 29% of the nation's crude oil supply, is produced in, processed in or transported through the State of Louisiana and is connected to nearly 50% of U.S. refining capacity. Nearly 16% of the Nation's refining capacity is located in South Louisiana, and of this, approximately 2 million barrels per day of refining capacity— nearly 12% of national capacity— was located in the area affected by Hurricane Katrina. This industry is supported by a skilled workforce that is based in coastal Louisiana and clustered near the most vital infrastructure. Clearly, any long-term impact to the infrastructure or communities which support this activity would have catastrophic effects on the Nation's economy. As of September 2, 2005 nearly 89% of Gulf of Mexico crude oil production, and nearly 73% of the natural gas production was shut in, leading to severe energy shortages and escalating prices in the short term. If the supplies and workforce needed to repair

and service this production are not accessible, this short-term impact could become a long-term situation with devastating effects on the national economy. If we do not take aggressive actions now to fortify our infrastructure and protect our coastal communities in the face of this increased threat, we are certain to be faced with another national catastrophe in the future.

Critical Oil and Gas Infrastructure—Overland access to critical oil and gas infrastructure in coastal Louisiana is limited and becoming increasingly vulnerable to flooding, even during extreme high tides. The most significant intermodal base for support of this industry is located at Port Fourchon, at the end of one of the most vulnerable roadways in coastal Louisiana - Highway 1 in Lafourche Parish. This port serves as the land base for support for the Louisiana Offshore Oil Port (LOOP), the Nation's only deepwater oil import terminal. This key energy hub is a vital conduit for nearly 18% of our nation's oil and gas supply coming just from foreign imports, and 75% of the Gulf of Mexico's domestic deepwater oil and gas production. Constructing the planned elevated portion of Louisiana Highway 1 and replacing the Leeville Bridge is critical to ensuring that this port is able to quickly respond to these storms and assist in restoring oil and gas production in the Gulf. In addition, the Henry Hub in southwest Louisiana is the largest centralized point for natural gas spot and futures trading; in fact, the New York Mercantile Exchange uses the Henry Hub as the point of delivery for its natural gas futures contract. The Henry Hub provides interconnection for nine interstate and four intrastate pipelines, providing access to markets in the Midwest, Northeast, Southeast, and Gulf Coast regions. Nearly half of the U.S. well head production of natural gas occurs near or passes through the Henry Hub. This energy source is of increasing importance for home heating and cooking, electricity generation, and industrial processing. There is no foreign source of natural gas to turn to if supplies from Louisiana were interrupted; therefore, it is also vital to protect this region to reduce damages caused by, and to speed recovery from, future hurricanes.

Critical Hurricane Protection Projects—Oil and gas production, transport, and processing is possible in Louisiana because of the close proximity of its skilled workforce to the Gulf of Mexico. Providing category 5 hurricane protection to these communities is a high priority to ensure the energy security of the Nation. Proposed USACE projects such as the Morganza to the Gulf and Donaldsonville to the Gulf hurricane protection projects should be accelerated and designed for category 5 hurricane protection. Accelerated construction of the Morganza to the Gulf Hurricane Protection Project in Terrebonne Parish is needed, as this area remains the most critically threatened portion of the coastal zone and provides key onshore support for oil and gas exploration and development. In addition, existing hurricane protection projects along Bayou Lafourche, in Metropolitan New Orleans, and along the Mississippi River should be repaired and upgraded to protect against a category 5 storm. Any bill for immediate coastal activities in the State of Louisiana should include authorization and appropriation of funds to implement these projects in an expedited manner.

Potential Ecosystem Restoration Projects

The Coast 2050 Plan, published in 1998 and supported by 20 coastal parishes, representatives of five Federal agencies, and the State of Louisiana, is a comprehensive conceptual plan for long-term, sustainable restoration of the coastal Louisiana ecosystem. In 1999, the USACE estimated that approximately $14 billion would be required to fully implement the restoration plan. A restored ecosystem will maintain the Nation's second largest fishery; assist in efforts to improve

national water quality, thereby contributing to the reduction of seasonal hypoxia (the so-called "dead zone") in the Gulf of Mexico; and work in tandem with more traditional flood protection projects to protect coastal communities and critical infrastructure.

Ecosystem Restoration project types that could contribute significantly to storm damage reduction are discussed in detail here. Critical natural landscape features such as barrier islands/shorelines, ridges, and lake rims serve to attenuate both surge and wave height as a storm moves inland. Modification of existing water diversions will serve to increase sustainability of existing and created land and, in some cases, build new land. Because these projects may be implemented quickly, are based on proven practices and technology, and address the needs of affected areas, they should be given the highest priority. However, the full suite of restoration measures identified in the Coast 2050 Plan should also be implemented.

Critical Natural Landscape Features—In addition to the habitat benefits provided by barrier islands and shorelines, these features have been demonstrated to attenuate both storm surge and wave height in the bay areas protected by them. An estimated 4-8 million cubic yards of dredged material will be available in the Mississippi River Gulf Outlet between the jetties and the bar channel due to efforts to re-open the channel. This material could be used to re-establish barrier islands or ridges in the vicinity of the Chandeleur Islands or the outer fringes of the Biloxi marshes. The Bayou La Loutre ridge could be restored in critical areas to provide additional elevation and associated reduction in storm surge. Critical ridges and barrier shorelines in the vicinity of Port Fourchon, including Grand Isle, could also be restored using offshore sediments from ship shoal and other appropriate sources to provide protection to Port Fourchon and Highway 1. In western Louisiana, the shoreline of the Chenier Plain, including the Rockefeller Refuge shoreline, may also be restored and protected. Marsh creation on the bay side of these islands and shorelines would be used as necessary to provide stability to these features.

Lake Rim Restoration is similar to barrier shoreline and ridge restoration but seeks to re-establish and strengthen elevated shorelines of major coastal lakes to provide additional wave damping and storm surge buffering. Material from Lake Borgne and the inland reach of the MRGO could be used to re-establish the western and southern shorelines of Lake Borgne. Material would be placed at an elevation conducive to the growth of terrestrial vegetation, and protection will be provided to prevent erosion of the newly established lake rim. This will provide additional flood protection benefits for Orleans, Jefferson, St. Bernard, and St. Tammany parishes and will re-establish a beneficial separation between the lake and the MRGO.

Marsh creation in critical areas can reduce wave heights and protect critical features such as levees and other infrastructure. Dedicated dredging for marsh creation and restoration could be accomplished as a high priority in the Golden Triangle, Central Wetlands, and New Orleans Land Bridge in Orleans, St. Tammany, and St. Bernard parishes. Additional marsh creation could be undertaken in the vicinity of the hurricane protection levees in lower Plaquemines Parish, specifically in the vicinity of Bayou DuPont/Myrtle Grove and from Empire to Venice. The Highway 1 corridor between Golden Meadow and Port Fourchon may also benefit from such marsh creation. The Mississippi River will be used as a sediment source to the maximum extent possible. If sediment is not available from the river or navigation channels, offshore areas will be preferred sources over inland lakes and bays.

Modification of Existing, and Construction of New Diversions—Existing river diversions can be modified to accelerate land building and increase marsh stability in critical areas. This would be accomplished through increased transport of Mississippi River sediments into the diversion outfall areas. The benefits for these activities are the same as for marsh creation by dedicated dredging. The structures and/or operations of the Violet, White Ditch, and Bayou Lamoque freshwater diversion projects could be modified to maximize marsh restoration benefits. The outflow of the Violet Diversion could be modified and enhanced to affect the Central Wetlands area. The gates on the Bayou Lamoque structure could be removed, and gaps could be made in the channel banks to provide linkage to the surrounding degraded marshes. In addition to these state-owned diversion projects, opportunities exist to modify the operations of the Federally-authorized Davis Pond and Caernarvon diversions. New diversions will also need to be considered, such as one at Myrtle Grove. These opportunities have been outlined in the Coast 2050 Plan and the LCA Ecosystem Restoration Study Report.

Source and Allocation of Funding

The three missions of flood control, ecosystem restoration, and energy security are best handled via a diversity of funding sources and mechanisms. Direct emergency appropriations should be supplied to the existing partnership between the USACE and the State of Louisiana for flood control and ecosystem restoration projects to substantially accelerate progress. The State of Louisiana recommends that a sustained source of funding, in the form of direct sharing of revenue derived from Outer Continental Shelf oil and gas production, should be provided to modernize and maintain energy production and transportation infrastructure.

Emergency appropriations should be allocated both to the USACE and directly to the State of Louisiana to implement the high priority projects recommended in this proposal. A total of $18.2 billion in direct appropriations is needed for accelerated and reliable hurricane protection. That amount would support repair and upgrade of existing authorized hurricane protection projects to a category 5-level of protection, and engineering and construction of proposed hurricane protection projects and related improvements.

To address the critical coastal restoration needs, State recommends emergency authorization of Coast 2050 Plan, along with the related refinements contained in the LCA Plan. To accomplish those measures, the State also recommends the appropriation of $14 billion, to include the following major categories: freshwater and sediment diversions and related modifications ($4.3 billion); restoration and protection of barrier islands, barrier shorelines, and similar critical landscape features ($5.2 billion); marsh creation including use of dredged material ($2.7 billion); major hydrologic restoration measures, such as locks and control structures in major navigation channels ($1.1 billion); and other critical coastal restoration measures ($700 million).

As indicated above, the pending legislation should require that project implementation be accomplished through a partnership between the State of Louisiana and the Mississippi River Commission. That legislation should provide explicit authority to proceed immediately to design and construction of the selected projects once engineering analysis is completed, and provide clear opportunities and mechanisms for the State of Louisiana to utilize its technical capabilities

for these purposes. Nothing in this proposal, however, is intended to give the State authority over the traditional responsibilities of the USACE, such as navigation and flood control.

To modernize energy production facilities and supporting infrastructure to minimize the potential for extended disruptions in service in the future, a share (50%) of the revenue derived from Outer Continental Shelf oil and gas production should be provided in the form of direct payments to coastal producing states, similar to the automatic payments for drilling on federal lands onshore, and before any other dispersal of those moneys. This money should not be subject to future appropriations, and is absolutely necessary to continue to maintain existing, and to develop future, energy supplies for the nation. This money would be used to upgrade, repair, replace, and maintain infrastructure such as major highways (e.g., Louisiana Highway 1 and the Leeville bridge); critical energy production, refining, and distribution infrastructure; and high priority coastal ecosystem restoration projects. This would support not only availability of existing energy sources, but also development and implementation of new technology and infrastructure to produce and deliver energy from new sources, such as wind and methane gas hydrates, offshore of coastal Louisiana.

Conclusion

We are now faced with the arduous task of recovery from an unprecedented natural disaster. As an integral part of the recovery process, we believe that it is in the national interest to aggressively implement those measures already recommended in joint Federal/State planning efforts focused on restoring the Louisiana coastal ecosystem and enhancing protection of critically important infrastructure. Such an approach is essential in order to minimize the Nation's risk in the almost certain event of another major storm striking this vital region of the country. We believe it is prudent to stop reacting to situations imposed on us by natural forces, and instead proactively minimize the future risk of such threats to our lives and economy.

STATEMENT OF
THE HONORABLE JERRY F. COSTELLO
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT
HEARING ON "HURRICANE AND FLOOD PROTECTION AND WATER RESOURCES PLANNING FOR REBUILDING THE GULF COAST"
THURSDAY, OCTOBER 20, 2005 AT 10:00 A.M.

Thank you, Mr. Chairman, for holding this series of hearings on rebuilding the Gulf Coast region.

The flooding that occurred after Hurricane Katrina in New Orleans and the surround Gulf Coast areas was one of the worst disasters our the nation's history. I recently visited the Gulf Coast region and saw the devastation and destruction Hurricanes Katrina and Rita left in their wake firsthand. The flooding, wind damage and storm surges were unprecedented. I listened to state and local officials describe their immediate infrastructure and resources needs. Those affected by these hurricanes should be commended as they continue to display tremendous courage and persistence.

This hurricane season has taught us all a very important lesson-we need to consistently invest in our aging infrastructure or else the impacts can be devastating and have deadly consequences.

Flood control projects, funding levee improvement projects, and other water infrastructure projects are critical investments for our nation's security. The federal government and the state and local communities must continue to invest in flood protection and levee improvement projects. Invest must be and should be on a national scale because no one knows when the next hurricane, rainstorm or flood will hit their district.

I welcome the witnesses here today and look forward to their testimony.

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Testimony of

Robert A. Dalrymple, PhD., P.E.

Willard and Lillian Hackerman Professor of Civil Engineering

Johns Hopkins University

On behalf of the

American Society of Civil Engineers

Before the

Subcommittee on Water Resources and Environment

Committee on Transportation and Infrastructure

U.S. House of Representatives

October 20, 2005

PARADISE LOST

It's gotten down to life or death for my people. The Red Cross will not even open a shelter below I–10 any more, because it's not safe. You go to the west bank of the Mississippi River at the FEMA office there, and they have a computer system you can log onto. You can see a simulation of what a category four hurricane does coming up Lake Bourne, or eastern New Orleans, coming up on the west side of New Orleans. They'll tell you that New Orleans will be inundated, 27 feet of water.

I said, my God, when I saw this. Is this really going to happen?

The guy who put the program together told me, Congressman, it ain't if, it's when, if we don't do something soon. ... [W]e'll be faced one day with horrific losses. We'll be faced on day with thousands of our citizens drowned and killed, people drowned like rats in the city of New Orleans because there's nowhere to go but up and they can't all get up.

And along the coast, we'll be leaving our homelands. We'll be having to vacate, just like the Red Cross has done. We'll have to leave the lands that our ancestors have lived on since before the Louisiana Purchase, lands that we settled on because we were kicked out of Canada, remember? We were kicked out of Nova Scotia by the British, finally settled in Louisiana, which we call paradise.

And our paradise is about to be lost.

Rep. Billy Tauzin (R-Louisiana), July 15, 2004[1]

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1 *Louisiana Coastal Area—Addressing Decades of Coastal Erosion: Hearing Before the Subcomm. on Water Resources and Env't of the House Comm. on Transp. and Infrastructure,* 108th Cong. 4 (2004).

Testimony of
Robert A. Dalrymple, PhD., P.E.
Willard and Lillian Hackerman Professor of Civil Engineering
Johns Hopkins University
On behalf of the
AMERICAN SOCIETY OF CIVIL ENGINEERS
Before the
Subcommittee on Water Resources and Environment
Committee on Transportation and Infrastructure
U.S. House of Representatives
October 20, 2005

Mr. Chairman and Members of the Subcommittee:

Good morning. My name is Robert A. Dalrymple, and I am pleased to appear on behalf of the American Society of Civil Engineers (ASCE)[2] as you examine "**Hurricane and Flood Protection and Water Resources Planning for a Rebuilt Gulf Coast**" in the wake of Hurricane Katrina.

We want to commend you for taking the time to study how to integrate hurricane, storm and flood protection, navigation, and coastal ecosystem restoration while meeting local objectives for rebuilding New Orleans and the Gulf Coast.

My career as an educator and an engineer has been dedicated to coastal engineering, a field that deals with the complexities of engineering at the coastline, where waves and storms create large forces on structures, high water levels, and coastal erosion.

The driving focus of coastal engineering research has been to develop an ability to predict the behavior of the shoreline over both short time scales, such as the duration of a major

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2 ASCE, founded in 1852, is the country's oldest national civil engineering organization. It represents more than 137,000 civil engineers in private practice, government, industry, and academia who are dedicated to the advancement of the science and profession of civil engineering. ASCE carried out Building Performance Assessments of the World Trade Center, the Pentagon and the Murrah Federal Building, and its technical assessments following earthquakes, hurricanes, and other natural disasters. The New Orleans levee technical group includes representatives appointed by the ASCE Geo-Institute and ASCE Coasts, Oceans, Ports, and Rivers Institute. ASCE is a 501(c) (3) non-profit educational and professional society.

storm, to long-term, such as the response of a shoreline over 100 years to human intervention. We have come a long way forward towards that goal, but much work remains to be done.

I. ASCE New Orleans Levee Assessment Team

ASCE's paramount concern is for the safety, health and welfare of the public. We believe there is a tremendous opportunity to learn from the tragedy of New Orleans to prevent future loss of life and property.

After the storm, the ASCE assembled several teams of experts to examine the failures of the New Orleans levee as well as to examine the shoreline damage along the Alabama and Mississippi coastline. I led a team of four coastal engineering experts, including two visitors from the Netherlands and Japan, both countries that are challenged to design against natural disasters from the sea. I was chosen because I had traveled to Thailand after the December 26, 2004, tsunami as a member of ASCE teams sent to Indian Ocean countries to determine what engineering lessons could be learned from that disaster.

Our New Orleans team of coastal engineers was joined by another ASCE team of geotechnical engineers and one from the University of California, Berkeley. Our three teams were joined there by a U.S. Army Corps of Engineers' Engineering Research and Development Center team, which provided considerable insight and logistical support.

The purpose of joint site visit was to gather information about the failure of the levees including that data that would be lost during the process of levee repair and the passage of time, such as evidence of high water lines and wave overtopping, and evidence of any foundation movement or failure.

Following a week in the field gathering data, we released a public statement on October 7, 2005, describing our initial observations concerning the performance of the levee system during and after Hurricane Katrina, which is available on the ASCE's web site.

We stated then that, while there was major overtopping of some of the levees around the city of New Orleans, such as the Industrial Canal that resulted in the flooding of the 9th Ward, "at the 17th Street canal breach, we found no evidence of overtopping. There is, however, evidence that a section of the levee embankment that supported the floodwall moved approximately 35 feet laterally. At the London Avenue Canal north breach, the evidence also indicates that storm water levels did not exceed the height of the levees. We also saw evidence of soil mass movement at that site."

In addition, we said: "The Corps of Engineers has agreed to provide additional background documentation and the results of their own ongoing field investigations. We have made recommendations to the Corps of Engineers regarding a number of additional studies and testing, and they have agreed to continue to share with us the data that results.

We expect to perform analyses and develop findings and recommendations based on the new information." Our joint team knows, in principal, how the levees in New Orleans failed, the exact details await further analyses.

II. Policy Considerations for Congress after Katrina

A. Controlling Coastal and Offshore Development

Development along the Nation's shorelines for either commercial or residential purposes should be done in a sound manner. For residences, simple measures such as elevating buildings above predicted coastal storm surges and adding hurricane clips to roofs are measures that have reduced the loss of life and property in hurricane-prone regions. Levees can provide protection from high water levels due to storm surge. Restricting development in fragile environmental areas is another important tool. These and other coastal management practices should be applied to prevent unsafe coastal construction and the loss of beaches and wetlands.

Further, we need to protect our nation's wetlands, which are disappearing at an alarming rate. These vital natural areas, important for reducing the impact of storms by providing a buffer area, are important biological assets.

The State of Louisiana is losing coastal wetlands at an alarming rate of 25 to 35 square miles per year. The current coastal wetlands provide a buffer from hurricane storm effects to approximately 2 million residents. The loss of coastal area means that this population, which includes the City of New Orleans, will experience the full force of the hurricanes, including storm surges that will top levee systems and cause severe flooding.

The levee system, constructed to contain the Mississippi River from flooding surrounding areas, while providing a vital benefit, is one of several reasons for the coastal land loss, as it stops the natural sedimentation that flooding brings. Other reasons include oil and gas activity in the coastal area, naturally occurring subsidence, and the rise in sea level.

The key to successfully restoring a sustainable ecosystem in Louisiana coastal wetlands is to manage and use the natural forces that created the coastal area. We need to create and sustain wetlands and barrier islands by accumulating sediment and organic matter.

Maintaining these essential habitat features also recreates and sustains the physical landscape that is so very critical to the nation's economy and security. The main strategies of the plan are watershed management, such as river diversions and improved drainage and watershed structural repair, such as restoration of barrier islands and protecting wetlands.

As a nation, we need to establish a new federal policy on the beneficial use of dredged material as the standard practice for federally sponsored dredging projects. We recognize of course that this would mean a virtual ban on offshore dumping of dredged material, at

least on the Gulf Coast, as well as causing a significant increase in the cost of dredging.

There can be no question that the use of suitable dredged material, no matter how seemingly expensive to place, is essential to maintaining our coasts and tidal wetlands around the nation. For Louisiana, we need to re-engineer the entire Mississippi Delta system to start capturing sediment for our wetlands and islands. Beneficial use of dredged material is the most obvious and immediate step in this re-engineering process.

Moreover, we need to establish integrated watershed planning for the lower Mississippi River and the Mississippi Delta as the basis for any flood protection or coastal restoration program. This would require the inclusion of navigation, flood protection, hurricane protection, and ecosystem restoration as integral parts of any infrastructure planning.

B. Mitigating the Impacts of Natural and Manmade Hazards

To better cope with natural disasters, we need to better understand them. Federal funding for research into hurricane waves and surges, tsunamis, coastal erosion, and other coastal natural disasters is very low as documented in a 1999 National Research Council report, *Meeting Research and Educational Needs in Coastal Engineering*. We need to educate and train more people with the ability to design our coastal structures to resist storms and tsunamis on our developed and undeveloped shorelines.

The nation needs sustained efforts to improve the planning, design, construction, operation, and maintenance of hurricane infrastructure systems that will mitigate the effects of natural and man-made hazards. The nation's flood protection infrastructure as well as its inland waterway system is in the same precarious state as much of the other civil infrastructure. ASCE, in its *2005 Report Card for America's Infrastructure,* has graded our navigable waterways a D- this year, down from a D+ in 2001. Dams were given a D grade. We need to attend to these essential life-protecting structures.

The U.S. Army Corps of Engineers needs to continue its policy of providing hurricane protection to coastal cities. Beach nourishment projects for beaches and barrier islands provide a real buffer between the full fury of the waves and the community. Appropriately designed levees can provide vital protection of lives and property as we have learned in New Orleans.

ASCE supports state and federal regulations and legislation to protect the health and welfare of citizens from the catastrophic impact of levee failure. The federal government must accept the responsibility for the safety of all federally designed and constructed levees and federally regulated levees.

C. Creating a National Levee Inspection and Safety Program

ASCE is concerned about levee safety and security because civil engineers are the principal professionals involved in the design, construction, maintenance, and operation of levees. Civil engineers also are the lead professionals that design new dams and

repairs to dams, conduct safety evaluations and structural security improvements at the state and federal levels. ASCE supports legislation and programs to address the legal, social, and moral responsibilities to construct, operate, and maintain dams in a safe manner

ASCE supports state and federal regulations and legislation to protect the health and welfare of citizens from the catastrophic impact of levee failure. The federal government must accept the responsibility for the safety of all federally designed and constructed levees and federally regulated levees.

We believe that Congress should enact a National Levee Inspection and Safety Program that should be modeled on the successful National Dam Safety Program.[3]

D. Restoring Louisiana Coastal Wetlands and Hurricane Protections

The key to successfully restoring a sustainable ecosystem in Louisiana coastal wetlands is to manage and use the natural forces that created the coastal area. The goals of the LCA Program are to create and sustain wetlands, including marsh, coastal swamps and barrier islands by accumulating sediment and organic matter, maintain habitat diversity by varying salinities and protecting key landforms, and to maintain the exchange of energy and organisms.[4]

Maintaining these essential habitat features also recreates and sustains the physical landscape that is so very critical to the nation's economy and security. The main strategies of the plan are watershed management, such as river diversions and improved drainage and watershed structural repair, such as restoration of barrier islands.

ASCE supports the efforts to reduce coastal land loss in the Louisiana coastal area, an area that has been named America's Wetland because of its national importance. ASCE urges continued support of the existing program for Louisiana coastal wetlands, funded by the Coastal Wetlands Planning, Prevention, and Protection Act (CWPPPA). ASCE also supports the ongoing effort to implement the comprehensive Louisiana Coastal Area

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3 S. 1836 tit. VIII (109th Cong.).

4 Congress has been considering two bills (S. 728 and H.R. 2864) that would authorize the U.S. Army Corps of Engineers to implement projects to slow the rate of coastal wetlands loss in Louisiana over the next decade. Both bills would authorize funding to implement a program that the Corps recommended in a November 2004 feasibility report. The Corps recommended $1.1 billion for activities to be initiated immediately, and estimated an additional cost of $900 million for future work. Of the $1.1 billion, $828 million is to complete planning and construct five projects, called "near-term features," where the planning process is well along, and construction could be completed in about a decade. The remainder would be spent on: monitoring program performance; building small demonstration projects (a maximum cost of $25 million per project); exploring options to use dredged materials to create wetlands; and continued planning of 10 additional projects that would have to be authorized at a future date.

(LCA) Program, which will further reduce land loss and provide additional preservation and restoration.

The current federal investment in preserving Louisiana coastal wetlands, through CWPPPA, is $50 million annually. The estimated cost of the comprehensive Louisiana Coastal Area Program for America's Wetland is approximately $470 million annually for 30 years, or $14 billion. The cost of inaction in America's Wetland has been estimated to be more than $100 billion in infrastructure alone over the course of those 30 years.

The value of wetland protection measures nationwide was documented in *Conserving America's Wetlands: Implementing the President's Goal*, a report to Congress published in April 2005 by the president's Council on Environmental Quality:

Wetlands reduce flooding and erosion by trapping and slowly releasing surface water, rain, snowmelt, and floodwaters. Preserving or restoring wetlands can often provide the level of flood control otherwise provided by expensive levees. Wetlands also provide protection from erosive forces. In coastal areas, tidal wetlands help buffer the land from storm surges caused by hurricanes and tropical storms.

As a general rule, most scientists say, every mile or two of marshland will reduce a storm surge by a foot. A storm surge is the wall of water that moves like an extremely high tide in front of a hurricane. Marshland, or any other kind of land, quickly reduces the strength of winds and waves because it robs hurricanes of the warm water that fuels them. When you replace water with land, you reduce wind speed, storm surge and wave height. We had lost too much of the Gulf Coast's wetland buffer long before Katrina or Rita.

Indeed, in a presentation at the National Press Club on September 9, Gerry Galloway, a member of ASCE and chairman of a federal interagency task force that evaluated flood protection after the Great Flood of 1993 on the Mississippi River, stated that the issues we face in a post-Katrina world require an integrated, all encompassing response.

Management of the floodplain—whether along the Gulf Coast, in the lowlands of Louisiana, or anywhere else in the United States—is the shared responsibility of federal, state, and local governments, business, and those who live in or work in the floodplain. Each must know its task and carry its weight.

To reduce vulnerability of those in the floodplain we need to provide a higher level of protection to those who live in existing population centers, and especially to critical infrastructure such as hospitals, water treatment facilities, and fire stations.

We must discourage new development in the floodplain unless there is a pressing need for it and adequate protection can be provided. Population centers must be given a higher level of protection than most now have.

Finally, we must use all the tools available to reduce damages. This means use of not only structural means such as levees, floodwalls, and dams, but also non-structural approaches such as floodproofing, voluntary relocation of homes and businesses, revitalization of wetlands for storage, and use of natural barriers such as the Louisiana wetlands.

With collaborative, integrated planning, the lower Mississippi River and the Louisiana coast can be managed and redeveloped for more effective hurricane protection, wetland restoration, and economic development. It is time to join together and do the right thing for Louisiana and the Gulf Coast.

We should begin a comprehensive program to restore the coast, specifically including coastal wetlands in the restoration agenda.

We must integrate this restoration effort with an effective hurricane protection system and with responsible management of coastal floodplain redevelopment. Such management must include the painful realization that some areas of the coast should not be rebuilt or inhabited again, and that navigation practice and infrastructure must be modified to accommodate wetland and hurricane protection.

III. Conclusion

No matter what other solutions we develop, there should be no illusions about the scope and size of this endeavor. Long-term, comprehensive coastal wetland protection and restoration efforts will take decades and cost tens of billions of dollars. This will be money well spent.

A restored coast with restored wetlands and intact barrier islands, all integrated with other hurricane-protection measures, will provide significant protection to New Orleans and southern Louisiana.

These efforts will not just be about preserving a people and a way of life, however. It would be far better, for a multitude of reasons, to rehabilitate and maintain the coastline and protect these and other valuable infrastructure components.

Thank you Mr. Chairman and members of the Subcommittee. That concludes my statement. I would be pleased to answer any questions you may have.

# # #

Robert A. Dalrymple, Ph.D., P.E., F. ASCE, is past president of ASCE's Coasts, Oceans, Ports, and Rivers Institute (COPRI). He was a founding member of the COPRI Governing Board. He is currently Willard and Lillian Hackerman Professor of Civil Engineering at Johns Hopkins University. Previously, he was the E.C. Davis Professor of Civil and Environmental Engineering at University of Delaware and Director of the Center for Applied Coastal Research.

Professor. Dalrymple is the co-author of two books with Robert G. Dean: *Water Wave Mechanics for Engineers and Scientists* and *Coastal Processes with Engineering Applications.* He has received the ASCE Moffatt-Nichol Harbor and Coastal Engineering Award and the International Coastal Engineering Award. He is currently a member of the Marine Board of the National Research Council.

Testimony of

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October 14, 2005

Hon. John J. Duncan, Jr.
Chairman
Subcommittee on Water Resources
Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, D.C. 20515

Testimony of Roy K. Dokka, Ph.D. Regarding the Effect of Subsidence on Flood Protection Options and Water Resources Planning in the Gulf Coast

EXECUTIVE SUMMARY

A major factor behind the destruction of the gulf coast by Hurricanes Katrina and Rita was the on-going sinking of the land, aka, subsidence. Subsidence is generally caused by unrelenting natural processes but has been augmented locally due to poorly managed groundwater withdrawal and/or drainage projects. Coastal Louisiana has subsided between ~2 and 4 feet since 1950. Subsidence is not restricted to the coast as previous thought but extends inland area for hundreds of miles, especially along the Mississippi River valley. As the land has sunk, so have our levees defenses, evacuation roads, and wetlands. Besides the making the coast increasing the vulnerability of coastal communities to storm surge, subsidence has ruined the official system of vertical control benchmarks we use to determine elevation in Louisiana, Mississippi, Texas, and portions of Arkansas, and Alabama. Examples of the implications of an inaccurate vertical control system:

- ✓ The USACE and levee districts cannot at present plan and build new or augment hurricane protection levees to proper elevations; The levees are as much 2 feet lower than they were designed;
- ✓ NOAA/National Hurricane Center cannot at present produce accurate storm surge models of the gulf coast;
- ✓ FEMA cannot make accurate flood insurance rate maps; areas mapped outside the flood zone may be in the flood zone.
- ✓ State and federal highways are being built below their design heights. They may not be able serve as escape routes during storms and will likely degrade more quickly due the elements.
- ✓ Consumers cannot get accurate elevations on home slabs for insurance purposes.

Subsidence measurements of the region published in 2004 by NOAA (Shinkle and Dokka, 2004) shows that the entire coast, as well as adjoining upland areas, have been sinking. These new authoritative data call into question the scientific causations underpinning mitigation strategies designed to restore Louisiana's coastal wetlands. These strategies were predicated on the belief that only the wetlands were changing. Wetland-centric strategies, however, cannot help protect the subsiding land areas of the coast where people live and work. Higher levees that span the entire coast from Texas to Alabama are needed now. The regional vertical control network needs to be updated now to support planning and levee construction.

PURPOSE AND SCOPE

The purpose of this report is to provide the Committee with information regarding the nature and societal implications of the ongoing subsidence affecting the states bordering the Gulf of Mexico. The report attempts to distill for the Committee the "state of the science" of subsidence that has been obtained from previous geological, geophysical, and geodetic studies. The analysis also draws heavily from a report written by Mr. Kurt Shinkle and myself and issued in 2004 by the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The report, *NOAA Technical Report 50,* is available at www.ngs.noaa.gov, and documents land movements that have occurred over the past fifty years using the most precise and reliable data available. Thematically, my testimony covers issues regarding:

- The definition of subsidence;
- The causes of subsidence;
- The detection and measurement of modern subsidence occurring in the south-central United States (Louisiana, Mississippi, Alabama, Texas and Florida);
- The prognosis for continued subsidence in the near future;
- The practical implications of subsidence for the future of the gulf coast;
- Comments regarding how Society can effectively cope with subsidence.

BACKGROUND

Subsidence: Definition

The word, subsidence, as used in this case, can be defined as: ***the lowering of the surface of the Earth with respect to a datum*** (Shinkle and Dokka, 2004). Lowering of the land surface implies that a change occurred in height with respect to a reference point or datum over a period of time. Thus, to measure subsidence at some point on the Earth requires:

- An appropriate measurement tool sensitive to resolve height change. The tool, e.g., ruler, defines the precision of the measurement.
- A datum with which to reference measurements. A datum is a point, line, or surface that serves as a reference. The quality of the datum is the critical factor in determining the accuracy of a measurement. If the datum is poorly chosen, then the accuracy of related measurements will be poor. It is the known point that allows unknown points to become known. An example of a precise datums is:
  - ✓ North American Vertical Datum of 1988 (NAVD88) – currently official vertical datum of the United States of America. It replaced National Geodetic Vertical Datum of 1929 (NGVD29). NAVD88 is a network of over 500,000 points spread over the continent whose exact spatial topology was known as of 1988. It is an orthometric datum. Several federal agencies still use the out-dated datum.

If measurements are made without reference to a proper datum, then all measurements are unknown. An example of an inappropriate datum for the measurement of subsidence is sea level. In 1988, the United States of America officially abandoned the use of sea level as the official reference for heights and elevations. It did so because it became known that sea level is not at the same elevation everywhere and that its elevation changes globally over time.

THE CAUSES OF SUBSIDENCE

A 190 Million Year History of Subsidence

Subsidence is nothing new to the south-central United States. It has been occurring in south Louisiana and the entire Gulf of Mexico basin since the Jurassic Period, the time of the great

dinosaurs some 190 million years ago. In support of the exploration of oil and gas, the region is the most heavily studied geologic province on Earth. It is widely known that the Gulf of Mexico basin (Fig. 1) contains an aggregate thickness of rock layers of nearly 60,000 feet (10 miles). To put this into perspective, this massive stack of sedimentary rock layers is equal to the layers of rock exposed in the Grand Canyon multiplied by 10! Most of these sediments consist of sedimentary rock deposited at or near (less than 100 feet water depth) sea level. How then did such a great thickness of sediments of shallow origin accumulate? It is again widely understood by geologists that the crust of the Earth has been shouldered aside over time by the weight of sediments deposited at the edge of the continent by the Mississippi River and other rivers on the gulf coast, and their ancestors.

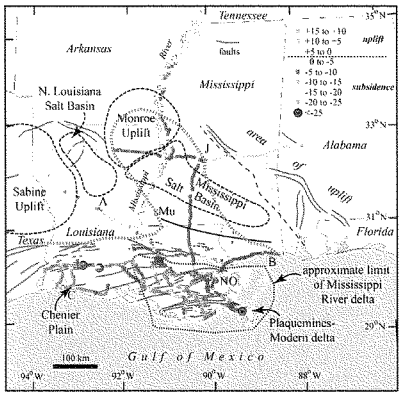
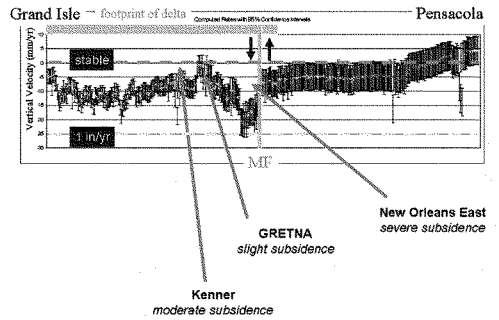


Figure 1. Tectonic map of states bordering the Gulf of Mexico. Colored point symbols are benchmark velocities determined by Shinkle and Dokka (2004). All rates are related to NAVD88. Rates are latest values from a given area and do not represent a single time interval. See Figure 2 for examples of changes in rates over time. Fig. 2 section endpoints: A, Alexandria; B, Biloxi; C, Creole; J, Jackson; NO, New Orleans.

An enormous volume of debris eroded from the Rocky Mountains and the Appalachians is carried by the waters of the mighty Mississippi River (and other rivers) each year. Upon entering the Gulf of Mexico, the river slows to a stop and the sediments come to rest forming the Mississippi River delta. This massive pile of sediments at the edge of the continent has two characteristics. First, its colossal weight has depressed, and continues to depress the Earth's crust and mantle. The sediments push down the edge of the continent just as a diver's weight causes a diving board to bend downward beneath his or her feet. Second, the pile of sediment is weak and unable to support itself laterally; it is wholly unsupported to the south. Over time, large tracts of the unstable pile have slumped southward along south dipping or sloping faults. Piling such massive loads of sediments have also lead to another geologic phenomena that Louisiana is especially famous, the mobilization of underground salt (Fig. 1).

The modern landscape of southeast Louisiana was created following the last ice age and is built upon a coastal delta created by the Mississippi River during the past 8,000 years (Fig. 1). Numerous studies have demonstrated that both natural and anthropomorphic processes have played roles in the lowering of the land surface relative to sea level since the last sea level low stand. Prior to human-induced change in the amount of sediment carried by the Mississippi River and to construction of flood control levees by individuals and local, state, and federal governments, subsidence was offset naturally to a large degree by deposition of river sediments during floods and *in situ* organic sediment production in marshes. Both of these changes were in large part due to direct actions of the US Army Corps of Engineers (USACE) as requested by Congress. It should be pointed out that if the USACE had not finished building the regional system of levees, the Mississippi River would have remained unreliable for commerce to and from the heartland of the USA and south Louisiana would have continued to be ravaged by yearly floods.

a)



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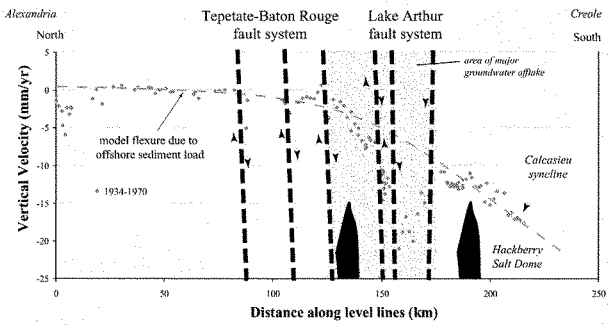

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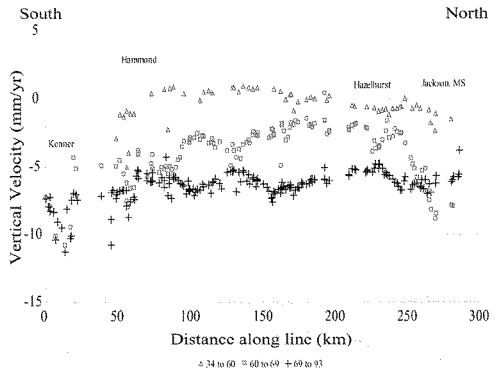


Figure 2. Selected vertical velocity profiles across the south-central United States highlighting areas of historic subsidence; data from Shinkle and Dokka (2004). See Fig. 1 for locations. a) Biloxi, MS to Kenner, LA (near New Orleans). Major episode of subsidence beginning near 1969 is associated with initiation of major movement along Michoud fault in east New Orleans. Aseismic but protracted interval of strain release is suggestive of a "slow earthquake" that ended between 1995 and 2005. b) Subsidence between Alexandria to Creole, LA between 1938-1970. Analysis of groundwater offtake records and fault slips strongly imply a causative relationship in the Lake Charles-Westlake-Sulphur area. These data show that most subsidence and fault motion stopped in the late 1980s when groundwater offtake was abruptly curtailed. Removal of the groundwater effect, however, leaves a residual subsidence that increases steadily towards the south. This suggests that large, ~6km thick, Pleistocene loads that lie offshore have not yet been fully compensated. c) Kenner, LA to Jackson, MS. Some local vee-shaped velocity anomalies are associated with groundwater offtake of shallow aquifers (e.g., near Jackson).

Causes of Subsidence Today

Several natural and human-related processes are known to be causing subsidence in coastal Louisiana today and in the recent geologic past. Almost all previous studies, however, have provided qualitative insights rather than quantitative measurements of actually how much sinking has occurred. It is my opinion that modern subsidence is the integrated effect of multiple natural and anthropomorphic processes that operate at several different spatial and temporal scales. It follows that the motion at any point on the Earth's surface is thus dependent on a unique set of local and regional conditions. A list of these processes is provided below:

- Natural processes
  - ✓ sediment compaction
  - ✓ sediment consolidation
  - ✓ compaction of semi-lithified rock
  - ✓ Major, regional faulting
  - ✓ Sediment load-induced down-warping
  - ✓ Salt evacuation

- Human-induced processes
  - ✓ organic sediment decomposition due to drainage projects.
  - ✓ groundwater extraction-compaction of shallow aquitards (clays)
  - ✓ groundwater extraction-compaction of shallow aquifers (sands)
  - ✓ Oil/gas extraction related-compaction of aquitards (clays) – area of subsidence *restricted to only the area of the oil/gas field*
  - ✓ Oil/gas extraction related-compaction of aquifers (sands)
  - ✓ Fault motion-induced by shallow groundwater withdrawal

Measurement of Modern Subsidence

The most comprehensive measurement of modern gulf coast subsidence is based on 1st order geodetic leveling measurements on benchmarks and tidal records published by NOAA Shinkle and Dokka (2004). In an effort to assess the accuracy of the National Spatial Reference System in the region, Shinkle and Dokka computed vertical motions on 2710 benchmarks throughout Louisiana, Mississippi, and coastal areas of Alabama and Florida were indexed to the North American Vertical Datum of 1988 (NAVD88). These authoritative rates demonstrate that modern subsidence has occurred at substantially higher rates than previously thought and that subsidence occurs far beyond the wetlands of the Mississippi River delta (MRD; Figure 1). The data do not support the widely held contention that modern subsidence is the result of merely young sediment compaction/consolidation and human related activities such as oil and gas extraction. The data instead demonstrate that subsidence has multiple natural and human-induced causes that include a large tectonic component and locally, a substantial fault component.

Figure 1 shows some of the vertical velocities computed by Shinkle and Dokka (2004) using NOAA data archives from ~1920-1995. Readers are urged to consult that paper for details on methods and assumptions. This map shows the latest rates at all benchmarks and thus does not represent a single interval of time. In contrast, Figure 2 shows several sections through the region and depicts motions over specific time intervals.

Examination of the spatial distribution of moving benchmarks in the context of their geologic setting provides important insights into processes governing subsidence. First, the most obvious observation is that subsidence occurs far beyond the areal limits of the deltaic plain (Fig. 1 and 2). This is in marked contrast with the prevailing view that considers subsidence to be: 1) concentrated in the modern Holocene delta (MRD) and the alluvial valley of the Mississippi River (MAV); and 2) is primarily the result of local sediment compaction and consolidation. Subsidence rates gradually decline away from the northern and eastern limits of the MRD in Louisiana, reaching zero velocities in northeastern Mississippi and Alabama. Beyond these areas, velocities are positive indicating uplift. North of the MRD (north shore of Lake Pontchartrain), velocities are negative and gradually decline to the north. They peak briefly near the Southern Mississippi "uplift" but subsidence continues far to north along the MAV to near southwestern-most Tennessee (Fig. 1). At the latitude of Vicksburg, an area of subsidence centered at Tallulah, LA, is flanked to the east and west by uplifted areas. This may be due to the weight of the Quaternary sediments in the MAV. To the west, rates remain high across both the coastal Chenier Plain and Cajun Prairie of southwestern Louisiana (Fig. 1). Here, faults and offshore sediment loads are the likely causes.

Previous studies indicate that subsidence continues west along the Texas gulf coast. In southwestern Louisiana, rates increase sharply south of the Tepatate fault system. Relations in the area show a strong association of fault slip to groundwater offtake as a function of time. As

the volume of water pumping increased markedly in from the early 1950s through the mid 1980s, so did the motion on local normal faults. Both processes slowed abruptly in the late 1980s. In contrast, much of west-central and northwest Louisiana has been stable.

Second, examination of benchmark velocities as a function of time shows that motions have not been linear through time. This suggests that multiple natural and human-induced processes in the area at work and that some processes have varied through time. Because some of these processes are probably unpredictable, e.g., faulting related strains, human responses to subsidence (e.g., improved groundwater management), eustatic sea level rise, prediction of future subsidence and resultant inundation of areas by the Gulf of Mexico will be uncertain.

The third observation is that subsidence rates based on benchmarks in coastal Louisiana are 2 to 50 times higher than previous estimates developed by state and federal agencies (Fig. 3); long-term geological estimates form part of the basis for the prevailing view on the cause of coastal inundation and land loss (see excellent discussion in Gagliano, 1999). The final observation is that differential motion between benchmarks straddling fault-line scarps or surface projections of subsurface normal faults of the region support the notion that many of these faults are indeed active today and contribute to subsidence and resultant inundation. The Michoud fault of east New Orleans, shown on Figure 2a, is an excellent example.

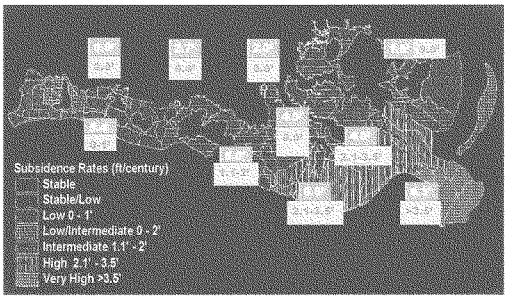


Figure 3. Generalized subsidence rates from wetland areas (Gagliano, 1999) with rates from adjacent land areas implied by geodetic study of Shinkle and Dokka (2004).

The Prognosis for Continued Subsidence in the Near Future

The natural processes causing subsidence will not cease in the next 50-200 years. All natural processes except faulting and load-induced crustal down-warping will likely be constant over this interval. For example, faulting (Fig. 2a, 3) varies through time. When faults are active subsidence increases in magnitude and produces regional effects. When fault motion stops, subsidence slows. Subsidence and resultant land loss at the latitude of New Orleans peaked recently near 1970. When the Michoud fault was active (slipping at ~0.75 inches per year), East New Orleans subsided at rates of nearly 1.75 inches per year. Today, this area subsides at a mere 1 inch per year as the motion on the fault has ceased. Most areas of south Louisiana from Plaquemines to Cameron Parishes have sunk between 1 and 2 feet in the past 20-25 years and faulting can be demonstrated to have played a major if not dominant role in most areas. Faulting, however, cannot be predicted with certainty.

Human-induced causes of subsidence can be stopped by ceasing the offending activity of through mitigation strategies. For example, major subsidence and related effects in the Lake Charles-Westlake-Sulphur area of southwest Louisiana that is associated with primarily industrial groundwater offtake was effectively stopped by switching to surface water sources beginning in the mid-1980s. New Orleans had similar success by changing to river water sources and limiting drainage projects. Large reductions in subsidence were also accomplished in the Houston-Galveston area over the past 30 years through improved management practices; subsidence continues by varying amounts (zero to several centimeters per year) in the region, however, due to continued offtake in some areas and unforeseen natural and natural causes.

Implications of Subsidence for the Long-Term Future of the Gulf Coast;

Several federal agencies (e.g., NOAA, EPA, and USGS) and independent scientists have reached similar conclusions abou the future of Louisiana and other low-lying parts of the Gulf Coast. If the 21st century is a repeat of the 20th century in terms of the combination of subsidence and global sea level rise, then low lying areas from the Mexican border to Pensacola will be below sea level or rendered dangerously vulnerable to hurricanes; unless walls are in place, these areas will be inundated by the Gulf of Mexico. Work by LSU and NOAA researchers validated this scenario in NOAA Technical Report 50. Fig. 4 illustrates the coming inundation if the recent past is similar to the near future. Using the 0.5 inches per year of subsidence seen in the past 50 years and the consensus value of current eustatic rise, most coastal parishes and communities of Louisiana will be inundated in the next 100 years. Hurricanes Rita and Katrina provided brief previews of the coming inundation. In the future instead of short-lived flood and then drainage, the waters will slowly drown the land and remain. There is one CRITICAL caveat, however.

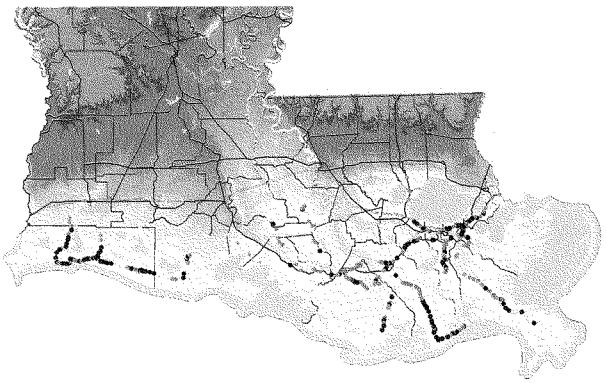


Figure 4. Topography of Louisiana. Cream colored areas lie between +3 feet and sea level. If subsidence and global sea level rise continues, these areas will be at or below sea level sometime by the end of the 21st century. This does not take into consideration any actions by humans or the future behavior of the Mississippi River if it changes course. Black dots, benchmarks that will reach sea level by 2050; gray dots, benchmarks that will reach sea level by 2100.

All predictions of future impacts of changes of nature generally omit how humans will react to this crisis. If we do nothing and the pattern continues, the coast will be gone or rendered too dangerous to live; it is a question of when inundation of unprotected areas will occur. However, it is my opinion that mitigation strategies can be developed to reduce short-term (100-200 years) risks to people and infrastructure, enhance the environment, and create economic development that could transform the state and region (see below).

The Practical Implications of Subsidence for the Immediate Future of the Gulf Coast;

Subsidence has and continues to have major impacts on fundamental aspects of infrastructure and public safety. NOAA told the Congress in 2001 that:

"Cities and cultures are at risk of losing their land and having to relocate. Flooding and sea level rise threaten the coastal region, most of which is only three feet above sea level. Flood plain models and evacuation plans, developed using outdated elevations, put the citizens of the low-lying areas at great risk during heavy rains. The current available geodetic control does not support the state's needs to evaluate and manage the changes in its environment and the impact on its economy and ecosystem. Problems with historic surveys, land movement, and sea level rise have made the current vertical geodetic control in Louisiana obsolete, inaccurate, and unable to ensure safety."

Simply put, if the benchmark is wrong, then everything based on it is inaccurate and may have major negative implications. Examples:

- ✓ Rebuilding New Orleans and communities devastated by hurricane driven storm surge will undoubtedly require upgrading existing levees to new heights that will withstand future events. Without correct data on topography, i.e., the lay of the land, accurate models of storm surge cannot be made by the USACE. **MOST IMPORTANTLY:** We must not merely design the levee that will hold back the waters of a Category 5 hurricane today, we must make that design applicable to 50 years into the future, i.e., the levee must be built to a higher level today to account for future subsidence. We therefore need accurate and precise subsidence rates for planning and continuous monitoring of subsidence to detect unexpected changes during design life of the levee. Similarly, <u>if the vertical control network is off, how will surveyors tell the builders when the levee has been constructed to the final proper grade?</u>
- ✓ Inaccurate elevations on levees and the land preclude the NOAA Storm Surge Modeling Group at the National Hurricane Center (NHC) from making the most accurate storm surge models possible during future hurricanes like Katrina and Rita. These models are used by emergency managers to decide when and where to evacuate. Note: Fortunately, NHC made basic adjustments to their models based on NOAA Technical Report 50 and successfully completed their Mission. The USACE and other also make models for planning purposes and have similar requirements.
- ✓ The viability of all evacuation infrastructure, i.e., roads and bridges, depend on accurate subsidence rates for planning and elevations for construction.
- ✓ FEMA flood maps are tied directly to benchmarks of the vertical control network. Incorrect benchmarks mean inaccurate flood maps, unprotected consumers, and less affective local planning and zoning. More:
    - o Local governments will make bad choices about land use and drainage. Ex., Treatment plants flood and spill toxic materials into neighborhoods.
    - o Consumers buy homes outside of the flood zone only to have them flood during rains.

- o A consumer obtains a FEMA flood certificate from surveyor who used a benchmark that was actually lower than the official elevation. It had moved a foot since the last time it was checked.
- o A city expands its drainage network based on topography derived from new Lidar technology. The only problem is that the benchmarks used for vertical control were off by differing amounts.

✓ Planning, construction, and monitoring coastal restoration projects are highly dependent on accurate subsidence rates and elevations.

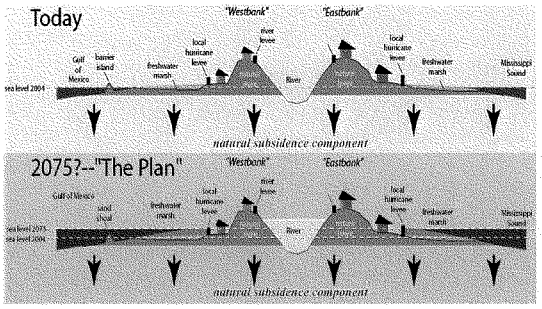
COMMENTS REGARDING HOW SOCIETY CAN EFFECTIVELY COPE WITH SUBSIDENCE

Mitigation strategies

The "disease" leading to coastal land loss in south Louisiana has been attributed generally to processes operating within the marshlands of the Mississippi River delta. The deteriorating wetlands are the most graphic symptom associated with this "disease", and unfortunately, it has been further reasoned that it is also where the disease is located. Thus, hypothesis development, multidisciplinary science integration, and data gathering has been generally limited to the confines of the delta. Mitigation strategies such as outlined in Coast 2050 and by the Louisiana Conservation Authority are therefore designed to treat the symptom. Existing plans lack appreciation of the extent and magnitude of subsidence processes operating today. Subsidence values reported in NOAA Technical Report 50 demonstrate that the ENTIRE coast and environs are subsiding at rates faster and in places than cannot be explained by the paradigm devised by state and federal coastal experts. Mitigation strategies to help wetlands areas do not take into account actual subsidence rates (see www.americaswetlands.org). Although building wetland by mimicking nature (water and sediment diversions) is by itself a good thing to do based on its own merits (e.g., enhancement of various habitats), the plan has been oversold to the public through unsustainable claims of substantial hurricane protection and flood control benefits. Figure 5 illustrates the fallacy of wetlands-centric coastal restoration as the primary solution to Louisiana's coastal woes. Intervention using wetland-centric strategies might initially provide improvement to wetland areas, but it should be obvious from Figure 6 that such a strategy cannot help subsiding land areas of the coast or provide surge protection where people live and work.

A new strategy is needed for the region and it needs to be developed before New Orleans and environs are substantially rebuilt. The strategy selected should reflect the desired outcomes of the local people and the Nation. A well chosen commission of thoughtful listeners and hard questioners could ferret out the possibilities, think about the "unintended consequences" and formulate an effective strategy. To begin this conversation to outline the possibilities, permit me to examine a few of the obvious desired outcomes. If the goal is only a healthy coastal wetland, save the taxpayers money and do NOTHING. Nature will accomplish this quite nicely over time through future flooding and replenishment of subsiding areas. However, use of the Mississippi River as a highway of commerce for the nation will be seriously compromised. Oil production in the deep water gulf will become more expensive as facilities and support centers are moved elsewhere. New Orleans as well as remaining coastal communities will wait for the final storm. Eventually, ever sinking coastal communities will drown or be placed in a position of untenable vulnerability.

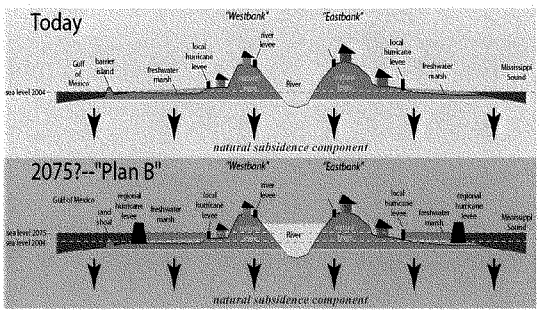
Current plans to save the Coast are focused on fixing the wetlands



As the wetlands are restored, coastal communities will continue to sink. Storms will ultimately make coastal communities uninhabitable.

Figure 5. Schematic cross-section of New Orleans area of today and in 2075 if only wetlands restoration programs are implemented. As the ENTIRE coast sinks, the places where people live will be become increasingly more vulnerable to surges over time.

Sea level rise and subsidence will likely result in inundation of the coast.



Solution: Protection for coastal communities. Or RETREAT!

Figure 6. Schematic cross-section of New Orleans area of today and in 2075 if higher levees are built and strategically placed to protect communities and critical infrastructure. Note that wetland areas could also be integrated if planned appropriately.

If our goal is to protect people, property and infrastructure, the choice is clear: higher levees built to meet requirements of the greatest expected storm surge expected over the design life of the project. The essential questions that must be asked and effectively answered are: "Where do we want protection and why? It would be prudent to integrate existing levees of southeastern Louisiana into the plan along with the USACE "Morganza to the Gulf" project. These existing levees need to be higher and made "ocean wave proof". New protection walls will likely be needed to be built along the coast west of Morgan City where none currently exist. Similarly, an effective design needs to be developed along the eastern edge of Lake Pontchartrain to keep out storm surges that might flood Orleans, Jefferson, and St. Charles Parishes from the north. If we as a nation are unwilling to take these steps, we must retreat from the coast.

Action Items that must be accomplished before we rebuild

- ✓ Accurate and sustainable vertical control network. Today there are only 86 points in all of Louisiana that NOAA National Geodetic Survey deems correct. Rebuilding New Orleans and other areas destroyed by the recent hurricanes require accurate vertical control. Acceleration of National Height Modernization Program currently underway by Louisiana State University in partnership with NOAA National Geodetic Survey (http://www.ngs.noaa.gov/heightmod/) is critical if we are prevent future massive mitigation. This could be addressed through funds from FEMA future flood mitigation program. Similar problems exist throughout coastal areas of Texas, Mississippi, and Alabama and require similar attention.

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STATEMENT OF
BENJAMIN GRUMBLES
ASSISTANT ADMINISTRATOR, OFFICE OF WATER
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
U.S. HOUSE COMMITTEE ON
TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON WATER RESOURCES AND ENVIRONMENT

October 20, 2005

Introduction

Good morning, Mr. Chairman and members of the Subcommittee. My name is Benjamin Grumbles and I serve as the Assistant Administrator for the Office of Water at the U.S. Environmental Protection Agency (EPA). Thank you for inviting me to participate in this hearing to talk about the role of our Agency, and specifically the Office of Water, in the response and recovery efforts in the wake of Hurricane Katrina. I look forward to sharing with you our experience, progress and expectations for the coming weeks and months.

The magnitude and range of the environmental challenges presented by the two Hurricanes is unprecedented in the United States. Our hearts go out to the people of the Gulf region, and we share with you an urgent sense of duty to help restore the communities affected by Hurricanes Katrina and Rita.

Last month, I had the opportunity to visit devastated portions of Louisiana as part of a joint task force staffed by the Centers for Disease Control and Prevention (CDC) and the EPA. The taskforce was charged with identifying the overarching environmental health issues facing New Orleans in order to re-inhabit the City. As we saw first hand, the enormity and complexity of this disaster will require sustained, long-term coordination and cooperation among federal, state and local governments and citizens.

My testimony will provide you with an overview of our role and activities in relation to the affected Gulf region, our coordination with federal, state and local partners, and a snapshot of our primary environmental concerns.

Initial Response to Hurricanes Katrina and Rita

EPA's response to Hurricane Katrina began on August 25th, several days before the storm made landfall. Our agency pre-deployed personnel to the FEMA National Response Coordination Center and sent On-Scene Coordinators (OSCs) to the Florida, Louisiana, Alabama and Mississippi Emergency Operations Centers. The OSC is the federal official responsible for monitoring or directing responses to all oil spills and hazardous substance releases reported to the federal government. After landfall, we sent additional personnel to the affected areas as soon as travel into the region was possible.

In anticipation of Hurricane Rita, EPA also deployed response experts to the multi-agency Regional Response Coordination Center in Austin, TX on September 20th. The number of EPA staff and contractors currently assisting with recovery efforts is more than 1,100 in the affected Gulf region.

EPA Role in Federal Response

After helping with immediate rescue needs, EPA turned its attention to its primary responsibilities under FEMA's National Response Plan (NRP). Under the NRP, EPA is the primary federal agency for Emergency Support Function (ESF)-#10, which addresses oil and hazardous materials response. Our responsibilities include preventing, minimizing, or mitigating threats to public health, welfare, or the environment caused by the actual or potential releases of

oil and other hazardous materials. Because of the potential environmental and public health risks associated with the floodwaters, our office has been thoroughly engaged in this area of response.

In addition to ESF-#10, EPA also works with other agencies to provide support for several other Emergency Support Functions, including ESF-#3, which addresses Public Works and Engineering. Our responsibilities under ESF-#3 include: testing the quality of floodwaters, sediments, and air in partnership with the Louisiana Department of Environmental Quality (LDEQ) and assisting with the restoration of the drinking and waste water infrastructure in the affected states.

The Army Corps of Engineers (USACE) has the primary responsibility for federal response activities under ESF-#3; however EPA, FEMA and other Federal agencies provide support. Since the beginning of the response, EPA's On-Scene Coordinators and other EPA personnel have worked closely with USACE to provide technical assistance, instructions, and advice on floodwater, drinking water and wastewater issues. Looking towards recovery, ESF-#3 designates FEMA as the primary agency to accomplish the ESF mission with respect to infrastructure recovery programs and the FEMA Public Assistance Program.

EPA will also be engaged with its federal partners in ESF-#14, which is focused on long-term community recovery. This is the first time that this Emergency Support Function, which was incorporated into the National Response Plan in 2004, has been activated. FEMA has the primary responsibility for coordinating efforts under ESF-#14. EPA's identified role is to provide technical assistance for planning for contaminated debris management and environmental remediation, and in carrying out this function, the Agency will also provide our expertise to support long-term efforts to restore drinking water and wastewater infrastructure.

It is important to note that as always, our primary responsibility is to support state public health and environmental agencies in addressing the significant challenges they face in fulfilling their missions. In the course of responding to the enormous challenges presented by this tragedy, states are relying heavily upon EPA personnel and technical expertise, and we are happy to be able to provide this assistance.

Floodwaters

In the immediate aftermath of Katrina, the potential exposure or contact by residents and emergency response personnel to contaminated floodwaters was among our leading concerns. EPA, in close coordination with LDEQ, began water sampling on September 3rd. Water sampling was halted from September 20 through September 24 due to Rita, but resumed September 25.

The floodwaters were analyzed for over 100 chemical priority pollutants as well as for bacteria. Results to date indicate that the water had levels of E. coli that greatly exceeded EPA limits for contact. Some tests found contaminant levels exceeding EPA drinking water action levels; however the floodwaters were never used, nor were they expected to be used, for drinking water purposes. In initial screening analysis of the floodwater, we utilized drinking water MCLs in order to provide some context for the results, not to provide a statement of health risk. Throughout this process, EPA has taken great steps to ensure scientific accuracy. EPA solicited the assistance of the Science Advisory Board to review the floodwater sampling plan, and EPA and CDC have routinely conducted a thorough data review, and interpreted the data for potential human health effects.

Surface Water Quality and Fisheries

As we moved beyond our immediate response, EPA began working closely with its federal and state partners to mitigate environmental impacts to Lake Pontchartrain caused by the floodwaters. Specifically, EPA worked with the Corps to institute the use of skimming booms and aerators in the Lake and canals. Skimming booms were deployed to remove oil and debris from floodwater prior to pumping. After pumping, additional booms in the canals leading to the Lake further reduce oil, debris, and solids. Aerators are also being used in the canals to raise the dissolved oxygen levels in the water prior to outfall to Lake Pontchartrain. The booms and aerators will remain in place through completion of un-watering operations and at least through the end of October.

As we move beyond the short term mitigation measures, sampling and monitoring data will be needed to help states and EPA answer the following questions:

1. Did storm-related contaminant releases occur that affected the quality of surface water, sediments, ecological and seafood resources in the impacted area, including Lake Pontchartrain, coastal and inland waters and Gulf of Mexico offshore waters?
2. When will it be possible to open coastal and inland waters to the uses for which the states have designated them in their water quality standards?
3. What contaminant releases are likely to continue during recovery and reconstruction and what risk management action may be necessary and appropriate to consider?

EPA is working with federal partners, including the National Oceanic and Atmospheric Administration (NOAA), the Food and Drug Administration (FDA), and the U.S. Geological Survey (USGS), and state and local partners on coordinated mid term and long term sampling and monitoring activities to provide the necessary data. Sampling of water and sediment quality

in Lake Pontchartrain; near coastal waters; coastal bayous, bays, and wetlands; and the Gulf hypoxia zone will be conducted by EPA, USGS, NOAA and the states. Efforts are currently underway to assess coastal ecosystems, biological condition, fisheries, water quality, sediment quality, seafood safety, and human-health risks in coastal ecosystems of Louisiana, Mississippi and Alabama.

In addition to assessing potential contamination in water samples, EPA is assisting in efforts to determine whether contaminants resulting from Katrina are affecting the quality of seafood. EPA worked with the states of Louisiana, Mississippi, and Alabama, and FDA to coordinate sample collection and analysis of contaminants in finfish and shellfish in Lake Pontchartrain, Lake Borgne, and the Mississippi Sound. All of the chemical and microbiological analyses will be conducted by FDA, which will help provide a level of consistency in the interpretation of the results. FDA and LDEQ are using the same sampling protocols, which also will help provide a level of consistency in the interpretation of the results. The State of Mississippi has commenced sampling in the Mississippi Sound using the FDA protocols. The data developed from this effort will help the states, FDA, and EPA know when the levels of pathogens have decreased to a level which would allow for the re-opening of oyster harvesting areas in these lakes, and to determine whether levels of chemical contaminants are increasing in the finfish to the point where public health may be at risk.

Drinking Water and Wastewater Infrastructure

Drinking water and wastewater utilities did not escape damage from Hurricanes Katrina and Rita. However, the type and extent of damage was dependent on the paths of the respective hurricanes. In Mississippi and Louisiana, some facilities experienced significant physical

damage due to storm surges and strong winds, and many more were primarily affected by loss of electricity and flooding. It is a high priority of the states and EPA to re-establish operations at all affected facilities.

In the aftermath of Hurricane Katrina, staff from our Regional offices moved quickly to provide support to state drinking water and clean water agencies to assess the status of facilities and identify their immediate needs. In Louisiana, more than 25 teams consisting of state, EPA, and rural water association staff spread across the affected area to assess the status of over 600 drinking water utilities in the southeastern parishes that were most heavily impacted by the storm. Shortly before Hurricane Rita, the state expanded its focus to evaluate all 1,591 drinking water utilities statewide. As of October 18, the state had assessed the status at all but 4 water utilities. Although some utilities may still have repairs to make, the majority are now operating without a boil water advisory. 40 utilities historically serving approximately 13,000 people are operating under a boil water advisory and 76 utilities historically serving around 105,000 people are not operating. Most of the utilities that are still not operational are located in the southwestern part of the state that was affected by Rita and in the parishes north of Lake Pontchartrain and southeast of New Orleans that were affected by Katrina.

In Mississippi, EPA staff began arriving on August 30 and partnered with state staff to assess the status of 1,367 drinking water utilities throughout the state. The teams completed their assessments by September 17. As of October 18, 54 utilities serving 43,000 people were still operating under a boil water advisory. 30 utilities serving 10,000 people were not operational. As is the case with Louisiana, many of the systems that are not operational have been subject to heavy structural damage and may no longer have customers to serve.

Alabama drinking water utilities largely escaped damages. As of October 18, all utilities in the affected area were operating without a boil water advisory.

In Texas, the state has not requested significant assistance from EPA and is still working to assess the extent of damages at drinking water utilities. As of October 18, the state had identified 1,057 utilities that had been affected by Hurricane Rita. The state has reported that 795 utilities serving 4.6 million people are operational. Another 186 utilities serving approximately 280,000 people were operating under a boil water advisory. 3 utilities serving 245 people are not operational and the state is still working to assess the status of 73 systems that normally serve 60,000 people.

Drinking water quality is not the only concern of EPA and state regulators. It is also critical to ensure that wastewater facilities are operational to protect receiving waters, particularly as drinking water utilities come back on line. The states of Louisiana and Mississippi focused their attention on utilities in the southernmost counties and parishes that were hit by the respective storms. As of October 18, 329 wastewater utilities in the affected areas of Mississippi were operational, although 12 collection systems continued to experience problems. In Alabama, 84 wastewater utilities in the affected area were all operational, although 2 collection systems continued to experience problems. In Louisiana, 13 of the 317 wastewater utilities in the affected area were still not operational and the state was still evaluating 5 utilities to determine their status. In Texas, all 70 wastewater utilities in the affected area were operational.

In describing the status of facilities, it is important to note that when we describe a utility as operational, it does not necessarily mean that the utility escaped damage from the storms. For drinking water, utilities designated as operational are those where a boil water advisory was not

required or has been lifted. The facilities may be fully operational, operating on emergency power, or operating with some damage to the distribution system. For wastewater utilities, operating facilities are those that are on-line and processing wastewater. These may be fully operational facilities, facilities operating on emergency power, facilities with partially damaged collection systems, facilities that have partially damaged treatment processes, and/or facilities operating with temporary equipment installed by EPA contractors.

As a more detailed damage assessment is completed, and applications for financial assistance from FEMA's Public Assistance program are received, we will be able to provide a more comprehensive status report on the facilities.

I would like to take a moment to highlight what I consider to be some of the more significant technical assistance efforts we have provided in the field. In Mississippi, EPA has been tasked by FEMA with multiple drinking water and wastewater missions which included completing initial damage assessments shortly after the storm's landfall, assisting in short-term relief by directing contractors to implement temporary repairs, and by completing long-term project worksheets under the FEMA Public Assistance Program. EPA professionals are currently overseeing contractor crews who are working to repair temporary blockages. In addition to assisting with recovery of public water service, EPA played a critical role in securing portable water treatment units for select public health priority facilities located in areas with severely damaged public water systems, including Biloxi Regional Medical Center and two communities in Waveland, Mississippi.

Many people living in the affected area are served by private wells and septic/decentralized systems. EPA mobile laboratories in Mississippi and Louisiana, which initially provided support to test water for public water systems, are now largely focusing their

efforts on testing private water supplies. To date, EPA's mobile lab located in Gulfport, MS has tested upwards of 1188 samples (516 of which have been from private wells). The EPA lab in Livingston, Louisiana has been analyzing private well samples and has received between four and twenty-seven samples per day. Another EPA lab, currently located in Kinder, Louisiana, has been assisting with analysis of special bacteriological samples for public water systems in southwestern Louisiana, and is now prepared to assist with analysis of private well samples.

Major Drinking Water and Wastewater Systems

New Orleans, Louisiana

The status of facilities in the New Orleans area has been of particular concern to the Agency and the nation as a whole. We understand the importance of making the City habitable again for residents, and to this end EPA and CDC formed a joint task force to advise local and state officials of the potential health and environmental risks associated with returning to the City of New Orleans. Their report, titled *Environmental Health Needs and Habitability Assessment*, was issued on September 17th and identifies a number of challenges and critical issues for consideration prior to the reoccupation of New Orleans. The task force is now incorporated into the Federal New Orleans Reoccupation Zip Code Assessment Group (Zip Code Assessment Group), which will provide information on a broad range of issues, ranging from infrastructure to health issues. Their recommendations will assist State and Local officials in their decisions regarding when to allow residents to reoccupy the city. As part of this larger group, EPA will continue to work to identify potential health and environmental risks associated with returning to the city based on the Agency's ongoing efforts to assess the quality of the air, water and sediment.

Many of the City's water utilities were significantly impacted by the Hurricane and subsequent flooding event. New Orleans proper is primarily served by two drinking water plants: the Carrollton plant on the East Bank of the Mississippi River, which normally serves approximately 428,000, and the Algiers plant on the West Bank, which serves close to 60,000. Likewise, there are two principal wastewater treatment plants, one located on the East Bank and one on the West Bank. The drinking water and wastewater utilities on the West Bank largely escaped damage and were operational shortly after the storm. The larger plants on the East Bank, which serve most of the City, experienced more significant problems.

While the drinking water treatment plant itself suffered moderate damage due to the storm, the distribution system was severely compromised, particularly in the 9th Ward. On October 6, after service was shut off to the lower 9th Ward and eastern parts of the City and tests indicated that water did not exceed EPA limits for potentially harmful bacteria, the Louisiana Department of Health and Hospitals (LDHH) lifted the boil water advisory for areas west of the Industrial Canal. The Department cautioned that water in the lower 9th Ward and east of the Canal remains under a boil water advisory.

The wastewater treatment plant serving the East Bank, which normally serves approximately 460,000 people, suffered significant damage to its treatment facility and collection system. The plant itself was flooded during both hurricanes, and until October 10, the access road to the plant was flooded. We understand that the Sewerage and Water Board of New Orleans achieved primary treatment on October 16, and expects to have secondary treatment by November 15, but that it could take at least 9 months to get their entire collection system back to pre-Katrina conditions.

EPA is currently participating in a multi-agency effort to fully restore the drinking water and wastewater utilities in New Orleans. Meetings are being held several times a week between the Sewerage and Water Board for New Orleans, FEMA, the COE, EPA, LDEQ, and LDHH to discuss the infrastructure reconstruction needs. Clearly, full recovery of the water and waste water infrastructure will take time and resources.

In Louisiana, EPA Region 6 has been assisting in monitoring drinking water quality provided via water haulers. With approximately 60 water haulers per day filling up at four different approved watering locations, EPA contractors became aware of some unapproved water haulers (non-food grade tankers), attempting to fill at approved watering locations and actually stealing water from unapproved watering locations (i.e., fire hydrants), and referred these activities to LDHH and EPA staff. EPA Region 6 is taking enforcement action against two companies that have been associated with unapproved water hauling practices.

Gulfport, Mississippi

The City of Gulfport operates four separate water systems, serving approximately 75,000 people. As a result of power loss and damaged infrastructure, pressure was lost in the water distribution lines, causing concern that pathogenic organisms in the floodwaters could contaminate the systems though leaks and cracks in the piping. City of Gulfport crews worked day and night to shuttle fuel supplies for the generators in order to maintain pressure. By September 26, the boil water advisory was lifted for all four systems.

Gulfport's major wastewater treatment plant suffered severe structural damage in the storm and was not operational for two weeks due to five feet of floodwater. The plant is now operating with secondary treatment, thanks in part to the work of EPA contractors who installed

temporary bypass pumps. The city's wastewater collection system was also heavily impacted by the storm, and EPA and its contractors continue working to clear manholes and collection lines.

Biloxi, Mississippi

Biloxi's three water systems collectively serve approximately 47,000 people and suffered greater water damage than Gulfport's due to a larger storm surge in the area. Ten wells were submerged, and there was extensive damage to equipment at well sites. The boil water advisory was lifted in late September.

Of the two wastewater treatment plants serving Biloxi , one suffered severe damage, also due to the storm surge. The flooding disabled standby generators and electrical controls at the facility. As of October 14, the plant is operating with primary treatment only. EPA contractors are currently working to locate the equipment needed to restore the facility's secondary treatment. Biloxi's second plant suffered less severe damage, and continued to operate.

Long-Term Recovery of Drinking Water and Wastewater Utilities

As noted, staff from the states, EPA and other agencies have worked to complete initial response assessments of water facilities in order to identify those utilities with immediate needs (e.g., generators) to become operational. In carrying out these assessments, the evaluators did not assign costs to damages. It will take more thorough assessments of damage to identify the long-term costs of recovery.

EPA is making an effort to work within the National Response Plan framework to see that work needed to help utilities recover is carried out. In Mississippi, 12 EPA professionals continue to assist FEMA in completing damage assessments among public water systems and wastewater systems eligible for reimbursement of costs to repair or replace infrastructure damage

under FEMA's Public Assistance Program, which has traditionally served as the mechanism for financing recovery efforts. EPA work entails reconciling FEMA and EPA inventories of utilities eligible for assistance; delivering Request for Public Assistance applications to utilities and assisting utilities in completing these forms; and assisting FEMA project officers in completing project worksheets by collecting and assimilating photographs, locational data, and other necessary documents. We are working with FEMA officials in Louisiana to provide assistance to expedite recovery efforts. As these assessments are carried out, EPA is collecting the information derived from them to complete a refined estimate of potential needs for returning systems to their pre-hurricane condition. EPA is also working with other state and rural water representatives to ensure that the needs for all water systems, including privately owned, profit-making systems (which traditionally cannot receive FEMA Public Assistance) are evaluated.

At the option of a state, the Clean Water or Drinking Water State Revolving Fund programs may provide emergency or long-term financial assistance to help water utilities recover. However, in previous disasters, State Revolving Fund programs have not traditionally provided emergency assistance – due in part to the structure of the program. One concern that state officials have expressed to the Agency is how they will manage outstanding loan agreements to communities that have been damaged by the storm and which may have difficulty maintaining a revenue stream from which to repay loans. EPA will work with states to identify appropriate solutions for these borrowers.

As infrastructure is rebuilt, it will be important to ensure that new construction is sustainable. In our water infrastructure programs, EPA is emphasizing practices that can help them operate more efficiently and effectively over the long-term. We encourage states, communities, utilities and other stakeholders to carefully consider how facilities can be rebuilt in

such a way as to facilitate sustainability by, for example, incorporating water efficiency techniques to reduce the volume of water that needs to be treated, adopting watershed approaches to managing stormwater, or by encouraging consolidation or regionalization of small drinking water utilities.

Wetlands, Buffers, and Barriers

This event underscores the importance of wetlands, buffers and barriers in protecting our coasts and communities from flooding. These key landscape features are often the first line of defense for our coastal communities, and their presence directly reduces the magnitude of the wind-driven storm surge (wave heights are reduced by 1 foot for every 1-3 miles of wetlands). Moreover, these areas are the nursery for this country's most productive commercial fishery, and they are a vital link for our domestic energy supply.

According to the U.S. Geologic Survey, Hurricane Katrina converted more than 30 square miles (approximately 25%) of preexisting marsh around the upper portion of Breton Sound to open water. Other adjacent areas also sustained major wetland losses not yet estimated, and the fragmentation of remaining marsh makes it vulnerable to further losses. Finally, barrier islands off the Louisiana coast sustained serious damage, which makes the coastline more susceptible to future storm damage.

As the USGS, DOI/FWS, USACE, EPA, the states and others complete their ongoing analysis of the impact of Hurricanes Katrina and Rita on Louisiana's wetlands and the broader Gulf Coast areas impacted, we will gain a clearer understanding of how these major storms have altered the coastal environment. This information can then be used to reassess, refine, and

develop needed environmental restoration plans to strengthen the coastal areas' natural aquatic system protective capacity for future storms.

EPA has a history of successful barrier island restoration projects in coastal Louisiana. Our most recent project, Timbalier Island Dune and Marsh Restoration, restored 2.2 miles of barrier island and was completed approximately $3 million under budget. The project was able to withstand an approximately 12-foot storm surge from Katrina. Our recent aerial assessments post-Katrina and Rita indicate that the project remains largely intact and able to absorb another storm surge as well as daily wave energies from the Gulf of Mexico.

Federal, state, and local governments will face many challenges in developing a restoration plan for the area. For example, the Alabama and Mississippi Gulf Coast does not have the deltaic wetlands that provide a buffer for developed areas. Still undecided is whether decision-making officials will need to address this in restoration plans. If they do, several options exist, such as the beneficial use of dredged material from the New Orleans District. This issue is but one of the many challenges within the restoration planning that Federal, state, and local partners will need to work together to address.

Environmental restoration efforts will be costly, and a thorough assessment in light of the changes brought by Hurricanes Katrina and Rita will be important for efficient and effective capital investments. In partnership with USACE, USGS, DOI/FWS, NOAA, the affected states, and others, EPA envisions a collaborative effort to examine restoration priorities in light of the best available information on the current state of the coastal environment. Another important piece of analysis is an evaluation of the dozens of coastal restoration projects constructed under the Breaux Act by the Army Corps, EPA, and others since 1990 at a cost of $500 million. Lessons learned from the demonstration projects should be applied to future efforts.

Sustainable Re-Development

The major public investments needed to reestablish a strong coastal line of defense should be leveraged by localized environmental enhancements linked to housing, commercial, industrial, and transportation system redevelopment. There is a compelling need to ensure sound environmental principles are incorporated into the design of rebuilt communities. An opportunity exists to define best practices for redevelopment and offer regulatory and other incentives for their application.

Government agencies could make experts in these design principles available to local communities as they consider redevelopment plans, to incorporate the best practices for making the built environment along our coasts as sustainable as possible.

A comprehensive approach to environmental restoration and community redevelopment, which effectively pairs the best efforts of all involved government and private parties, can protect people and the critical resources of this area from future tropical storms. By restoring the coastal environment's capacity to buffer our communities from harm, and rebuilding in a more resilient manner, we can ensure the long-term vitality of the National treasure that is the Gulf Coast.

Informing the Public

We view communication to the public, workers, and other agencies to be a critical component of our response effort. The Occupational Health and Safety Administration (OSHA) was on-scene early in the response effort, distributing over 3,500 fact sheets by hand in the first two weeks and conducting interventions that removed more than 850 workers from serious or life threatening hazards. OSHA continues these activities and on a daily basis, EPA response

personnel and contractors receive health and safety instructions regarding field conditions and safe work practices. EPA's preliminary sampling results are also provided to On-Scene Coordinators to facilitate field decisions and ensure health and safety of workers.

Within two days after Katrina hit, Office of Water quickly sent thousands of copies of "What to Do after the Flood" to Louisiana and Mississippi. Subsequently, we sent copies of both "Emergency Disinfection of Drinking Water" and "Septic Systems–What to Do after the Flood." Because more than 34,000 residents of Mississippi and Louisiana speak Vietnamese or Spanish, EPA provided the Gulf Coast states with Spanish and Vietnamese translations of these three fact sheets.

Additionally, EPA has partnered with LDEQ to record public service announcements in English, Spanish, and Vietnamese that provide information on mold, cleaning up sediment, asbestos, lead, carbon monoxide, household cleaners, gas leaks, hazardous materials and floodwater.

More generally, EPA has established a hurricane website, which provides information to the public on a variety of issues, including drinking water, well water and floodwater sampling results. The site contains newly added flyers and a long list of frequently asked questions that provide basic information to returning residents and the general public. The flyers are being distributed in affected communities as part of EPA's continuing outreach to help the Gulf Coast region recover. The materials provide information on environmental and health issues in impacted areas and highlight possible hazardous situations residents may encounter during cleanup activities.

Future Challenges and Conclusion

Looking ahead, much remains to be done to help address the public health and environmental impacts of Hurricane Katrina. EPA will continue to work with state health and environmental quality agencies, the USACE, and FEMA to support local governments in their efforts to repair and restore public facilities, including drinking water and waste water systems. We will also continue to monitor in the region and make sure that this information is readily available to federal, state and local officials, other responders, and the public.

The nation faces an enormous challenge in restoring and rebuilding the affected areas, but we are also faced with a unique opportunity to demonstrate and encourage sustainable practices in infrastructure and development. We expect that citizens and government agencies will look to EPA and our Federal partners for technical expertise, scientifically sound data, and practical advice on environmental and public health conditions in the region for some time to come. We are focused on meeting that challenge.

Safety in the Netherlands

Statement to the United States Congress on October 20, 2005

By Jan R. Hoogland
Director of Rijkswaterstaat (ret.)

Mr Chairman, distinguished Members of the Committee, ladies and gentlemen, it is a great honor for me to testify on the subject of flood protection policy in the Netherlands.

Let me tell you something about myself. I spent my entire career in the Netherlands' Ministry of Public Works and Water management, in the department called Rijkswaterstaat. It is comparable to the U.S. Army Corps of Engineers. From 1981 till 1997 I was in charge of policymaking on flood protection.

As you know, Mr Chairman, I have submitted my paper, called "Flood Defense in the Netherlands – Lessons Learned from Dutch History." I respectfully request that this paper be inserted in the Record of your Committee.

First of all I need to point out that the water situation in the Netherlands is quite different from the United States. It is a fact that almost 60 percent of our country is threatened by water: either by storm surges, and/or by floods due to high discharges of rivers. We earn 70 percent of our Gross National Product in these flood prone areas. Millions of people live below sea level. Cities such as Rotterdam (our main harbor), Amsterdam (our capital), and our largest international airport are below sea level. That is why in the Netherlands dedicated organizations were established in the past with the sole purpose to defend the country against flooding from the sea and rivers. On a local (or county) level these are called the Water Boards, and on the national (or federal) level it is my organization, Rijkswaterstaat.

My main message to your Committee, Mr Chairman, is that we have learned – and continue to learn – from history, especially the history of flood disasters. Each flood disaster in the Netherlands – from the 13th century onwards – has brought us new lessons to be learned for keeping our country habitable.

After the disaster of 1953, in which nearly 2,000 people died, we designed our Deltaplan, primarily meant for the coastal areas. In this Deltaplan for the first time we developed a comprehensive system of standards for designing dikes and barriers for the whole country. These government-endorsed standards assure the quality of our water defense system. All our dikes were rebuilt accordingly, and the total length of our coastline was shortened by more than 700 kilometers as the result of closing estuaries with dams or storm surge barriers.

It took half a century to implement this plan. It is important to notice that in the 1970's new insights were gained about morphological as well as ecological processes.
For these reasons the last two barriers, constructed at the end of the Deltaplan, are partly open and movable:

- the Easternscheldt Barrier because of the fishery, sedimentation, and the environment;
- the Stormsurge Barrier in the Rotterdam Waterway because of shipping and sedimentation.

These barriers are only closed in case of storm surges to keep out the water. During half a century, we have invested about 15 billion in today's US dollars in our Deltaplan.

In 1993 and 1995 in the river areas, the extreme discharges of the major rivers nearly overtopped the dikes. 250,000 people and their livestock were evacuated. That event made clear again that we could not postpone upgrading the river dikes. But what we have learned (in that period) too is that a water defense system includes not only technical solutions. It is not just building and maintaining dikes. Disasters can always happen, and therefore you need evacuation plans.
In addition, it is always advisable to think about zoning, that is to say legislating the areas to be reserved for urban development and for water. Our government designed this new policy in a document called "More Room for Water", in which our "Spatial Planning Act" plays a pivotal role.

Now, if you were to ask me what are the most important elements of our protection-policy, I would say the following:

- knowhow & organizational structure
- standards & legislation
- priorities & budget
- prevention & zoning

As to *knowhow*, it clearly includes technology, morphological and ecological knowledge, statistics and predictions. New developments such as sea level rise and climate change are important components. To safeguard that the development of this knowledge stays on the highest level, we have and need a department such as mine, working on the national level, as a respected partner in the international exchange of knowledge. My department, Rijkswaterstaat, by the way, has been around since 1798.

On the *local* level, we have – for 800 years – one-issue organizations, called "Water Boards" whose only task is water management, which includes flood protection. Water Boards are public administrations with their own election and tax system.

Now I come to standards and legislation.
Our *standards* are accepted risks related to the design-criteria of our dikes. Those standards are laid down in the "Flood Defense Act".

- For the economically most important and densely populated part of the country, we design our dikes and dunes to be strong enough to withstand a storm-situation with a probability of 1 to 10,000 a year! That means, that a Dutchman – if he should live a 100 years – has a chance of 1 percent to witness such an event. For our parliament, these odds became the acceptable standard.
- For the less important coastal areas we calculate the probability of 1 to 4,000, and
- along the main rivers 1 to 1,250.

Every five years, the entire defense system is checked for compliancy with the standards by assessments from the local Water Boards. A summary of these assessments is submitted to the national parliament. In order to be able to make these assessments, it is essential to know what the hydraulic specifications, belonging to the political standards, are. My department, Rijkswaterstaat, publishes these hydraulic specifications, in which we implement the latest knowledge of statistics, failure mechanisms of dikes, sea level rise and climate change.

A few words about priorities and budget.
Since 1953, financing of renovating the dikes has been a *national priority*. All funds for rebuilding are allocated by the central government. Maintenance – financially and operationally – is totally controlled by the Water Boards, who in turn, tax the local population. Since the Water Boards have no other responsibility than water, this implicitly means that other priorities never go to the detriment of the water defense system.

And finally I get to the matter of prevention and zoning.
The notion of *zoning* is fairly new in our approach. We need to answer questions such as whether we reserve space for urban developments or whether we dedicate space exclusively for water.
Last but not least it is important to realize that total safety does not exist and therefore it is essential to *be prepared*, for instance by having evacuation plans. After all, Members of the Committee, disasters do happen.

Thank you, Mr Chairman.

Flood defense in the Netherlands:
Lessons learned from Dutch history

Table of contents

0. Summary: lessons learned from Dutch flood defense 2
1. Introduction 3
1.1 Water boards and Rijkswaterstaat 3
1.2 Policy fields 4
1.3 The floodable area in relation to Dutch Gross National Product (GNP) 4
2. History 5
2.1 Afsluitdijk 5
2.2 Deltaplan 5
2.3 High discharges of the Rhine and Meuse 6
3. The dutch legislation system on flood defense 6
3.1 Flood Defenses Act (1996) 6
3.2 Flood protection along the Dutch coast 7
3.3 Safety assessment of the dikes (Flood defenses act, 1996) 7
4.A different Approach to Water 8
5. Financial and Economic consequences in the Netherlands 10
6. The meaning of the flooding of New Orleans for the Netherlands. 11

During the hearing of the The Subcommittee on Water Resources and Environment this testimony is expressed by Mr. Jan Hoogland. The subject of the hearing is "Expert Views on Hurricane and Flood Protection and Water Resources Planning for a Rebuilt Gulf Coast".
This paper is background information to the testimony of Mr. Jan Hoogland from the Netherlands.

Mr. Ir. Jan Hoogland

Thursday, 20 October 2005, 10.00 a.m
Committee Room 2167 Rayburn House
Office Building (HOB) in Washington D.C

0. Summary: lessons learned from Dutch flood defense

a. The history of water management in the Netherlands reveals the major role that has been played by the district water boards and the national-level Directorate-General for Public Works and Water Management (Rijkswaterstaat). These organisations have water management as their primary responsibility. The water boards have their own independent source of funding in the form of a tax paid to each board by the residents of its district. The fact that residents are paying separately for flood protection greatly reduces the probability that other priorities will take precedence over flood control. Flood protection is likewise the main task of Rijkswaterstaat and the organisation draws its funding from the general central government resources.

b. Throughout history, every major water control project in the Netherlands (including the barrier dam across the mouth of the Zuiderzee and the Delta Project in the south-west of the country) has been carried out in the wake of catastrophic flooding. Although plans and studies had usually already been prepared, it always took a disaster to create the necessary political and public support for their implementation. The choice of plan and any modifications to it were invariably influenced by the details of the disaster.

c. Following disasters, specific legislation was always passed – for example, the Delta Act in 1958 – establishing administrative responsibilities and guaranteeing financial resources over a prolonged period.

d. The 1957 Delta Plan concluded at the end of a detailed analysis that 'From all this it follows that the safety of the storm flood protection is definitely inadequate and insufficient along the whole coast and that the necessary improvements must be carried out as expeditiously as possible'. The Delta Plan established varying flood protection levels for different areas of the country; for the western part, including the main cities, the flood protection level was formulated as a return period of 10,000 years. This is still the design standard for flood protection in coastal areas and along the major rivers. The result was to place the emphasis in the Netherlands on flood prevention.

e. The task of managing and maintaining flood defenses, setting flood protection levels and reporting on these matters is enshrined in separate legislation: the Flood defenses act. Reports are presented to parliament so that it is kept abreast of any deficiencies and can earmark extra resources if necessary.

f. In order to keep management and maintenance – and hence the level of protection – up to standard, the Dutch government has decided to invest in monitoring to assist the understanding of processes such as land subsidence, wave run-up etc., the effects of which will be visible only in the longer term.

g. Land has been earmarked in the Netherlands for future flood defense measures such as reinforcing dikes or moving them further away from rivers. This helps to prevent land use developments which might block dike improvement works at a later date.

h. During the implementation of the Delta Project, changes were made in the design of flood defenses. Factors like the growing awareness of sedimentation processes and of the need to preserve ecological systems and permit navigation led to the use of mobile storm surge barriers (in the Eastern Scheldt and the New Waterway).

i. The Dutch government has decided to anticipate climate change and its expected consequences for the country's hydrology by 2050 by investing in advance in measures to create more room for the rivers and remedy potential weaknesses in the coastal defenses. This is explained in A Different Approach to Water, 2000, the government's position paper on water management policy in the 21st century. Important principles in this respect are greater flexibility in water level management and the three-step strategy of absorption, storage and discharge.

j. A careful balance needs to be struck between the first link in the flood protection chain (prevention) and the second link in the chain (evacuation). In the Netherlands, the main emphasis has been on prevention; since Katrina, however, there has been much greater interest in evacuation strategies.

k. As you know, the Netherlands is helping in the initial relief effort for New Orleans and surrounding area (by providing a pumping team). The Netherlands will likewise be pleased to contribute knowledge and expertise to help in the effort to strike a new balance between prevention and evacuation strategies for New Orleans and surrounding area. The Memorandum of Agreement with the US Army Corps of Engineers provides a good basis for this.

1. Introduction
Without dikes and dunes, more than half of the Netherlands would be regularly inundated. So the extensive system of dikes and dunes is essential to the safety and habitability of the country and an absolute precondition for healthy economic development. The Flood Defenses Act is the statutory basis for flood protection.
For centuries, flood protection was virtually synonymous with dike building and maintenance. However, the floods of the nineties have taught us that sustainable protection means more than periodic dike strengthening. It can best be achieved by working hand in hand with natural processes wherever it is possible to do so. We need to step back and give the rivers, estuaries and coast more room to evolve.
In a country like the Netherlands, flood protection must never be neglected. The management and maintenance of flood defenses must always be a top priority. Climate changes are likely in future to lead to higher design water levels. Our water systems need room to evolve if they are to cope with uncertain and unforeseen future developments. For the rivers, this means water conservation throughout the entire catchment area and enlarging the flow area of the river rather than embarking on a further round of dike strengthening. Where the coast is concerned, it means extensive sand nourishment instead of 'hard' engineering structures. Around the IJsselmeer, the offshore bank protections will also be used to achieve the required standard of flood protection. In the regional water systems, the capacity of the collecting and transporting systems will be enlarged. Room for water also means that we may sometimes need to take a step back and, for instance, stop building in the winter flood plains of the rivers, on the beaches and in the dunes facing the sea. And reserve land now for possible future use to maintain flood protection.
Where flood defenses are concerned, measures relating to the sea defenses have the highest priority (risk to human life, little advance warning of flooding), followed by those in the IJsselmeer area and the diked sections of the rivers (risk to human life, more advance warning). Measures along the undiked sections of the rivers have a lower priority because they present no risk to human life.
But there is no such thing as absolute safety. Whatever we do, we may at some time face a water level which our flood defenses are simply not designed to withstand. We must learn to live with the awareness of that residual risk and be prepared to cope with such circumstances if they occur.

1.1 Water boards and Rijkswaterstaat
The flood defense history has produced a special kind of organisation: the Water board and Rijkswaterstaat. The origin of the Dutch governmental system is the water board. Legislation etc was in the Middle Ages also

Rijkswaterstaat
Rijkswaterstaat is responsible for the main traffic and transport arteries, by road and by water. They are used by millions of people every day.

Having 16 million customers involves a unique responsibility. You want to travel from A to B, preferably quickly and of course safely. You also want to be able to live safely, without the risk of flooding. And of course you want there to be sufficient surface water for the users of that water.
Our job is to make sure that all this is possible, both today and in the future.

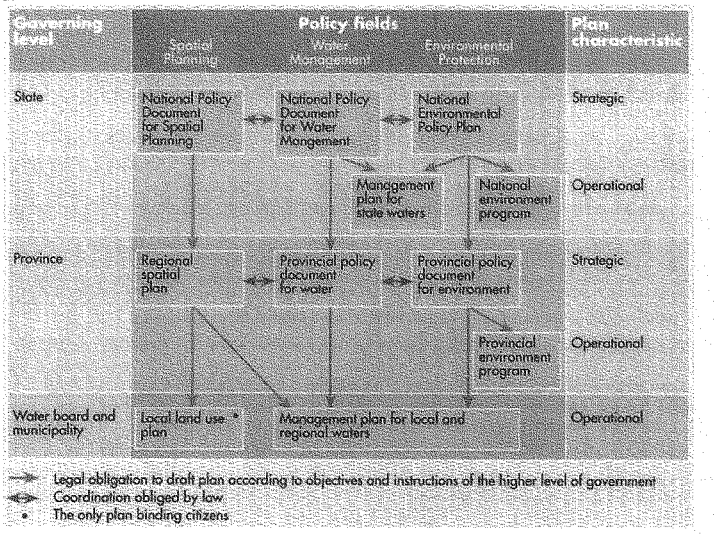
Our job demands alertness, as the Netherlands is changing. According to forecasts, the number of travelers and the amount of freight to be transported will double within fifteen years. However, the number of roads certainly will not double during that period. Therefore we are constantly seeking ingenious solutions to make better use of the road capacity and solve bottlenecks quickly. Providing good information is an essential part of this. Roads are linked together, which is why Rijkswaterstaat provides direction at a national level to keep traffic growing as smoothly as possible. Our climate is also changing. Storms and periods of intense rainfall in the basins of our major rivers like the Meuse and the Rhine are increasingly resulting in flooding. On the other hand, long periods of drought cause a shortage of water. Rijkswaterstaat carries out the measures that are needed to be able to live with the water.

The water boards
The Netherlands: 34,000 square kilometres where land meets water. Much of this area consists of artificial land created by man. Without dunes and water barriers, more than half of the Netherlands would be under water. The many dykes, locks, pumping stations, flood barriers, canals and ditches keep the Netherlands habitable.

Local and regional water management in the Netherlands is in the hands of Water Boards. Water Boards are decentralized public authorities with legal tasks and a self-supporting financial system. Water Boards are responsible for flood control, water quantity, water quality and treatment of urban wastewater. Operational task include the management of pumping stations, wastewater treatment plants, maintenance of waterways and flood defense structures. Water Boards are embedded in the general democratic structures. In 1953 there were about 3000 Water Boards. Mergers soon reduced this number. By 1 January 2005 there were 27 Water Boards. Approximately 10,000 people work at the Water Boards.

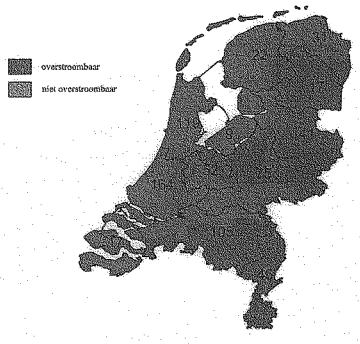
a task of the Water board. People have to cooperate to keep the water away and to drain the land. To defend the land from flooding out of the rivers and the see, there was a need for centralization of some tasks of the regional water boards. This national organisation is the Rijkswaterstaat that was founded in 1798.

1.2 Policy fields
In the Netherlands there are different policy fields. The picture below describes how these policy fields are organized.



1.3 The floodable area in relation to Dutch Gross National Product (GNP)
The Rijkswaterstaat and the water boards are well integrated in the Dutch governmental system.
The need for special attention for the struggle against flooding is shown in the map below. Almost 70% of the Dutch Gross National Product is earned in area's that can be flooded from the sea, the rivers of both of them.

Figure: Dutch Gross National Product in relation the floodable area



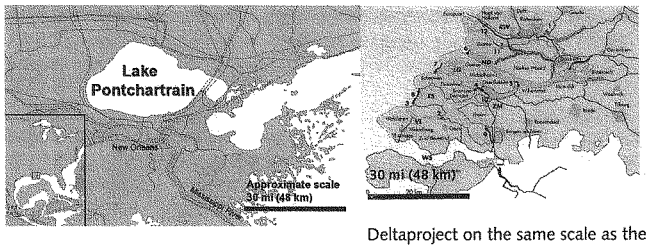
2. History
The earliest inhabitants of the Netherlands protected themselves against flooding by constructing mounds ('terps') on which to build their farmsteads and houses. Later occupants of these mounds started to protect larger areas of land by building dikes between them.

Around 1300, large parts of the present-day Netherlands still lay under water. In the centuries that followed, more and more land was wrested from the sea by constructing dikes and using windmills to pump away the water. It was the advent of the windmill in around 1300 and its use in land drainage that formed the landscape of the Netherlands as we know it today. By 1800 there were some 9000 windmills in the Netherlands. The 16th and 17th centuries saw a boom in wind-powered lake reclamation schemes financed by wealthy Amsterdam merchant-entrepreneurs.
Throughout history, the populations of the Dutch coastal provinces have been regularly afflicted by devastating storm surges. The most famous are the St. Elisabeth Flood of 1421 and the All Saints' Day flood of 1570, which cost the lives of many thousands of people and caused enormous damage.

2.1 Afsluitdijk
The area around the Zuyder Zee suffered badly in 1916. The danger of flooding could come either from the Zuyder Zee or from the Rhine/Maas delta in the southwest. As early as 1667, Hendric Stevin, son of the more famous Simon Stevin, produced a plan to prevent flooding around the Zuyder Zee by damming the channels between the islands in the Wadden Sea. At that time the technology simply did not exist to do this but the idea persisted and in 1889 a thorough study was made of its technical feasibility. One of those responsible was Cornelis Lely (1854-1929), later Minister of Water Management. It was he who - prompted by the disastrous floods of 1916 - was finally to commission the necessary works to seal off the Zuyder Zee from the North Sea by constructing a Barrier Dam from the tip of North Holland to the Frisian mainland. Work began on the 32-km-long dam in 1927 and the last opening in it was sealed on 28 May 1932. Later, large parts of the Zuyder Zee - rechristened the IJsselmeer - were drained to create two huge new polders: the Noordoostpolder and Flevoland.

Special Act: Zuiderzee Act 1919
Purpose: reduction of coastline with 360 km
Design level: 7.50 m above Amsterdam Ordnance Datum
Length: 32 km
Costs: 55 million US dollars (1930 - 0,5 billion US dollars, 2000)
Execute time: 1919-1932

2.2 Deltaplan
In February 1953 the Netherlands faced disaster when the dikes protecting the southwest of the country were breached by the joint onslaught of a hurricane-force northwesterly wind and exceptionally high spring tides. In the night of 31 January to 1 February 1953 more than 1800 people drowned, thousands of farm animals were lost and 150,000 hectares of land were inundated. Flooding caused by storm surges were nothing new to the Netherlands, but this time the nation was stunned by the extent of a disaster unparalleled for centuries. Emergency aid flowed in from all over the world to help soften the blow to a country only just recovering from war. Ironically enough, the Ministry of Transport, Public Works and Water Management had published a policy document only a few days previously detailing plans to prevent precisely this sort of disaster. The document proposed that all the tidal inlets and estuaries in the provinces of Zeeland and South Holland should be dammed. In the light of the disaster, urgent action was taken to implement this plan, known as the 'Delta Project'.



Deltaproject on the same scale as the New Orleans-region

Special Act: Delta Act 1957 approved by the Dutch parlement Purpose: reduction of coastline from 700 km tot 25 km Design level: 1:10.00 year for the Randstad, 1:4.000 for other areas that can be flooded from the sea. For the river area the standard is 1:1250 Period of realisation: 1953-1997 Costs: 5-6 billion US dollars

The Delta Project was one of the greatest post-war feats of hydraulic engineering in the Netherlands. Immediately after the devastating storm surge of 1953, a Delta Commission was appointed to advise the government on the necessary works to protect the south-western part of the country. The first step was to construct a moveable storm surge barrier in the Hollandse IJssel, east of Rotterdam (1958).
In the following decades, most of the estuaries in the Delta-region were closed by great dams, some with great sluices to regulate the discharge of water from the major rivers.
Plans for the closure of the last open estuary, the Eastern Scheldt, were also on the table, but evoked a clamor of protest from mussel and oyster farmers and environmentalists. Eventually a compromise was reached. A partially open storm surge barrier would be built, with huge gates that could be closed in the event of high water levels. This would preserve the ecological value of the Eastern Scheldt as a tidal area while at the same time guaranteeing the safety of Zeeland. The last element of the Delta Works was finished in 1997, when a moveable storm surge barrier was completed in the New Waterway. This consists of two vast gates which are normally kept open but can be closed when a storm is imminent.
During the same period a programme of strengthening all the other major dikes according to the political agreed standards was realized.

2.3 High discharges of the Rhine and Meuse
In 1993 and 1995 there were two new flood emergencies in the Netherlands. There were no fatalities, but the economic damage was enormous. This time the flooding came not from the sea but from the rivers. In 1995, melt water from the mountainous heartland of Europe and extremely heavy rainfall downstream combined to burst the banks of the Rhine and the Maas and more than 250,000 people had to be evacuated. This latest flood emergency led immediately to the drafting of a Delta Plan for the Major Rivers. This provides for the major rivers transecting the Netherlands to be given greater freedom to spill out across some parts of their traditional floodplains, while the height of the dikes controlling them is increased elsewhere.

Special Act: Delta Act Major Rivers 1995 Purpose: reinforcement of 1000 km river dikes Design level: cf Delta Act Costs: 1.3 billion euro Execute period: 1995-2002

3. The dutch legislation system on flood defense
3.1 Flood Defenses Act (1996)
During the activities in increasing the safety-situation in the Netherlands, the ideas growed to guarantee the realized new safety for coming generations by legislation. That brought in the end the dutch "Flood defenses act" (1996).
The essential items of this act are:

a. The legal base for the safety standards in terms of a probability of an extreme event.
b. Publishing technical criteria by the central organization (Rijkswaterstaat) every five years as a translation of the safety standards in design- and check-criteria (wave, wind and water level conditions) for dikes, dunes and constructions. By renewing these criteria every five years, influence of sea level rise and climate change are taken into account.
c. The water boards and Rijkswaterstaat have to report every five years whether their system of dikes, dunes and other constructions is compliant to the safety criteria or not. If not, plans to make the system compliant to the criteria have to be presented. An overall report of the whole country as a summary of the regional reports has to be presented to Parliament. Safety is an issue on the highest level of political decision making.
d. Financing the maintenance of dikes and dunes is a task for the water boards. If renewing plans urge major budgets, central government will co-finance.

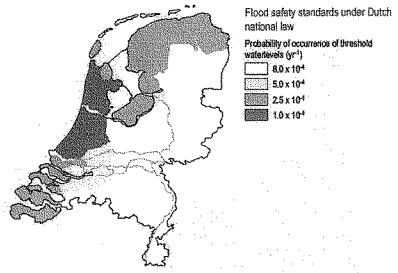


Figure 1. The Delta Commission's safety standards showing the annual risk of exceeding the normative water table.

3.2 Flood protection along the Dutch coast

Meeting the standards of the Flood defenses act
The Dutch government reported that – during the first round of testing – nearly all 268 kilometers of coastal dunes in the Netherlands fully met the standards of the Flood defenses act. No definitive assessment could be made for four kilometers of coastal dunes due to lack of data. No new information is currently available. The report for the next round of testing will be released in 2006.

Changing insights into wave behavior
The changing views on coastal wave behavior reported in 2003 led to the conclusion that a number of dune and dike sections no longer meet the standards of the Flood defenses act. To better assess the consequences for flood defense structures and with a view to effecting definitive measures, the managers of flood defense structures drafted supplementary management assessments in 2003. These assessments clearly show that there are other dune and dike sections that are not up to standard.

Since 1998, the rate of basic coastline transgressions has stabilized at around 10% for the coastal system as a whole. It is unlikely that this rate will decline any further. After all, dynamic maintenance offers room for natural processes. In addition, small-scale replenishments (in response to transgressions involving one or a few measuring sections) are not effective.

Act: Spatial planning act
Purpose: reinforcement of potential weak links in the coastal defense structure
Design level: 1:10.000 cf Delta Plan
Costs: 0.7 billion euro
Expected execute period: 2005-2015

3.3 Safety assessment of the dikes (Flood defenses act, 1996)

All dikes along the major rivers of the Netherlands and the area around Lake IJsselmeer (including Lake Markermeer) and the delta are part of the primary flood defense system. Every five years the water boards and Rijkswaterstaat have to report about the safety assessment. If the safety assessment warrants this, the report shall contain a description of the measures deemed necessary. In 2004 the Dutch Government reported that on the reference date (1 January 2002), 50% (1,792 kilometres) of the primary flood defense structures met the statutory flood protection standards. However, 15% did not meet these standards, although work is being implemented to change this. A definitive assessment could not be made for the remaining 35% given the limited amount of information available. For example, there was no information available about soil surveys, or historical information had been lost. In addition, the soil mechanics preconditions were sometimes inappropriate. Efforts are being made to ensure that all the key data are available for the next round of testing. It is expected that all the necessary information will be collected in time for the 2006 report.
All other flood defense structures, generally identified as regional flood defense structures, are deemed non-primary. In the Netherlands, there are 14,000 kilometres of secondary flood defense structures, including regional river dikes (for the smaller rivers), storage basin dikes, dikes/flood defense structures used to separate areas with different functions (comparttalisation dikes), polder dikes and dikes/flood defense structures dividing differences in ordnance datum, all of which are managed by the water boards. No flood protection standards have been laid down for the majority of these flood defense structures. The Fourth National Policy Document on Water Management indicates that provincial authorities and water boards

must draft requirements for these flood defense structures in the 1998-2006 period.

In 2000, the Association of Provincial Authorities – in consultation with the Association of Water Boards and the Technical Advisory Committee for Flood Defense Structures – established guidelines for determining the flood protection level offered by storage basin dikes. This guideline was then adopted by each of the provincial authorities and used, in co-operation with the water boards, to establish standards to be included in flood defense structure byelaws. The standard provisions necessary for the subsequent processes of assessing and improving storage basin dikes will also be drafted in conjunction with the Association of Water Boards. The aim is to link these to the provisions of the Flood Defense Structures Act. The tempo of this process was stepped up in response to the collapse of peat dikes in 2003. A taskforce including representatives from the Association of Water Boards, the Association of Provincial Authorities, the Netherlands Foundation for Applied Water Management Research and the Technical Advisory Committee for Flood Defense Structures is conducting an inventory of other standards currently maintained for the regional system.

4.A different Approach to Water
Considerable material damage occurred during the periods of high water on the Meuse and the Rhine in 1993 and 1995. This affected private individuals, businesses and various authorities. New high water situations cannot be avoided, but further damage can be prevented. It is necessary to impose such conditions on future activities in the major beds of the main rivers that further damage can be prevented in the event of high water.

Climate Change and water management,
The climate is changing. The temperature is rising and there is more precipitation, particularly in the winter. As a result, the water levels in the rivers and ditches are higher than before. In the summer, there are more frequent periods of drought with low water levels. Furthermore, the sea level is rising and, in the west of the Netherlands, the ground level is descending. To keep water manageable, a policy is being pursued that offers more room for water This will allow the water to follow a more natural course and further reduce the risk of flooding. Climate scenarios In 2001, the Royal Netherlands Meteorological Institute (KNMI) worked out climate change scenarios for the Netherlands.

1. **The sea level is rising,**
   The higher the sea level, the higher the water level in the IJsselmeer lake and the tidal river area and the harder it is for river water to drain off.
2. **The risk of floods increases**
   River discharges increase. The more water has to flow through the 'river channel', the higher the water level will be. The risk of floods increases.
3. **The sea level rises, river discharges increase and the soil is subsiding**
   The larger the difference between water level and lower-lying polders, the greater the impact of floods.
4. **Precipitation in winter increases**
   Impending flood risk. Increasing water levels, increasing precipitation and subsiding soil More frequent AND higher peaks in river volumes combined with reduced drainage of this increased quantity of river water to the sea as a result of (accelerated) rise in sea level are the expected results of climate change. The risk of water overflowing dunes and river dykes increases. The higher peak volumes of rivers are caused by the expected increased frequency of violent rainstorms in winter. In summer, longer dry spells with increasing chance of water shortages are forecast. The effect of higher high-water levels of sea and rivers is intensified by a steady advance in soil subsidence, resulting from the slow geological tilting of the Netherlands along the Groningen-Bergen op Zoom axis and rapid soil consolidation of drained polder areas in the Netherlands.

Average rise	**Values between:**
Temperature	+1 C° and +6 C°
Summer precipitation	+1% and +4%
Winter precipitation	+6% and +25%
Sea level	+20 cm and +110 cm*

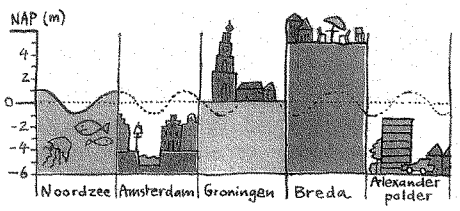
*This figure takes into account the effect of soil subsidence in the Netherlands.

Source: KNMI, Third IPCC Report, 2001

In December 2000 the Dutch Government presented a new policy, called "A different Approach to Water."

In this document the Dutch Government underscores the need to anticipate expected developments in climatic change and land subsidence, continue to guarantee safety, prevent increased risk of flooding and limit water-related problems. Furthermore, allocation of extra space for water in addition to the implementation of technological measures and the conclusion of agreements on terms of reference between the various authorities are essential for the success of this policy.
The Dutch Government understands that this new approach requires a substantial additional effort. A good mix of spatial and technological measures is required to address safety requirements and reduce water-related problems, for which the Dutch Government prefers constant consideration of spatial measures, including widening or lowering flood plains and construction of water retention and storage areas, in addition to technological measures, including dyke heightening and reinforcement, dewatering operations and damming. The Dutch Government's position reflects the overall vision in its approach to ensure safety and address water-related problems. Naturally, the Dutch Government would wherever possible like to combine the implementation of this with approaches to other water management problems, such as diffuse sources of pollution, contaminated water beds, water shortages and dropping water-tables. It also sees good opportunities to combine the plan's implementation with the objectives of other policy areas including the reconstruction of rural areas, construction of the ecological infrastructure, surface mineral extraction, land use and other area-specific projects, residential construction and development of business parks. The Dutch Governments' approach to create additional space for water, in addition to the implementation of technological measures, serves the need to ensure safety and limit water-related problems. It also offers a crucial qualitative impulse to the spatial planning of our country.

The policy applies to the Rhine and the Meuse (including the undiked stretches of the Meuse) and the major tributaries (i.e. those under national jurisdiction), with the exception of a few former sea inlets and tidal rivers in the lower delta region. Whether the area covered by the policy should be extended or not (to include rivers which do not come under national jurisdiction) will be considered, in due course, by the authorities concerned.



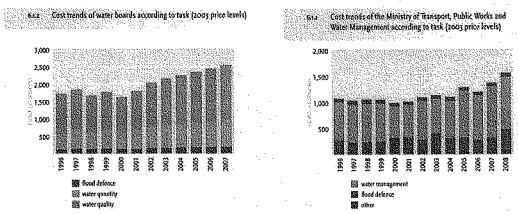
Room for the river, Safety against extreme river floods
Due to anticipated climatic changes the Rhine delta river branches have to accommodate ever-higher extreme discharges. Until recently it was standard policy to raise the crest levels of the dikes to maintain the required level of flood protection. This centuries old policy was abandoned in 2000 in favor of 'Room for the River'. In the new policy, river cross sections are widened by situating the dikes further away from the river, or by lowering the river forelands.
This will result in lower flood levels. By the year 2015 the river should be able to safely discharge 16,000 m3/s.

Improvement of overall environmental conditions
In giving 'Room for the River' care should be taken not to affect valuable features of landscape, nature and cultural history. More space can also be found by enlarging the river channel within the dikes. In the process, one should aim at a balance between present and foreseeable future spatial requirements, keeping an open eye for every opportunity to enhance safety as well as the master landscaping and the improvement of overall environmental conditions.

The Dutch cabinet recently proposed a Spatial Planning Key Decision in which the spatial planning for the entire area related to the Rhine delta is laid out. The document presents an integrated spatial plan with the main objectives of flood protection, master landscaping and the improvement of overall environmental conditions. Completion of a basic package of about forty projects is foreseen for 2015, with a budget of 2.2 billion.

Act: existing Spatial Planning Act: PKB procedure
Purpose: creating room for the river, laying back dikes, flood by-passes, lowering of river foreland
Design level: delta plan
Costs: 2,2 billion euro
Expected execute time: 2005-2015

5. Financial and Economic consequences in the Netherlands



Cost trends of water management

The expenditures of the Directorate-General for Public Works and Water Management total approximately EUR 1 billion a year. The money is used for the preparation and implementation of policy, as well as the management and maintenance of the main water system, waterways, harbors and flood defense structures. In 2005, expenditures for water management will increase to approximately EUR 1.3 billion due in part to additional costs incurred for the management of waterways. All of the amounts presented in the diagrams are expressed in constant prices, based on 2003 price levels. Of the expenditures for actual implementation, 25% goes towards the flood defense infrastructure and 75% towards management of the water infrastructure. The expenditures of the Directorate-General for Public Works and Water Management are financed using funds raised through general income tax (i.e. financed by individual tax payers).

Cost trends of water boards and municipal authorities for regional and municipal water management

In 2003 costs incurred by water boards for regional water management totaled more than EUR 2 billion. The majority of the costs (62%) were incurred for water quality management, including the operation of wastewater treatment plants. This is followed by water quantity management (30%) and finally the management and maintenance of the flood defense infrastructure (8%). Since 2000, total costs (expressed in constant prices) have increased annually at an average rate of 10%. In 2003, total costs were 33% higher compared to 2000.

Municipal authorities incur costs for the storage, collection and transport of sewage to wastewater treatment plants. In 2002 and 2003, the costs associated with these activities totaled EUR 1 billion. The costs of dealing with sewage (expressed in constant prices) in 2003 increased by 32% compared to 2000.

Revenue trends of water boards and municipal authorities for regional and urban water management
Water board revenues consist of apportionment levies (used to finance water quantity management, flood defense structure maintenance and road/waterway management) and pollution levies (used to finance water quality management). These levies are imposed on households and businesses located within the management area of a water board

The amount of levies paid by individuals has increased substantially in recent years, due in large part to water board levies. Compared to 2000, the water board levies imposed in 2003 (expressed in constant prices) increased by approximately 25%, which was in line with the cost increases incurred by the water boards during the same period. During this period, the sewerage charges paid by individuals increased by 33%. In 2003, the revenues for municipal authorities totaled EUR 790 million, EUR 70 million more than in 2002.

Costs and benefits of water management measures

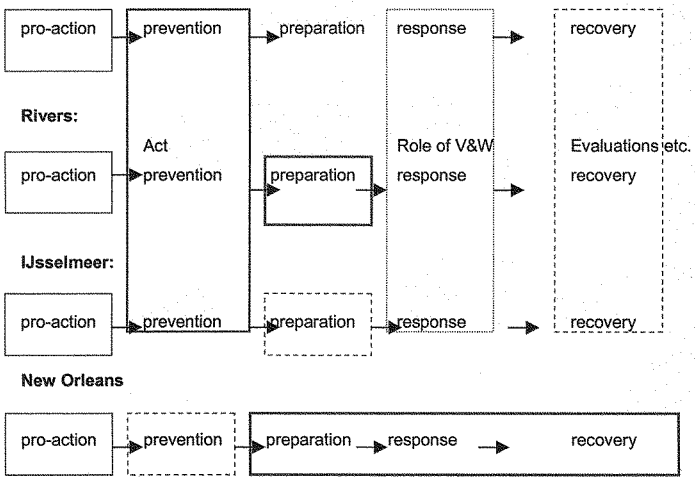
According to a report published by the Water Management in the 21st Century Advisory Committee (2000), the manner in which we deal with water insufficiently reflects the costs and benefits. Since the publication of this report, the number of cost-benefit analyses performed for water management has increased from year to year.

6. The meaning of the flooding of New Orleans for the Netherlands.

The safety chain as a conceptual framework for future flood protection measures:
In the United States, safety policy is often based on the concept of a five-link safety chain: pro-action – prevention – preparation – response – recovery. For flood protection policy in the Netherlands, this is still a new approach. However, an examination of the policy field shows that we are already doing a lot of work in each of these areas.

If Dutch policy and American policy on New Orleans are translated into the links in the security chain, the picture is as follows:

Coast:



Dutch policy is based firmly on prevention. Somewhat less attention is paid to proaction and perhaps this link could be strengthened, for example as regards the interaction between water management policy and policy on land use planning. Disaster response (rescuing people and investments when things go wrong) is probably not a task for the Ministry of Transport, Public Works and Water Management, but rather for the army and the disaster and emergency services. Recovery means post-disaster reconstruction: the sort of action taken after the 1953 floods. The main differences in flood protection policies for the coast, the rivers and the IJsselmeer and Markermeer relate to preparation: in other words, the evacuation of people and livestock and planning for this eventuality.

In New Orleans, there was relatively little investment in the field of prevention: policy was strongly focused on the remainder of the chain, starting with preparation.

Learning from disasters: feedback within the safety chain:

An important feature of the safety chain is feedback from the final link (recovery) to the first 4 links. Recovery refers to restoring the country to normality following a disaster and learning lessons from what has gone wrong. Looking at New Orleans, it is clear that there will be many lessons to be learned at that stage in the chain.

TESTIMONY OF

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BEFORE

THE SUBCOMMITTEE ON WATER RESOURCES AND THE ENVIRONMENT
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
U.S. HOUSE OF REPRESENTATIVES

ON

COASTAL ECOSYSTEM RESTORATION ON THE GULF COAST AND THE RELATIONSHIP TO FLOOD PROTECTION AND WATER RESOURCES PLANNING

20TH OCTOBER 2005

Testimony of

Dr. Denise J. Reed
Professor
Department of Geology & Geophysics
University of New Orleans

before
The Subcommittee on Water Resources and the Environment
Committee of Transportation and Infratstructure
U.S. House of Respresentatives

on
Coastal Ecosystem Restoration on the Gulf Coast and the Relationship to Flood Protection and Water Resources Planning

Mr. Chairman and Distinguished Members of the Committee:

Thank you for this opportunity to explore with you the relationships between ecosystem restoration and other water resources planning issues on the Gulf coast. I will specifically describe potential synergies and conflicts between restoration and both navigation and flood control, and will address the issue of sustainability of restored ecosystems in the face of sea-level rise and subsidence. The context for this discussion is the recent impacts of Hurricanes Katrina and Rita on the north central Gulf and how our response to these events can mesh with both our existing and future restoration, flood protection and navigation needs.

My expertise in this area is based on my training as a coastal geomorphologist at the University of Cambridge, specializing in the sediment dynamics of coastal wetlands, and almost twenty years of research on coastal marshes in Louisiana. I have authored scholarly publications on coastal wetland response to sea-level rise, and the effects of hydrologic change on marsh sustainability. I have also worked actively in restoration planning in Louisiana since the early 1990's and these efforts include my contributions as an author of the 'Coast 2050' report issued in 1998, and as a member of the Project Delivery Team for the Louisiana Coastal Area restoration plan. In addition, in recent years I have conducted research on coastal wetland restoration and participated in restoration planning in the Sacramento-San Joaquin Delta and San Francisco Bay. I live in Terrebonne Parish, Louisiana in the small town on Montegut.

As a Professor at the University of New Orleans my research on coastal ecosystems is currently funded by NOAA and the US Geological Survey. My work at the University on restoration planning in Louisiana has been supported

the State of Louisiana as part of their local sponsorship of the US Army Corps of Engineers Louisiana Coastal Area study. The thoughts and opinions expressed here are my own and do not represent the views of the University or any of these agencies.

The Need for Coastal Ecosystem Restoration

The recent hurricane damage to our coast has heightened awareness of their fragility in the face of storm surge and wave action. But even prior to this hurricane season, many of our coastal ecosystems on the Gulf Coast were in need of restoration. Around the shores on Mobile Bay and the landward bays of Mississippi Sound the area of coastal marsh has progressively declined as natural shorelines have been replaced by bulkheads. Seagrass beds have diminished as runoff from coastal communities changes water quality in the shallow bays. Restoration of these areas was already necessary to maintain the productivity of the coastal ecosystem, and the livelihoods of many coastal communities. While temporary changes in water quality associated with storm passage are unlikely to exacerbate existing problems with seagrasses or oyster beds, the physical erosion of marsh shorelines which have evolved over thousands of years as sea-level has gradually risen and submerged the shoreline is not readily rebuilt without human intervention.

The dramatic erosion of barrier islands from Dauphin Island, AL to Cat Island, MS indicates to many a need to reinforce those shorelines but from the perspective of the ecosystem this is likely unnecessary. Natural processes will gradually bring sand back to beaches which are currently little more than exposed mud. The process is slow and dependent locally on the size of nearshore sand deposits but this process has been observed during many storms. This natural healing, however, does not re-position the barrier island in its former location and the landward 'rollover' continues as sand moved into back barrier bays becomes colonized by marsh. 'Restoration' in most cases here is usually to meet some societal use of the system rather than to rehabilitate the ecosystem.

Within coastal Louisiana, the existing need for restoration is well established. Land loss rates in excess of 25 square miles per year have been continuing for decades. Without additional restoration, over and above projects already built under the Breaux Act and the projected effects of the freshwater diversions at Caernarvon and Davis Pond, we project loss of an additional 500 square miles by 2050. The benefits of various restoration options in providing habitat for commercial species such as shrimp and oysters, as well as the waterfowl and recreational fish species has been documented in recent planning documents (e.g., www.lca.gov) and I will not elaborate here. However, I must emphasize that to allow further degradation of this important ecosystem, the delta of the sixth

largest river in the world, means to deny our responsibility as stewards of the natural environment.

On the upper Texas coast, estuarine ecosystems are similarly degraded. Massive loss of seagrasses in Galveston Bay is still largely unexplained, and local hot spots of marsh loss are as dramatic as many in the coast of Louisiana. In the same area, detailed studies of how juvenile shrimp and blue crabs utilize coastal habitats show the importance of these degraded ecosystems to the commercial fisheries of the Gulf.

The productivity of these coastal ecosystems is tremendous and all across the Nation people recognize their value for seafood production, waterfowl habitat, ecotourism and many other uses directly related to the presence of complex patterns of barrier islands, bays and marshes. The problems identified in general here, and specifically in a myriad of case studies, show a clear need for restoration of ecosystem processes and the prevention of further degradation.

Ecosystem Restoration and Coastal Navigation: Conflict or Opportunity?

How many of the problems identified above result from the construction and maintenance of navigation channels through the coastal bays to onshore port facilities? When dredging occurs in these systems there is an obvious and immediate disturbance to the ecosystem. Shallow bay bottoms are lost, along with any present seagrasses or oyster beds. The footprint of such channels forever changes marshes and swamps to open water. These effects cannot be denied and for the most part along this coast, the habitat losses associated with the footprint of navigation channel dredging occurred decades ago.

Changing Salinity Gradients

As well as the footprint, a change in estuarine hydrodynamics – the daily balance between freshwater outflows and saltwater penetration – results from this channelization.

One of the best documented examples of this type of change is associated with the Houma Navigation Canal. When this channel was dredged, straight and deep, between the town of Houma, Louisiana and the Gulf of Mexico in the early 1960's, there was an immediate increase in the annual amount of days that the Houma water plant experienced chloride levels greater than 250 mg/l. While the changes soon after construction of such channels can be dramatic, the effects are not progressive. The estuary reaches a new 'equilibrium' – the balance between salt and freshwater simply moves further inland. Yet, habitat loss is frequently the result – the change is simply too fast and too persistent for the ecosystem to adapt. In the Houma example, extensive cypress forests were lost to the saltwater after the construction of the navigation channel as they have little tolerance for salt.

These kinds of effects have been manifest across the Gulf coast as shipping channels have provided easy access for salt to penetrate the estuary, and the effects are particularly pronounced where navigation canals link the Gulf directly with freshwater systems. In some cases, the canals allow the salt to move further in but they also provide avenues for freshwater to leave the system more quickly than it would through shallower natural channels and bays. The ecosystems thus become subject to a more 'flashy' salinity gradient – salinity increases more quickly but also drains more quickly.

The potential role of such canals in distributing freshwater is also illustrated by the Houma Navigation Canal. Like most navigation channels in the Gulf coast, the Houma Navigation Canal links to the Gulf Intracoastal Waterway – a direct east-west link between coastal communities and ports – with the Gulf. As you know, levees along the Mississippi River have restrict freshwater inflows to Louisiana coastal wetlands but in this instance dredging of navigation canals has actually facilitated that freshwater flow. As discussed above, after the Canal was dredged in the 1960's saltwater penetrated further inland. However, the emergence of the Atchafalaya delta after the flood of 1973 and the construction of the Bayous Chene, Black and Boeuf project in the western Terrebonne basin in the early 1980's both changed the flows of Atchafalaya River waters into the Gulf Intracoastal Waterway to the east. The increased flow of freshwater toward Houma has, at least seasonally, altered the effect of the Houma Navigation Canal on the salinity gradient in Terrebonne Parish and now, in concert with the other navigation channels, it acts as a conduit for freshwater to nourish marshes in that area. The LCA plan calls for the proposed lock on the Houma Navigation Canal to be used to direct this freshwater source into areas of greater need, and to prevent its quick exit to the Gulf of Mexico.

Using Dredged Material for Restoration

Perhaps a more direct and widespread relationship between ecosystem restoration and navigation channels is the use of dredged material to create or nourish coastal marshes and barrier islands. With funds available through the Section 204 Continuing Authorities Program to support the transportation and containment of dredged material beyond that justified by the navigation project itself, the Corps, in partnership with local sponsors, has been able to contribute to restoration through its navigation mission.

Programs to beneficially use dredged material from the Houston Ship Channel have both increased the area of marsh in Galveston Bay and provided important habitat for fisheries species. Designs have been improved through experimentation such that techniques for placement, containment, planting and drainage all work to ensure the creation of functional habitat. These are not just piles of mud!

However, not all Corps Districts or local sponsors are as forward thinking as those in Galveston Bay. In the face of the need for ecosystem restoration outlined above, it is no longer acceptable for suitable dredged material to be placed in upland disposal sites, as it has been for many years in the Pascagoula. Sediment is simply too valuable a resource and the need for restoration is too great. The recent restoration project on Deer Island in Mississippi could be an important prototype for other such projects in this area.

The New Orleans District of the Corps has an active beneficial use program. Marsh creation adjacent to the Calcasieu Ship Channel and in the Atchafalaya Delta, for instance, have produced extensive marsh areas. Sediment is a limiting resource for restoration in Louisiana and it is essential that where continued navigation requires dredging, even in emergency circumstances, that the best use of that material is made. In coastal Louisiana, there is no higher purpose for much of this material than marsh restoration.

Future Navigation Improvements

Many of the effects of navigation channels described above occurred decades ago when we were less aware of the consequences, or considered them less important than we do now. Given our need for restoration, if new navigation projects are to be undertaken, then it is essential that lessons are learned from the past, and that to the maximum extent possible, not practicable, these impacts are avoided.

The success of many coastal restoration in the northern Gulf, especially those that involve wetland creation or re-nourishment, relies on the provision of a hydrologic regime that allows for healthy vegetative growth and regular flooding to allow juvenile fish and shrimp to access the habitat that provides. Dredging deep straight channels through this coast alters the local hydrology. The 1998 Coast 2050 plan for Louisiana calls for locks or other navigable hydrologic barriers to be placed at Sabine Pass and at Cameron on the Calcasieu Ship Channel. If we can develop restoration plans that provide for navigation while reversing ecosystem degradation, then there is simply no reason why we should not be implementing similar measures on any new navigation projects.

While locks or floodgates can mitigate the effects of navigation canals on estuarine salinity gradient, the footprint of the canal on the coast will always lead to habitat loss. All material from new navigation channels must be used to further our restoration needs, not simply to satisfy mitigation requirements.

We know too much to let the past repeat itself. We have improved our technologies and approaches – we know this is achievable. It is not simply the figment of some scientist's imagination.

Ecosystem Restoration and Flood Protection

The Role of Barrier Islands
The need for more robust flood protection for our coastal communities has been vividly demonstrated in the recent weeks. Many have discussed the potential role of coastal wetlands as 'buffers' against storm surge. In coastal Louisiana, many local residents see the barrier islands as their first line of defense against hurricane storm surge and this feeling is common across the Gulf coast.

However, well documented studies of this effect on the Gulf coast are limited. Numerical modeling conducted as part of Louisiana barrier shoreline restoration studies in the mid-1990s' showed that, in some parts of the coast, substantial barrier island restoration could result in storm surge reductions of 3-4 ft at some locations. This study considered two tracks for a Category 5 hurricane and the effects were greatest when the barrier shoreline restoration options provided both a high barrier and restricted openings between the estuary and Gulf. The effects shown by the models were lessened in parts of the coastal system which were more open to the Gulf with a less intact barrier shoreline system. These studies were conducted a decade ago. Improved modeling tools, better topographic information for the coast, and more documentation of storm surges from Hurricanes Andrew and Lilli as well as the 2005 storms should all be used in future modeling of these potential restoration effects.

The Role of Coastal Wetlands
The effect of extensive coastal wetlands in providing protection has also been reported in several studies. The Coast 2050 report includes observations of storm surge elevations from Hurricane Andrews impact on the Louisiana coast in 1992. Using several point measurements the report notes reduction in storm surge amplitude of 2.8 to 3.1 inches per linear mile of marsh or marsh and open water. These data are from one storm and are based on opportunistic measurements of water level relative to the storm track. While they may be illustrative of the effect of coastal wetlands in storm surge reduction, they are by no means definitive.

Some unpublished work suggests that during Category 4 and 5 storms the marshes and barrier islands are submerged to the point where they are ineffective at reducing the storm surge. Modeling studies of the change in coastal land loss on storm surge elevations in Terrebonne Parish suggests that at least locally storm surge for a Category 3 storm may have increased several feet since the 1950's. However, the patterns are complex and determined by local hydrology and topography. It is difficult to generalize a 'rule of thumb' from these studies.

Future Needs
The way in which coastal landscapes interact with storm surge is clearly the key to understanding how ecosystem restoration and flood protection are linked in

the future. Thus far, restoration planning in Louisiana has paid only lip service to this issue, describing the relationship in general terms. It is now essential to conduct detailed analysis of this relationship and identify the role of specific ecosystem components in determining the height of coastal floodwaters.

To meet the needs of the ecosystem, we may not need to predict the specific configuration of marshes and open water, swamps and forested ridges, barrier islands and bays resulting from our restoration actions. But if we seek to afford some measure of flood protection while restoring the ecosystem, then these specifics will likely be crucial.

There may be places where restoration is cheaper and easier than in others. But these may not be the places where we can get that added flood protection benefit. We must introduce this additional factor directly into our analysis of restoration solutions so that the effect of restoration on our ecosystem and our communities can be evaluated. This requires direct integration of our coastal planning. Project-by-project 'business as usual' approaches to water resources planning on the Gulf coast will not seek out these potential synergies.

Ecosystem Restoration in the face of Subsidence and Sea-Level Rise

Natural processes of sediment compaction and gradual sea-level rise can submerge marsh plants and swamp forests unless soil builds up to compensate and keep the elevation high enough for plants and trees to survive. Processes contributing to soil building include sediment deposition from rivers or by tides and storms, and the accumulation of organic material in the soil. Healthy plant growth and active sediment deposition are thus essential to the coastal ecosystem.

Louisiana's coastal wetlands have been subjected to high rates of relative sea-level rise for centuries due to subsidence associated with the compaction and dewatering of deltaic sediments. Some Louisiana marshes have adjusted, and still survive in areas where measured rates of relative sea-level rise from tide gauges are over 0.4 inches per year; but others are experiencing stress which may in part be driven by the relative sea-level rise. Some studies predict that in salt marshes with high sediment loading (such as the Pascagoula River, the Pearl River, and parts of Galveston Bay) marshes should be able to build to keep pace with relative sea-level rise of at most 0.5 in/yr. Global sea level factors are projected to result in a sea-level rise of approximately 8 inches by the year 2050. If high rates of subsidence continue this suggests that many Louisiana marshes may deteriorate markedly under future sea-level rise conditions as rates increase beyond their maximum ability to build substrate. However many of the studies of marsh response consider tidal flooding to be the primary determinant of sediment deposition. In Louisiana it is well documented that high water events associated with frontal passages, tropical storms and hurricanes, including Katrina and Rita,

cause the delivery of most of the sediment that is currently deposited in coastal marshes and it is thus possible they can cope with even higher rates of subsidence and sea-level rise than existing modeling studies predict.

Recent studies have documented high rates of subsidence at benchmarks located along highways across the north central Gulf. Whether these rates of subsidence can be applied to the coastal wetlands is yet to be determined. However, we do know that many coastal marshes in Louisiana have survived high rates of subsidence in the late 20th century. Thus, if our coastal restoration efforts in the Gulf are based on natural process approaches that allow sediments to accumulate and marsh peats to accumulate, then our marshes will stand a fighting chance in the face of future sea-level rise.

Future Water Resources Planning

Most coastal communities on the north central Gulf depend directly on their environment. The coastal waters provide them a living directly through seafood harvest or indirectly as our ports and harbors support trade, energy supply, and shipbuilding. However, at times those very waters produce a threat to lives and property that stuns us all with its power.

The current coast is a mosaic of projects and plans – linked only by the waters that move between them and that ebb and flow each day. Hurricanes Katrina and Rita have decided for us that the coast will be different. The forces of the storm make no distinction in their impact as they erode barrier islands, infill coastal waterways, and overtop protective levees. Similarly, our response to the storm and our plans for the future should not distinguish based on prior authorizations, mission areas, or political boundaries.

We must apply our understanding of the coast - the sediment movement, the tidal flow, the migrations of birds and fish, the saltwater and the freshwater, and, yes, also the storms – to see how these processes can support our local communities and the Nation. Flood protection, navigation and ecosystem restoration are not mutually incompatible. But how we manage the landscape and invest our limited resources for one purpose can fundamentally constrain our actions toward another unless our vision for the coast sees all three together.

Thank you Mr. Chairman and members of the Committee. This concludes my testimony.

COMPLETE STATEMENT OF

Lieutenant General Carl A. Strock
CHIEF OF ENGINEERS
U.S. ARMY CORPS OF ENGINEERS

DEPARTMENT OF THE ARMY

BEFORE THE

Subcommittee on Water Resources and Environment
Committee on Transportation and Infrastructure

UNITED STATES HOUSE OF REPRESENTATIVES

October 20, 2005

Introduction

Mr. Chairman and distinguished members of the Subcommittee, I am Lieutenant General Carl A. Strock, Chief of Engineers. I am honored to be testifying before your Subcommittee today, along with the Assistant Secretary of the Army (Civil Works), the Honorable John Paul Woodley, Jr., on ways in which the Corps of Engineers can assist in the water resources planning for a rebuilt New Orleans. My testimony today will provide a brief status of our post-Katrina assessments and describe how the Corps of Engineers can facilitate and leverage the Nation's public and private engineering activities to assist in the planning, design, and reconstruction of New Orleans and vicinity.

Background

We are continuing to execute the Corps FEMA-related missions of debris management, roofing, and un-watering in the impacted area. As of now, all areas are essentially dry. With our contractors, we are working around the clock on the levees and floodwalls to provide an interim level of protection to see the city through this hurricane season, which continues until the end of November, and the rainy season that the city normally experiences in December and January. Our goal is to restore the pre-storm level of protection before the start of the next hurricane season, which begins in June 2006. We

are actively gathering data and information from the recent storms, and we have also begun an after action assessment of the hurricane protection system.

Performance of Hurricane Protection Systems in New Orleans and Surrounding Areas

We are mapping the damage to the hurricane protection systems as part of our after action review process. The Engineering Research and Development Center from Vicksburg, Mississippi has deployed a team to New Orleans to catalogue data observed during the rescue and recovery operations, and to perform surveys of the hurricane protection system. In addition, the Corps is hosting two visiting teams. One is a National Science Foundation (NSF) team from California that is looking for lessons learned to apply to levee systems in their Central Valley area. The second team is a group of volunteers from the American Society of Civil Engineers (ASCE). ASCE routinely visits hurricane-impacted areas to study lessons learned to apply to the development of new criteria for the design of infrastructure. A team from the Louisiana Department of Transportation and Development, which includes Louisiana State University (LSU) has joined the Corps, ASCE and NSF. The four teams are working together in the field and are sharing collected data. This analysis is essential to ensuring that the restoration of flood and hurricane protection for the City of New Orleans is accomplished in the most technically sound, environmentally sustainable and economical manner. We will make all findings available to the public and invite the public and the scientific and engineering community to share any information they may have.

As for the evaluation phase, the Secretary of the Army has requested that the National Academy of Sciences conduct a forensic analysis and independent peer review of the performance of the hurricane protection system. The purpose of the forensic analysis and independent peer review is to provide credible and objective engineering and scientific answers to fundamental questions about the operation and performance of the hurricane protection system. Through such an analysis, we will be able to evaluate the performance of the system during the storm, evaluate its performance in recovering from the flooding, identify any weaknesses, and recommend ways to improve the performance of the hurricane protection system at the authorized level of protection.

Our future role in the disaster area

In his address to the Nation last month, the President made three commitments. The first commitment was to meeting the immediate needs of those who had to flee their homes and leave all their possessions behind. The next two were specific to the restoration of the disaster area. The President's second commitment is to help the citizens of the Gulf Coast overcome this disaster, put their lives back together, and rebuild their communities. The Corps is working to replace hundreds of public buildings in Mississippi, including police and fire stations, city halls, post offices and other governmental buildings. We have already delivered a building to the De Lisle Fire Department. Corps employees are also putting children back in classrooms, again helping to bring towns back to a bit of normalcy, throughout Mississippi. Governor

Barbour, Governor Blanco, Mayor Nagin, and other state and local elected officials will have the primary role in planning for their own futures. For instance, communities will need to move decisively to change zoning laws, building codes and flood plain management plans as necessary to assure the greatest efficacy for the engineering solutions to future storm events. The Corps stands ready to work in close partnership with the states of Louisiana and Mississippi, the city of New Orleans, and other Gulf Coast cities, so they can rebuild in a thoughtful, well-considered way. The Corps is likely to have an active role in the restoration of public infrastructure in the disaster zone. Because of the breadth of its expertise, the Corps has the unique capability to facilitate and leverage the Nation's public and private engineering and technical activities to address national infrastructure problems like the security and restoration of public works infrastructure.

The President's third objective is that communities be rebuilt better and stronger than before the storm. Protecting a city that sits lower than the water around it is not easy, but it can, and has been done. City and Parish officials in New Orleans and surrounding parishes and State officials in Louisiana will have a significant and active role in planning how this region is rebuilt. The President has directed the Corps of Engineers to work with them to make the flood and storm damage reduction system better than it was before the storm.

The Corps completed a reconnaissance study in August 2002 that concluded that there is a federal interest in examining a higher level of protection. Development of a better hurricane and flood protection system is an extremely complex issue, and more analysis is required to evaluate the range of options and determine the best way to reduce the risk of future flood and storm damages. We will work with local officials, and all interested persons to advance these investigations as expeditiously and cost-effectively as possible. In collaboration with FEMA officials, actions are being taken to ensure appropriate levels of protection from flooding are implemented.

In a feasibility study for a higher level of protection than currently authorized, a full suite of alternatives would be developed and analyzed for economic and environmental benefits and impacts, and mitigation plans developed where necessary. Any potential solutions would be fully coordinated with elected officials and other decision makers, stakeholders, and the public, and fully integrated with other water resources decisions. The current estimate for such a feasibility study is $12 million, which would be shared 50/50 with non-Federal interests. It is expected that such a study could be completed in 2-3 years, under an expedited timeframe and subject to the negotiation of a cost sharing agreement and availability of Federal and non-Federal funding.

As we set about the process of evaluating potential changes to the flood and storm damage reduction system in the New Orleans area, we must not lose sight of the important role that the Louisiana coastal area and the coastal wetlands play. Many of the features of the proposed Louisiana Coastal Area Ecosystem Restoration Project would provide a benefit by preventing on-going wetlands loss through subsidence, creating new marsh and nourishing existing marsh. While there is adequate justification

for coastal wetlands restoration for a host of reasons, it is also certain that these features would also provide an important component of the storm damage reduction system by helping to maintain the integrity of the landscape surrounding that system. According to the United States Geological Survey, one mile of wetland reduces storm surge by one foot. It is crucial that the storm damage reduction system include components that complement coastal restoration and management features.

This concludes my statement. Again, I appreciate the opportunity to testify today. I would be pleased to answer any questions you may have.

Testimony Before the

U.S. House of Representatives

Subcommittee on Water Resources and Environment

on

"Expert Views on Hurricane and Flood Protection and Water Resources Planning for a Rebuilt Gulf Coast"

by

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October 20, 2005

Testimony Before the U.S. House of Representatives
Subcommittee on Water Resources and Environment
October 20, 2005

Introduction and Overview

Much of the beautiful Mississippi Gulf Coast and it's highly productive coastal marshes and estuaries was recently devastated by Hurricane Katrina. The entire coastline found itself in the most damaging northeastern quadrant of this category 4 (at landfall) hurricane for some twelve hours. While the property damages caused by this catastrophic event are evident to anyone who has visited the area since the storm and seen first-hand the swathe of total destruction along U.S. Highway 90 and inland for several blocks, the affects on sensitive coastal ecosystems and the renewable natural resources that depend upon them are less evident to the casual observer.

Unquestionably, the destruction to man-made coastal resources – harbors, marinas, piers, jetties, beaches and the like as well as the destruction of homes and businesses – could have been partially avoided or at least minimized if hurricane protection structures had been in place. Wider beaches, larger barrier islands, a more extensive dune system, and more expansive coastal marshlands are some examples of hurricane protection that would simultaneously also serve to improve and enhance coastal ecosystems, essential fish and shellfish habitats, and available habitat for shorebirds, mammals, reptiles, amphibians, and other estuarine-dependent aquatic species.

The Mississippi Sound and the adjoining waters of the open Gulf of Mexico lie in an area long known by fisheries biologists as the Fertile Fisheries Crescent. Home to a wide variety of estuarine-dependent species including spotted sea trout (*Cynoscion nebulosis*), red drum (*Sciaenops ocellatus*), blue crab (*Callinectes sapidus*), Eastern oysters (*Crassostrea virginica*) and Penaeid shrimp of various species, this area also supports some of the nation's most productive recreational and commercial fisheries. The total economic impact of the Mississippi commercial seafood industry for 2003 was over $900 million and employed nearly 17,000 people. Mississippi's recreational fishermen took over one million trips in 2004 and had an economic impact of $170 million.

The prolific fisheries productivity that the waters of the Fertile Fisheries Crescent enjoy is dependent on the coastal marshes and freshwater inflows that provide habitat and suitable salinities for the larvae and juveniles of many of these species. In the westernmost reaches of Mississippi Sound near the Louisiana state line, the Pearl River and the Bay of St. Louis which receives flows from the Wolf and Jourdan Rivers provide the necessary freshwater to ensure the vitality of Mississippi's most productive oyster reefs near the mouth of the bay. This oyster complex includes Square Handkerchief reef, St. Joseph's Point Reef, Buoy Reef, Waveland Reef, Pass Christian Tonging Reef and Pass Marianne and Telegraph Reefs. These reef complexes comprise approximately 10,000 acres. Less extensive oyster reefs are also present in waters south of Jackson County, encompassing some 1,500 acres. Based on preliminary resource surveys, all of these productive areas suffered extensive damage as a result of

silting, sediment deposition, and scouring from the waves generated by Hurricane Katrina. The original reef structure is, no doubt, intact beneath these sediments, but revitalization efforts in the form of a combination of cultch deposition and turning over covered oysters is needed to restore these reefs to their former level of productivity. In recent years, these oyster reefs produced an average of some 400,000 sacks of oysters annually with a dockside value to the fishermen of over $7 million. The economic impact of Mississippi's oyster industry in 2003 was $100 million and employed some 2200 people.

The loss of fish and shellfish nursery habitat resulting from Hurricane Katrina and the loss of fisheries infrastructure, boat dockage, public access, seafood processing capacity, etc. will adversely impact the area's economy. Sewerage and other infrastructure damages have resulted in direct inflow of untreated sewage into coastal habitats. Stormwater drainage systems are damaged and significantly infiltrated with untreated sewage. These destroyed systems must be repaired and expanded to allow our nursery habitats and their dependent resources to fully recover and flourish. If the area's economy is to rebound in the near term, dramatic and immediate action is in necessary. Some 60% of the state's shrimp fleet was either destroyed or heavily damaged by Katrina, and a significant portion of the seafood processing sector met with a similar fate. With assistance, Mississippi's fishing and processing capability will successfully rebuild in the short term to meet the needs of the industry.

Mississippi's offshore barrier islands include Petit Bois, Horn, Ship, and Cat Islands – the islands comprising the Gulf Islands National Seashore. This island chain, located some 12 miles south of coastal Mississippi, provide a natural first line of defense against hurricanes and other tropical storm systems. Such is the nature of a barrier island system. Unfortunately these natural barriers have suffered from a series of onslaughts – first by Hurricane Camille in 1969 which created a major breach in Ship Island, then by Hurricane Georges, which breached Horn Island, and several years later Hurricane Ivan which caused further damages, and, most recently, Hurricane Katrina. Katrina alone destroyed over 2000 acres on these four islands. Deer Island, Mississippi sole inshore barrier island, lost nearly 25% of its total 430 acres and some 70% of its vegetative cover to Hurricane Katrina. As important as the acres actually lost, the elevation of the remaining island footprints has been reduced to near sea level through almost complete destruction of all island dunes and at least 50% of all island vegetation. These damaged barrier islands, along with Deer Island located immediately south of the City of Biloxi, are in danger of further catastrophic erosion without extensive and immediate mitigation and beach, dune, vegetation (trees and undergrowth), and marsh restoration. Coastal vegetated marshes and submerged aquatic vegetation (seagrass beds) also serve the Mississippi Gulf Coast by providing critical essential fisheries habitat and also buffer the effects of coastal storm surges. The overall footprint of vegetated mainland coastal marshes remains similar to that before Katrina, but the elevation of these marshes and particularly the upland areas immediately to their north has been reduced significantly, making them, and the landward areas which they protect, extremely vulnerable to future hurricanes. Seagrass beds, or submerged aquatic vegetation (SAV), which in 1999 covered almost 3000 acres of Mississippi waterbottoms, now occupy less than 300 acres, a 90% loss of these critical fish and shellfish habitats due directly to Hurricane Katrina.

Offshore, Mississippi's artificial reef program was extensively damaged by Hurricane Katrina. These reef areas, created through a partnership between MS DMR and Gulf

Fishing Banks and funded by the Mississippi Legislature, local governments, and the private sector, created artificial fishery habitat by placing derelict vessels, concrete rubble, and other structures at specific locations in federal waters offshore from Mississippi. These areas provide habitat for numerous recreationsl and commercial fishes, including red snapper, red drum, grouper, amberjack, jack crevale, sharks, and other species important to the economic robustness of our charter boat and recreational fishing industries. The economic impact of Mississippi's artificial reef program is $80 million annually.

The sea grass beds along the leeward shores of the islands have slowly deteriorated over the years, but the adverse cumulative effects of successive hurricanes have hastened their demise. Many of the coast's estuarine dependent species utilize these essential sea grass habitats as prime nursery grounds for the development of larvae and juveniles. The spotted sea trout, the most popular species among the state's saltwater recreational fishermen, is among them. If these grass beds are not restored, sea trout populations and the economically valuable recreational and charter fisheries that depend upon them will be adversely affected.

Mississippi's spotted sea trout hatchery, a joint venture of the MS Department of Marine Resources and USM's Gulf Coast Research Laboratory, was completely destroyed by Hurricane Katrina and must be rebuilt if we are to continue our efforts to restore and supplement this critical recreational fishing resource.

Cultural and historical coastal resources that were damaged or destroyed by Hurricane Katrina include the Seafood Industry Museum in Biloxi, Beauvoir - Jefferson Davis' historic home and once the capitol of the Confederacy, the historic Ship Island Lighthouse, which only recently had been reconstructed, the Old Brick House, the oldest structure on the Mississippi Gulf Coast, and the J.L. Scott Marine Education Center, to name but a few. That Hurricane Katrina destroyed the heart and soul of the Coast would be a gross exaggeration. That she erased many cherished monuments to its historical charm and beauty, however, is clear. While the Mississippi Gulf Coast attracts many visitors with its dockside gaming, others come to the area for its traditional charm, southern hospitality, its rich cultural heritage seafood, and recreational and charter fishing opportunities. The value of the historic and cultural resources to the multi-million dollar tourism industry of the Coast is incalculable and must be restored.

Congress in 2004 authorized establishment of the Coastal Mississippi National Heritage Program within the U.S. Department of Interior and in 2005 appropriated some $250,000 to initiate this program. Additional appropriations to this program would significantly expedite the restoration of historical and cultural resources.

An emerging ecotourism industry focused on birding and related natural resource activities also suffered damages as a result of hurricane impacts to shorebird habitat and public access facilities. Restoration of birding nature trails and habitat areas is key to maintaining the vitality of this developing industry.

Proposed Action

Our plan presents a two-phase approach. Phase 1 focuses on restoring Mississippi's natural storm defenses, flood control capacities, and coastal habitat functions to pre-Hurricane Katrina levels. Phase 2 addresses restoration and enhancement efforts to return these capabilities and functions to pre-Hurricane Camille levels. Both phases will also investigate some additional non-natural defenses such as breakwaters, seawalls, and other mechanical storm surge diffusion approaches. The time frame for this plan is 15-20 years. We anticipate completing Phase 1 activities in the short-term, 1-5 or so years, with Phase 2 efforts beginning in near term and extending out some 20 years.

The magnitude of work required to restore storm protection and flood control capacities, coastal environments, and critical habitats to their former state can only be accomplished through the synergism of a multi-agency (Federal and State), private sector initiative. Our plan proposes that federal assistance be provided to the state of Mississippi through a variety of mechanisms involving multiple federal agencies, including but not limited to the U.S. Army Corps of Engineers (USACOE), the U.S. Environmental Protection Agency (USEPA), the National Oceanographic and Atmospheric Administration National Marine Fisheries Service (NOAA-NMFS), the U.S. Department of Interior (USDOI), the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) and others that may be appropriate.

Much of the anticipated restoration efforts will likely be possible through specific funding to the USACOE, Mobile District. The Mississippi Department of Marine Resources has a long-standing working relationship with the U.S. Army Corps of Engineers in the areas of wetlands permitting and associated marsh, beach, and other habitat restoration efforts. For example, the MS DMR has been partnering with the Mobile District of the USACOE for nearly three years to implement a Beneficial Use of Dredged Materials Programs at DMR. This program, designed to use dredged materials produced from Corps and other (county, casinos, private citizens) maintenance dredging efforts to restore coastal marshes rather than dispose of them offshore or in landfills, has recently enabled the DMR and the Corps to cooperatively restore a 55-acre marsh area on the northeast tip of Deer Island, the first step in our planned restoration of Deer Island to its 1900 footprint. While Katrina did damage the newly restored marsh, some 70% of the area survived, giving credence to our belief that restoration done right will indeed survive further attacks by hurricanes and add significantly to the storm protection afforded by these areas to Mississippi's populated mainland. There are two additional smaller coastal marsh habitats in Jackson County and one in Hancock County that have been restored by the Corps using dredge materials, and all three of these areas survived Katrina unscathed.

We anticipate that multiple regulatory, environmental, and local political entities will be involved in providing guidance and prioritization to these storm protection, flood control, and habitat restoration efforts. In addition to the federal agencies already mentioned, it is important that county Board of Supervisors, city mayors, seafood industry representatives, the recreational and commercial fishing industry, the tourism industry, the MS Department of Environmental Quality, the Gulf States Marine Fisheries Commission, and environmental groups such as the Nature Conservancy and others be included to provide critical guidance to the process of identifying and prioritizing specific approaches and projects that will ultimately lead to the rebuilding of a Coastal

Mississippi that will provide a fertile climate for economic development and environmental stewardship and at the same time guarantee improved protection from future storm and hurricane challenges.

We anticipate that through cooperative efforts by the aforementioned groups, we will identify actions needs to meet the restoration needs of Coastal Mississippi with respect to storm protection, flood management, and habitat restoration. Specific required actions include:

1. **Studies and projects directed at evaluating and mitigating for losses of essential fish habitat, marsh and sea grass areas, oyster reefs, and other critical wetlands habitat.**

Actions would focus on restoration and enhancement of riverine floodplains and near-shore resources. Specific activities would include desnagging and streambed reconfiguring of some tributaries to our major river systems to reduce flood potential, restoration of marsh habitats and beaches, re-establishment of our spotted sea trout hatchery, and restoration of offshore environments, including Mississippi's artificial reefs. Specific restoration efforts would include:

a. Pearl River and Tributaries from Jackson to Mississippi Sound
b. Pascagoula Drainage Basin to Mississippi Sound
c. Other Mississippi Rivers and Coastal Watersheds to the Sound (St. Louis Bay and tributaries, Biloxi Bay and tributaries, others)
d. Mississippi Coastal Area Restoration Initiative (restoration of mainland coastal marshes and beaches). An estimated 1050 acres of coastal marshes (and an additional 840 acres of coastal forests) have been severely damaged or destroyed by Hurricane Katrina. These acres must be restored to provide necessary protection from future storms as well as provide critical habitat for fish, shrimp, and shellfish resources critical for the economic recovery of Coastal Mississippi.
e. MS/LA Coastal Studies (water and silt diversions, reduction in saltwater intrusions, fisheries infrastructure restoration, and related projects). These activities will be driven by the needs of Coastal Mississippi and to the extent possible be conducted in concert with Louisiana activities to divert Mississippi River water and sediment critical to the needs of oyster, shrimp, and finfish resources of Coastal Mississippi.
   Historical side-scan sonar and conventional benthic surveys document the pre-hurricane Katrina status of the state's oyster reef resources, and Coastal Preserves aerial surveys of the coast's marshlands provide a similar measure for the wetlands. Identifying specific areas where losses occurred and where restoration should be focused is needed in all three coastal counties.

2. General Investment in Hurricane Protection and General Coastal Ecosystem Restoration:

Hurricane Protection, Flood Control and Infrastructure Restoration efforts are acutely needed in all six coastal Mississippi counties. This program is designed to completely restore all Mississippi barrier islands to their pre-Hurricane Camille footprint and protective level (Phase 2). Hurricane protection would include restoration of coastal marshes and habitats, critical surge reduction safeguards

during hurricanes and tropical storms, to pre-Hurricane Camille status. Mississippi has four barrier islands, Cat, Ship, Horn, and Petit Bois, under the control of the Gulf Island National Seashore, and restoration of these islands would be in concert with the USDOI Gulf Islands National Seashore. A fifth barrier island, Deer Island, is owned by State of Mississippi. DMR has a program in place to restore Deer Island to its 1900 footprint, essentially doubling the present size. Infrastructure restoration would include rebuilding of access and service facilities such as marinas and fuel docks. This program will be implemented in two phases, Phase 1 to restore hurricane protection levels, flood control capacities, and infrastructure capacities to pre-Hurricane Katrina levels and Phase 2 to provide restoration to pre-Hurricane Camille levels.
To minimize future risks, we will identify those areas along the Mississippi Gulf Coast that are most susceptible to hurricane damages and design and implement structural solutions for these specific areas. Construction of coastal marshes, offshore and near shore breakwaters, jetties, and other surge-diffusing structures where appropriate and replenishment of near shore and barrier island beaches would all constitute potential solutions to these problems on a case-by-case basis. The ability of coastal marshes and wetlands to buffer the effects of hurricanes is well-documented, and full advantage should be taken to develop these buffering systems and make them more robust and expansive wherever possible. We need to simultaneously restore public access facilities to provide services to the commercial and recreational fishery and to allow the citizenry access to coastal waters.

2. Wetlands Ecosystem Restoration:

a. Coastal Marsh and Other Emergent Wetlands Restoration
b. Seagrass and Barrier Island Ecosystem Restoration
c. Oyster Reef Ecosystem Restoration
d. Restoration of Historical and Cultural Resources

Among the cultural resources lost as a result of Hurricane Katrina were the recently restored Ship Island Lighthouse, the Round Island Lighthouse near the mouth of the Pascagoula River which was undergoing restoration work, Beauvoir, the historic home of Jefferson Davis, the Old Red Brick House, and the Church of the Redeemer and Tullis-Toledano Manor in Biloxi as well as Grass Lawn in Gulfport. The Seafood Industry Museum and the J.L. Scott Marine Education Center in Biloxi were also destroyed. In fact, among the structures of historical and cultural significance along the Coast, the Biloxi Lighthouse is one of the few that remained undamaged by Hurricane Katrina.

The aforementioned broad categories of projects can be best served by various funding sources including emergency appropriations to the existing partnerships between the MS Dept. of Marine Resources and the U.S. Army Corps of Engineers, NOAA's National Marine Fisheries Service, USDA's NRCS, the private sector, and others.

The Mississippi Gulf Coast is faced with recovering from the greatest natural disaster in this nation's history. Such a daunting challenge also presents unprecedented opportunities. It is in the best interest of the region, and indeed the nation, that this recovery be expedited. In its present state with weakened

natural buffers, the Coast is at risk of even greater damages from future hurricanes, and more will inevitably be on their way. It is incumbent upon us as wise stewards of our coastal resources to strive towards minimizing these risks by bolstering Coastal Mississippi's natural buffers – our barrier islands and coastal marsh ecosystems.

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

COMPLETE STATEMENT
OF

HONORABLE JOHN PAUL WOODLEY, JR
ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)

BEFORE THE

Subcommittee on Water Resources and Environment
Committee on Transportation and Infrastructure
UNITED STATES HOUSE OF REPRESENTATIVES

OCTOBER 20, 2005

MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE:

Introduction

I am John Paul Woodley, Jr., Assistant Secretary of the Army for Civil Works. I am pleased to appear today with Lieutenant General Carl Strock, Chief of Engineers, to discuss the role of the Department of the Army and the U.S. Army Corps of Engineers in reconstruction efforts that lie ahead for the Gulf Coast.

The Corps' Future Role in the Disaster Area

The Administration stands ready to work with local and state officials as they plan for the rebuilding of New Orleans, parishes in Southern Louisiana, Mississippi and other parts of the Gulf Coast. As we know, New Orleans has a particular challenge because much of the city lies below sea level. Protecting the City has never been easy. Thorough analysis, much thoughtful consideration of alternatives and careful attention as to how best integrate future protection objectives with one another and with the coastal wetlands ecosystem will guide future consideration and decision making, to be sure. The President has pledged the support of the Corps of Engineers to work with the State, City, and Parish officials to make the flood protection system stronger and these local officials will have a large part in the engineering decisions to come because they will be the project sponsors and partners.

Need to Reconstruct Storm Damaged Hurricane and Flood Protection Features

However, our first and most urgent need is to assess the performance of the hurricane protection projects in place at the time of the Katrina and Rita storm

events. We will use these findings to ensure that restoration plans for existing hurricane protection features are technically sound, will have efficacy and can be accomplished in a way that is environmentally acceptable. Information developed by forensic information and from performance assessments must be available in time to be integrated into the design, engineering and reconstruction of existing hurricane and flood protection feature for New Orleans that is to be completed before the beginning of next year's hurricane season.

Indeed, the Corps is already hard at work in this regard, having established an Interagency Performance Evaluation Task Force (IPET) to collect and assess information that can inform decisions to reconstruct existing authorized structures. Also, an independent team from the American Society of Civil Engineers (ASCE) is already collecting information to apply to the development of design criteria for these features. Other organizations and individuals are doing important work in this regard, as well. To the extent practicable, all relevant data will be carefully considered and objectively assessed as the Corps makes the immediate decisions necessary for reconstructing the features damaged by the storm events. Working with other Federal partners, such as FEMA, we will evaluate all information to ensure the appropriate level of flood protection and rebuilding activities.

In addition, the Secretary of Defense has directed the Secretary of the Army to convene a panel of experts under the auspicies of the National Academies of Science (NAS) to evaluate the information collected and developed by the IPET and other parties so as to provide an independent and peer reviewed assessment of the performance of the hurricane protection systems in New Orleans and the surrounding areas.

The NAS will assemble an independent multidisciplinary panel of acknowledged national and international experts from the public and private sectors and academia. This National Academies panel is to be drawn from the membership of the National Academy of Sciences and the National Academy of Engineering. This panel will issue a final set of findings based primarily on the forensic data gathered by the Interagency Performance Evaluation Task Force and the American Society of Civil Engineers Independent Review Panel, and will draw upon information and assessments provided by other sources.

The National Academies will report directly to me. The NAS study is expected to take approximately eight months to complete. All reports generated by these panels will be made available to Congress and to the public, of course.

While the forensic analysis may recommend ways to improve the performance of the hurricane protection system at the currently authorized level of protection, more analysis and a broader range of considerations are required to determine how to best increase levels of protection for the City of New Orleans and surrounding parishes.

The Corps of Engineers, in collaboration with FEMA, will be an integral member of the close federal partnership with the states of Louisiana and Mississippi, the city of New Orleans, and other Gulf Coast cities, parishes and counties. The Corps stands ready to provide advice to assist their rebuilding in a way that provides full consideration of all relevant factors. The President has pledged that Federal funds will cover a large measure of the costs of repairing public infrastructure in the disaster zones, from roads and bridges to schools and water systems. If called upon, Corps of Engineers stands ready to execute a broad array of engineering, construction and contract management services.

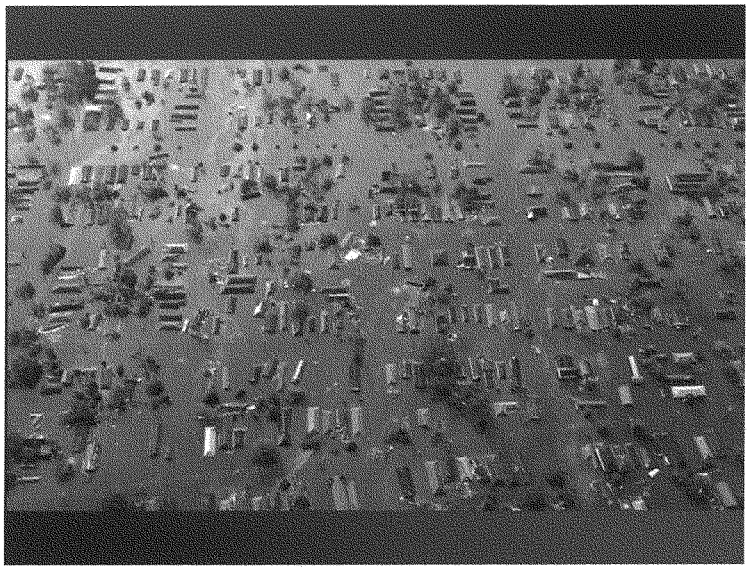
The coastal wetlands ecosystem can provide a buffer against the impacts of some storms. The coastal wetlands are the literal, figurative and conceptual foundation upon which future potential hurricane, flood protection and other development infrastructure must be integrated. The Administration is working with Congress and the State of Louisiana to develop an appropriate, generic authorization for the Louisiana Coastal Area Ecosystem Protection and Restoration Program that will expedite the approval process for projects and their implementation while providing greater flexibility in setting future priorities and increased opportunities for application of adaptive management decision making. Such an integrated, programmatic approach to coastal wetlands protection and restoration is essential for efficiency and efficacy. This same approach should be considered in a process that allows for a holistic solution to the challenges presented in New Orleans and coastal Louisiana.

Conclusion

Mr. Chairman, this concludes my statement. I look forward to working with you and the Ranking member and other Subcommittee members on matters of mutual interest and concern. Following Lieutenant General Strock's statement, I would be pleased to answer any questions you or the other Subcommittee members may have.

Katrina Images and Graphics

Picture1: Breached levee.



Picture 2. New Orleans.

Picture 3: St. Bernard Parish

Picture 4: Mississippi Coast

Figure 1. New Orleans area levees before Katrina.

LAST LINE OF DEFENSE: HOPING THE LEVEES HOLD

Army Corps of Engineers officials say hurricane levees in the New Orleans area will protect residents from a Category 3 hurricane moving rapidly over the area. But computer models indicate even weaker storms could find chinks in that armor.

BARRIERS OF EARTH AND CONCRETE

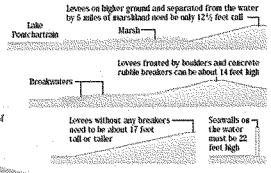
Levees and floodwalls that protect against flooding from both the Mississippi River and hurricanes are built by the Army Corps of Engineers and are maintained by local levee districts. The corps and the local districts share the construction cost of hurricane levees, while the Mississippi River levees are a federal project. Local levee districts also build and maintain nonfederal, lower-elevation levees with construction money from each district's share of property taxes and state financing.

LEVEES AND FLOODWALLS
Mississippi River
Hurricane protection
Interior parish

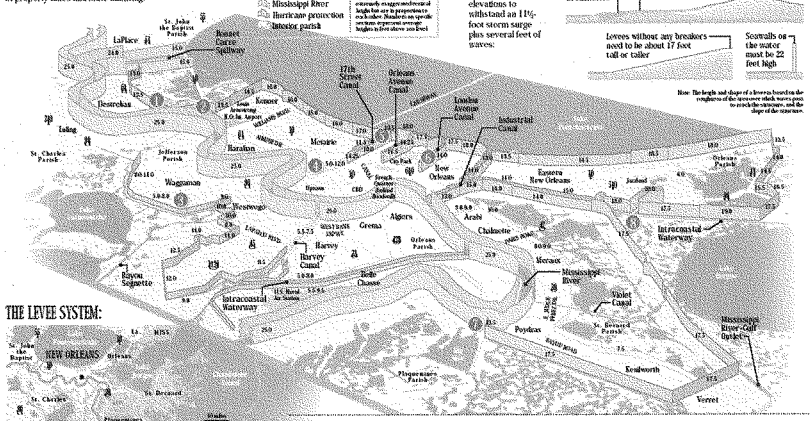
Bars: levee and floodwall elevations are shown with its height above sea level. Numbers in parentheses represent average heights in feet above sea level.

HEIGHT ISN'T EVERYTHING

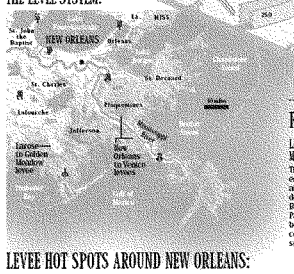
Different factors permit Lake Pontchartrain levees of varying elevations to withstand an 11½-foot storm surge plus several feet of waves:



Note: The height and slope of a levee is based on the roughness of the waves over which waves pass to reach the rainscape, and the slope of the rainscape.



THE LEVEE SYSTEM:

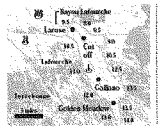


FARTHER SOUTH

Residents and businesses in developed areas along bayous and the Mississippi River have successfully argued that the benefits of building levees around their communities outweigh the costs of construction.

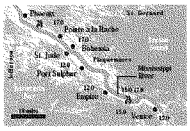
LAROSE TO GOLDEN MEADOW LEVEE

This 40-mile-long levee encircles residential and commercial developments along Bayou Lafourche. Parts of the levee are being raised to counteract subsidence.



NEW ORLEANS TO VENICE LEVEES

There are 37 miles of levees in this project on both sides of the Mississippi River between Phoenix and St. Jude to the north and Boheme and Venice at the southern end of the river. Different pieces of the levee are 60 percent to 99 percent complete.



LEVEE HOT SPOTS AROUND NEW ORLEANS:

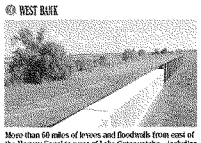
① ST. CHARLES PARISH

Construction of a new drainage structure west of Louis Armstrong International Airport is part of an incomplete 10-mile levee from the Bonnet Carré Spillway to the parish line, five miles inland from Lake Pontchartrain. Computer models indicate storm surge from smaller hurricanes would flood populated areas toward the river through gaps.

② ST. CHARLES-JEFFERSON PARISH LINE

This 5-foot to 10-foot wall of sandbags and sheet piling runs south of Airline Drive to the Mississippi River levee near the airport. Surge water from the lake could pool along the river levee and pour over this barrier into Jefferson Parish and New Orleans, according to computer models.

③ WEST BANK



More than 60 miles of levees and floodwalls from east of the Harvey Canal to west of Lake Cataouatche – including this stretch of completed floodwall and yet-to-be-raised levee along Bayou Segnette State Park – are years from completion. Small hurricanes can push water from Timbalier and Barataria bays into West Bank neighborhoods.

④ JEFFERSON-ORLEANS PARISH LINE

Chesterfield Street passes through a low levee from Monticello Avenue in Jefferson Parish into New Orleans near the city's water plant. Computer models indicate this is the likely spot for floodwater to enter the city from St. Charles and Jefferson parishes during hurricanes.

⑤ JEFFERSON-ORLEANS PARISH LINE

The Hammond Highway bridge over the 17th Street Canal is being replaced with a new, hurricane-resistant structure. Huge sandbags are kept nearby to plug this hole in the hurricane protection for Jefferson and Orleans parishes.

⑥ NEW ORLEANS

The Filmore Avenue bridge over the London Avenue Canal is being replaced with a new span with floodwalls. Until its completion, only sandbags will stop hurricane surge from pouring into city neighborhoods.

⑦ ST. BERNARD-PLAQUEMINES PARISH LINE

A computer model indicates storm surge could overtop a V-shaped area where levees meet at the parish line near the Caernarvon Freshwater Diversion Project along the east bank of the Mississippi River.

⑧ EASTERN NEW ORLEANS AND ST. BERNARD PARISH

Computer models indicate surge from Lake Borgne might rise in the Mississippi River-Gulf Outlet and overtop New Orleans levees near the Paris Road bridge and a section of levee in St. Bernard during a hurricane.

Sources: Army Corps of Engineers, New Orleans District; Orleans Levee District; East Jefferson Levee District; West Jefferson Levee District; Lake Borgne Basin Levee District; Plaquemines Parish Levee District
Research: Bonnett Mayer III and Mark Schleifstein

Staff graphic by Bonnett Mayer III/nmayer@timespicayune.com
STAFF PHOTOS BY ELIS LUCIA, ALEX BRANDON AND DEVAUGHN MARADEWA

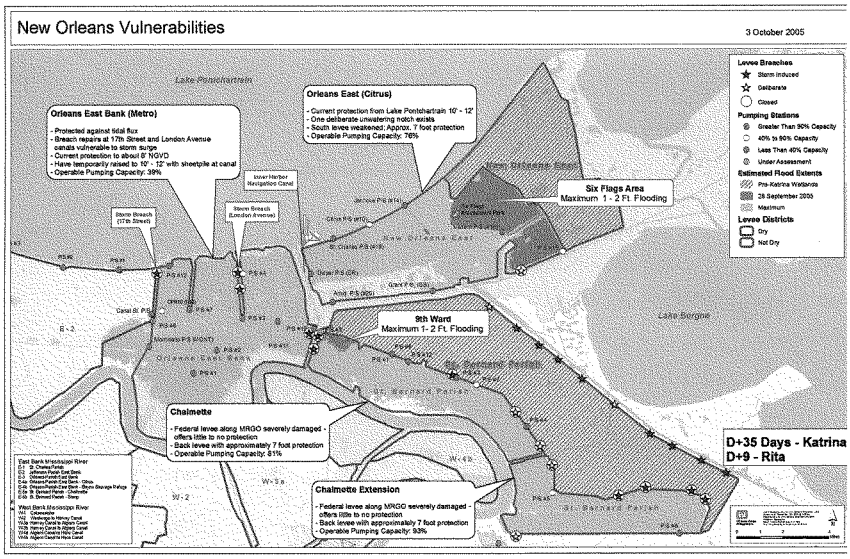


Figure 2. Levee breaches, New Orleans, St. Bernard Parish.

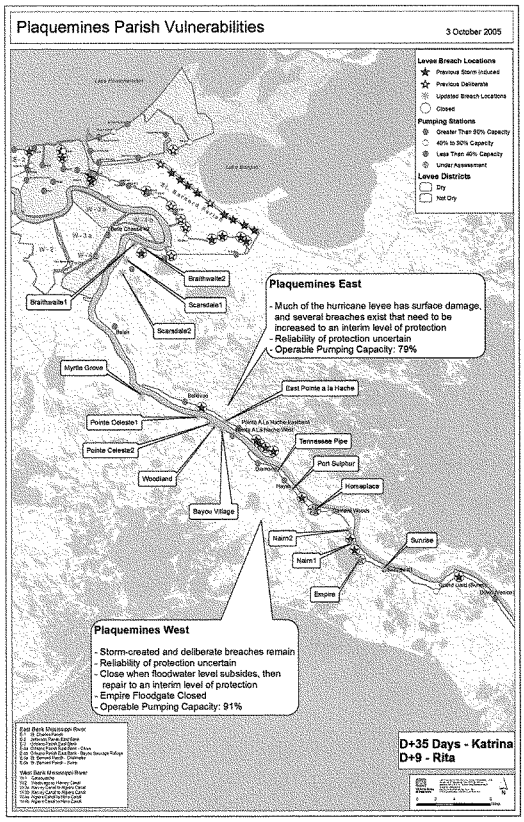


Figure 3. Levee breaches, Plaquemines Parish.

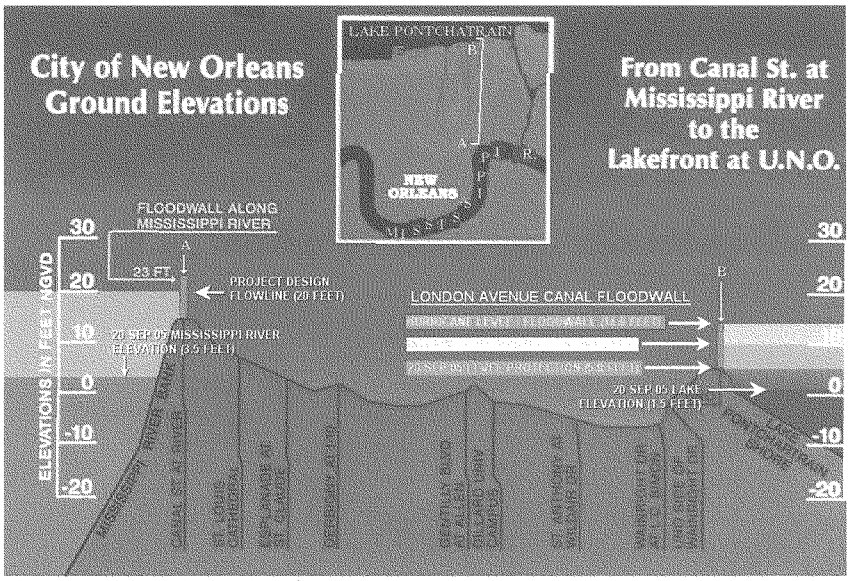


Figure 4. New Orleans elevations.

Written Testimony of Mark Rounsavall
Director, Rural Community Assistance Program of the
Community Resource Group Inc.

Submitted to the Subcommittee on Water Resources and the Environment
House Transportation and Infrastructure Committee

Hearing on

Expert Views On Hurricane And Flood Protection And Water Resources Planning For A Rebuilt Gulf Coast (October 20, 2005)

October 20, 2005

Chairman Duncan, Ranking Member Johnson, thank you for the opportunity to submit a statement for the record on issues surrounding the rebuilding of the Gulf Coast and water resources planning in the wake of the devastation from Hurricane Katrina. My name is Mark Rounsavall and I am the Director of the Southern Rural Community Assistance Program (RCAP) operated by the Community Resource Group, Inc. (CRG), a private non-profit organization with headquarters in Fayetteville, Arkansas. CRG operates in seven southern and southwestern states, including Tennessee, Arkansas, Alabama, Louisiana, Mississippi, Oklahoma and Texas. Since Hurricane Katrina struck, CRG has been working non-stop to assist small rural communities with their water and wastewater needs, which are of a scale that is hard to describe.

I am pleased to submit testimony in support of your goal to ensure that efforts to rebuild the Gulf Coast are technically feasible, environmentally sound, and economically justified. The focus of my testimony is designed to provide the committee with insight on how rebuilding efforts and water resources planning on the Gulf Coast should address the needs of devastated small rural communities in the region in both the short- and long-term.

It was clear before the hurricane struck that small communities serving fewer than 10,000 people in the Gulf region had critical water and wastewater issues that needed to be addressed. We now have an opportunity to address these needs through rebuilding and water resources planning and RCAP is ready to help.

The RCAP mission is to help rural Americans improve their quality of life through ensuring the availability of safe and clean water. Since its founding in 1969, RCAP has worked with federal and state agencies to help people living in small communities address their drinking water and wastewater treatment problems. The RCAP network includes field staff in all states and Puerto Rico, six regional offices with multi-state service areas, and a national office located in Washington, D.C.

Communities in greatest need of assistance in meeting their wastewater infrastructure needs are typically very small communities with fewer than 3,500 people and found in

very remote rural areas. Several problems confront them, including being geographically remote from easy access to equipment, lack of staff capacity to deal with regulatory compliance issues, and lack of financial resources to install and operate systems. The RCAP program works in every State to provide technical assistance to small, rural communities to help them meet their wastewater infrastructure needs.

RCAPs help small communities and small wastewater treatment utilities in many ways. RCAP staff provides technical assistance to assess wastewater treatment needs, we help them prioritize these needs, and help develop and implement a plan of action including steps necessary for compliance with the Clean Water Act. RCAP's on-site technical assistance and training focuses on: facilities development, management and finance, operations and maintenance, planning and development, capacity building, education and training, source protection, and funding for small and very small systems.

With funding from a range of public and private sources, RCAPs delivered services to more than 2,000 rural communities last year. Ninety percent of these communities had populations of 2,500 or fewer. Leveraging approximately $25 of additional funding for every $1 dollar received by RCAP, the RCAPs direct public investments to produce lasting results.

Wastewater Needs in Rural Communities Are Great

The aftermath of Hurricane Katrina emphasized the vulnerability of small communities to a disaster. The need for greater federal assistance for wastewater infrastructure in America's small rural communities is indeed great, and a storm such as Katrina only highlights this need. Indeed, over 1,000 water systems were affected by Hurricane Katrina.

Consider these additional statistics:

- Nearly 1 million rural households do not have indoor plumbing;
- More than 70% of our nation's housing units that lack complete plumbing are in small communities; and
- Water systems in communities serving fewer than 10,000 residents are more than twice as likely to violate drinking water standards for microbes and chemicals than systems serving more than 10,000.

The Environmental Protection Agency estimates that $13.8 billion is required to meet the clean water needs of small communities of 10,000 or fewer nationwide. In 1996, the State of Tennessee and the EPA estimated that in Tennessee alone $311 million will be needed through 2016 to just meet the wastewater treatment needs of systems serving 10,000 people or less. For systems serving fewer than 3,500 people, the estimated cost is $220 million.

These numbers are indeed daunting. The numbers become even more daunting when one considers the disproportional burden small communities carry compared to larger systems: households in small communities bear four times the costs of installing and maintaining water and wastewater systems than do households located in larger

communities. Small communities simply do not have the taxpayer base to support the amount of resources that will be required over the next twenty years.

Situation in the Gulf Coast after Hurricane Katrina
The RCAP expertise and capacity have been sorely tested as a result of Hurricane Katrina, which has only exacerbated the issues facing small rural communities in the Gulf Coast Region. However, CRG has risen to the challenge and has assisted over 146 Mississippi communities to restore water and wastewater services. Many of the communities affected by the hurricane had severe problems with their drinking water and wastewater systems before this disaster. Now they are reeling from near total destruction, making them closely resemble a war zone.

Water resources planning for a rebuilt Gulf Coast must recognize that there is a need to get greater assistance into rural areas and ensure that there is assistance to commit to these communities over the long-term. The assistance should be of both an immediate nature and a long-term commitment to rebuilding. The goal in the short term is to repair existing water and wastewater systems. The longer term goal is to finance the upgrade of water and wastewater systems with proper ongoing management but also planning for potential disasters such as Hurricane Katrina.

Following is a brief summary of the ongoing efforts of CRG staff in Mississippi, which highlights the types of problems small communities across the Gulf Coast Region are facing as a result of Hurricane Katrina.

Since the onset of the storm CRG has completed 195 Site Visits at 146 Community Water Systems in Mississippi. These visits do not include daily site visits to coordinate mutual aid assistance to hard hit utilities on the Mississippi Gulf Coast.

Of these 195 site visits, CRG completed:

- 18 Preliminary Damage Assessments
- 3 FEMA Emergency Group Site Surveys
- 86 Public Water System (PWS) Status Assessments
- 9 PWS assisted with Sampling (minimum 2 per PWS)
- 78 Bacteriological Sample Pickups
- 1 Well Disinfected

CRG dispatched a crew of five of its water and wastewater personnel from the RCAP program to the Mississippi Gulf coast on September 23-24 at the request of the U.S. Public Health Service, which has been working along the coast since early September on water and wastewater problems in that area.

CRG's initial assignment from the US Public Health Service was to conduct the following activities:

1. Sampling and/or disinfecting of home wells;

2. Assisting in leak detection and repairs of community water distribution systems; and
3. Lift station repairs (pumps, motors, electrical), etc.

Due to the conditions we found on our arrival our mission changed dramatically. CRG is now trying to provide assistance to some of the largest local water systems – which are more prevalent on the coast – such as Pass Christian (pop. 8,386), Bay St. Louis (pop.8,350), and the City of Long Beach (20,000). CRG staff are also assisting the Mississippi Department of Health to assure that the 45 FEMA-EGS' (Emergency Group Sites, i.e. temporary housing sites) scattered around eight counties are providing safe drinking water and sanitary wastewater disposal to dislocated residents.

All of these systems have significant distribution problems. Leaks are scattered throughout, valves cannot be completely shut down in some places, water pressure cannot be maintained, pumps are not operational, and waste water lift stations are not functioning. Many of the major utilities remain under boil orders.

None of these systems have any help in the form of labor to perform repairs, replace and install new equipment or provide basic maintenance. For example, Bay St. Louis had a public works department labor force of 25 before Katrina but now has four people for all of their public works functions; the rest have evacuated and are not expected to return. CRG staff located and secured work crews from other utilities by enlisting the help of utilities crews from Adams County, Mississippi and other systems in southwest Mississippi. The City of San Antonio water utility responded and arrived on October 6th with a crew of 21 and full equipment. Huntsville, Alabama water utilities also responded and arrived on October 10th with two additional crews to begin work in Pass Christian.

CRG is maintaining a minimum of three RCAP personnel onsite to help coordinate these activities in conjunction with FEMA and MSDH. Some RCAP staff from other regions began rotating into the area to relieve CRG staff on October 13th. The RCAP mission remains to return as many public water and wastewater systems as possible to pre-storm condition, reduce boil orders and make sure that displaced residents are provided with safe drinking water.

Immediate Relief

There is clearly a long-term need for water-sewer financing but there is an immediate need for short-term financing for repair and renovation. The demand for interim financing to make emergency loans is great. Because of the extent of the destruction, many communities applied for "expedited direct federal assistance" through FEMA and this will help them with emergency federal funding, which in some cases will cover 100% of the cost of getting their water and wastewater systems up and running again.

In spite of this kind of assistance, flexible revolving loan funds with the ability to deploy small amounts of capital quickly and efficiently also have a role in systems that have not completely lost their customer base. CRG operates a small system revolving loan fund capitalized at $3,000,000 for water and wastewater system repairs and upgrades but the

current need is much greater than available financial resources. Through this fund CRG has made nearly 200 loans totaling more than $12 million in its seven-state service area and has a track record of deploying capital efficiently where it is needed. Groups such as CRG could use additional funds for the following purposes:

1. Provide emergency loans and grants to rural communities within the hurricane damaged areas in order to restore or preserve public water and wastewater.

2. Provide for the repair and replacement of damaged equipment and water and wastewater system components. CRG would expect to include as part of this activity the purchase and installation of back up generators at all rural water and wastewater facilities in the damage area.

3. Provide for emergency interim financing of water and wastewater facilities and improvements until permanent financing can be arranged. Interim financing could be provided for up to 36 months.

4. Provide financing for the planning, design and installation of water lines and sewer collection lines to areas containing temporary housing for persons and families whose homes have been destroyed.

5. Meet other unmet community water and wastewater needs that may be discovered during onsite inspections by RCAP staff.

S. 1709, the Gulf Coast Emergency Water Infrastructure Emergency Assistance Act, which was sent to the Subcommittee on Water Resources and Environment on September 28 could provide some immediate relief. The bill would provide the three states affected by Katrina with the authority to forgive the principal on clean water loans. It will also waive the requirement that states can only fund drinking water projects that appear on their annual intended use plan to ensure drinking water systems affected by Katrina are immediately eligible for state funds. It also enables EPA to conduct testing of wells at the request of homeowners. Eligible projects include those (1) to repair or rebuild a publicly-owned treatment works in an area affected by Hurricane Katrina or a related condition or (2) that is a water quality project directly related to relief efforts in response to Hurricane Katrina or a related condition, as determined by the state in which the project is located.

Long-Term Planning

In addition to existing needs, water resources planning moving forward should aim to improve existing small rural community water systems. Much of the damage to water and wastewater systems caused by Hurricane Katrina was exacerbated by the fact that many of the systems were already aged and suffering from neglect due to a lack of resources for their upgrade.

HR 2864, the Water Resources Development Act of 2005 offers some help in this direction. Section 2023 of the bill amends Section 22 of the Water Resources

Development Act and authorizes annual appropriations of $5 million, of which $2 million may be used to enter into cooperative agreements with nonprofit organizations to provide assistance to rural and small communities. Types of assistance include the provision and integration of hydrologic, economic, and environmental data and analyses. This type of assistance is crucial to the efficient maintenance and operation of community water systems in communities that typically do not have the resources to shoulder the burden alone. In the Gulf Coast Region, where the Army Corps of Engineers plays such an important role and where its role will be even greater during the rebuilding process, the RCAPs could be an important partner in working with small rural communities by providing the types of hands-on technical assistance that the Corps cannot provide.

In addition, HR 2694 - the Clean Water Infrastructure Financing Act of 2005 – could provide the type of assistance to small rural communities that would enable them to plan for and mitigate the effects of disasters such as Hurricane Katrina by maintaining efficient and well-managed wastewater systems. The bill authorizes $25 million for wastewater and drinking water system upgrades. The bill also amends Section 603(d) of the Clean Water Act, which authorizes the water pollution control revolving loan funds. The amendment authorizes the provision of technical and planning assistance in financial management, user fee analysis, budgeting, capital improvement planning, facility operation and maintenance, repair schedules, and other activities to improve wastewater treatment plant operations. Funding for these activities cannot exceed two percent of all grant awards to such a fund under this title.

New legislation that has not yet been introduced – the Clean Water Trust Act – also offers promise in improving small rural community water systems by providing resources for technical assistance for small communities. This legislation acknowledges that there is a continued need for targeted assistance to small communities aimed at helping small rural systems maintain and upgrade their wastewater systems.

Accordingly, this legislation authorizes grants to qualified nonprofit technical assistance providers to assist small rural wastewater utilities (no more than 10,000 users/located in a rural area) in four ways:

1. Planning, developing, and obtaining financing for eligible projects;
2. Technical assistance and training;
3. Disseminating information with respect to planning, design, construction, and operation of wastewater systems;
4. Capitalizing revolving loan funds for predevelopment costs and related activities.

The legislation would authorize this program at $50 million a year, from a Clean Water Trust Fund.

Conclusion

In spite of the focus on the devastation wreaked by Hurricane Katrina in cities such as New Orleans, many rural communities in the Gulf Coast Region faced almost complete destruction and still lack basic services such as clean drinking water and wastewater

systems. Before Hurricane Katrina hit, it was already clear that small communities serving fewer than 10,000 people in the Gulf region had critical water and wastewater issues that needed to be met.

These communities could not meet their water and wastewater needs alone before the storm and now face a nearly insurmountable obstacle as they attempt to rebuild. In the face of the human tragedy that the Gulf Coast Region has suffered, we must redouble our efforts to provide sufficient resources to small communities to ensure that their water supplies are clean, safe and affordable.

As the committee and Congress wrestle with how to ensure that efforts to rebuild the Gulf Coast are technically feasible, environmentally sound, and economically justified, we hope that CRG and the Rural Community Assistance Programs and other similar technical assistance programs can be a part of the solution. Thank you very much.

Statement for Record of S. Jeffress Williams
United States Geological Survey,
U.S. Department of the Interior
Subcommittee on Water Resources and the Environment
House Transportation and Infrastructure Committee
on
"Expert Views on Hurricane and Flood Protection and Water Resources Planning for a Rebuilt Gulf Coast"

Hearing Held
October 20, 2005

On behalf of the Department of the Interior, I thank you for the opportunity to provide this statement to the Subcommittee on "Expert Views on Hurricane and Flood Protection and Water Resources Planning for a Rebuilt Gulf Coast." I am a coastal-marine geologist, with over 30 years of research experience, including doing research in Louisiana for the past 20 years, for the U.S. Geological Survey (USGS) at the USGS Woods Hole Science Center located in Woods Hole, Massachusetts. My statement reflects results from a collaboration of research and science efforts by many in the USGS, by university scientists, and by our partners over the past 20 years. This statement provides a summary of research investigating the effects of geologic processes such as land subsidence, as well as the effects of human activities as both relate to coastal erosion, wetland loss, sea-level rise and the increased vulnerability of New Orleans infrastructure and ecosystems to natural hazards like hurricanes, flooding and future increased sea-level rise.

Over the past ~7,500 years, complex geologic processes have caused dramatic changes in the geography of the low-lying Mississippi River delta plain. The processes have

produced more than six major shifts in the river channel; a sea-level change ranging from -400 feet at the end of the Ice Age, 20,000 years ago, to -15 feet about 7,500 years ago, when delta plain development started; and significant redistribution of sediments caused by frequent storm impacts that erode the relict deltas. The Louisiana Gulf Coast has been a dynamic environment for thousands of years, during which time the landscape has changed continuously.

We currently have a reasonably well-developed understanding of the geologic history of this region, and the effects that human activity has had on the evolution of the delta plain and the New Orleans landscape over the past 200 years.

Like many other low-elevation population centers, for example Venice, Shanghai, Bangkok, the Nile delta, the Mekong delta, and Bangladesh (Peck and Williams, 1992), the New Orleans region remains extremely vulnerable to natural hazards such as storm-surge flooding, as recently demonstrated by Hurricanes Katrina and Rita. In addition to the well-publicized damage to New Orleans and the other cities of the Gulf Coast, the recent storms have caused a significant loss of wetlands and marshes and massive coastal erosion throughout the entire region. USGS investigations conducted in response to Hurricane Katrina show that major parts of the Chandeleur barrier island beaches and dunes were eroded completely. Some wetland areas east of the river have lost 25 percent of their land area, and storm surge east of New Orleans and along the Mississippi coast was as high as 25 to 30 feet.

As destructive as Hurricane Katrina was, however, post-storm analyses suggest that as a Category 3 storm with a path east of the city, this was not the "big storm" predicted to devastate New Orleans. A strong Category 5 storm moving slowly along a path directly up the Mississippi River and slightly west of New Orleans would produce an even higher storm surge coupled with a significant increase in wind velocities. The predicted storm effects on New Orleans and adjacent urban areas would be far more destructive. Like other delta plain regions around the world, New Orleans continues to be particularly vulnerable to future near-term storm events and likely accelerated sea-level rise will make risks to New Orleans even greater.

Research by the USGS and others has provided a reasonably good understanding of the delta plain framework geology and how active geologic processes, such as subsidence, operate; but there are still significant data gaps which challenge our ability to quantify the various processes and to differentiate natural from human-caused processes. In order to mitigate coastal natural hazards in the future, we must continue to develop predictive models and improve our scientific understanding of all of the geologic processes acting on the Louisiana delta plain and New Orleans region.

When New Orleans was founded by the French and Spanish in the early 1700s, in a cypress swamp area between Lake Pontchartrain and a prominent crescent-shaped oxbow bend in the Mississippi River channel, the population was small, and the city was built on the natural levees of the Mississippi River about 5 to10 feet above sea level. This is the

site of the current French Quarter, Garden District, and Uptown. The rest of the swamp was at or close to sea level. As the city developed into a trading center and river port during the mid-1800s to early 1900s, there was pressure to expand.

This expansion was facilitated by systematic city-wide land reclamation and forced drainage using a network of dredged canals and large pumping stations to move storm water to the Mississippi River and Lake Pontchartrain. At the same time, the natural levees were raised many times, and landfill and levees were built along the lakeshore by the 1930s as the city expanded north. The result of this construction was to alter the topography of the city, creating the current bowl-shaped configuration that prevents natural drainage. The highly effective system of canals and high-capacity pumps not only force-drained surface storm water, but also lowered the water table and dried out the organic-rich soils, which has led to their removal by oxidation and erosion processes.

From the early 1900s to today, these activities have resulted in the widespread loss of land elevation across the entire city due to compaction and oxidation of the soils. The result is that more than 50 percent of New Orleans is below sea level, some areas by as much as 10 feet. The only areas above sea level are either on the old levees or sandy linear ridges (e.g., Gentilly, Metairie ridges) marking old river channels or relict shoreline features. The geologic character and 200 year history of land reclamation are largely responsible for Hurricane Katrina's ability to flood 80 percent of New Orleans. In planning for the future of the city following Hurricane Katrina, detailed information is needed on topics such as: high-resolution elevation data of the land surface from the

1700s to 2005; geotechnical characteristics of the soils at depth and their potential for subsidence; and geologic maps showing features that influence the land surface and development.

The biggest impact and primary geologic process driving Louisiana's coastal land loss as recognized by most scientists is land subsidence. There are three subsurface processes that contribute to subsidence: large regional-scale processes that result in crustal down warping; consolidation and compaction of soils resulting from both natural processes, such as dewatering of muddy sediments, and hydrocarbon extraction; and geologic faulting. While there is agreement that faults exist and several are active, there is considerable disagreement on the locations of the faults, whether they intersect the land surface, and especially the rate and frequency of fault movement (Lopez, 1991; Gagliano, 2005).

New Orleans and the entire delta plain to the south have changed a great deal over the past 200 years due to a complex combination of natural processes and anthropogenic activities that have had significant cumulative effects on the landscape. The result for the past two centuries has been a shift in the natural balance from net land-building deltaic processes to net land loss due to a variety of human alterations and natural processes.

As a result, Louisiana's barrier islands erode more than 30 feet per year, and wetland loss has averaged 24 square miles each year over the past decade, a rate decrease from the 40 square miles per year observed in the period 1950s to 1970s. USGS studies suggest that

wetland loss rates are down to 12 square miles per year (Williams, Penland and Sallenger, 1992; Barras et al., 2003). The primary natural and anthropogenic processes driving these changes are land subsidence (geological/faulting, local consolidation/ compaction), global sea-level rise, storms and floods, and human alterations to the Mississippi River and delta plain (river levees, dredged canals, land reclamation, oil and gas extraction, induced subsidence, dredged navigation channels, reduced sediment volumes).

The dramatic loss of Louisiana's wetlands and barrier islands is well documented and recognized. Estimates of the contribution of human activities in driving land loss range between 10 percent and 90 percent. To further our understanding of the role of natural processes and multiple human factors, the USGS undertook a study to quantify and classify the processes causing wetland loss from the period 1932 to 1990. The results describe local processes only; important regional processes such as global sea-level rise, regional subsidence, and river flood controls were beyond the scope and not considered in the study.

While there is considerable debate as to exactly how much wetland loss is attributable to specific causes, results published in two USGS reports demonstrate that approximately 31 percent of coastal land loss is caused by natural processes, and 69 percent is caused by a wide variety of human processes. These findings indicate that the greatest impact is associated with subsurface fluid (oil, gas, water) production, which could account for up to 36 percent of the land loss over the 58-year period. Generally, human processes

causing land loss include a suite of activities such as extraction-induced (oil, gas, water) land subsidence, dredged canals and channels, and altered surface and subsurface hydrology. For further discussion, see http://pubs.usgs.gov/of/2000/of00-418/ofr00-418.pdf.

USGS-funded research led by Robert Morton on subsidence in the Louisiana delta plain conducted during the past five years has resulted in significant scientific findings. Regionally, the areas having the highest historical and geological subsidence rates coincide with the thickest modern deltaic sediments. However, the areas of highest historical subsidence rates (greater than 12mm per year) coincide closely with locations of producing oil and gas fields or faults. The lowest average subsidence rates were located between major hydrocarbon producing fields.

In addition, our scientific research shows that rapid interior wetland loss was caused primarily by subsidence rather than erosion of the marsh, as demonstrated by submerged marsh sediments that drowned in-place and are still preserved beneath water depths of up to 3 feet. Morton et al. (2002, 2003) show that historical subsidence rates, subsurface fluid production, and wetland loss are closely correlated temporally and spatially. Finally, these USGS studies demonstrate that mapped wetland loss rates have been substantially lower since the early 1990s and especially in the last decade than during previous decadal periods, 1950s to 1970s.

Land subsidence due to fluid extraction (oil, gas, ground water) has been demonstrated in many locations around the United States (e.g., Houston, TX, Wilmington and San Joaquin Valley, CA) and throughout the world (e.g., North Sea, Venezuela) and is well documented in the science and engineering literature (Nagel, 2001). The causes for the decreased rate of wetland loss in Louisiana from the 1990s to the present are still not certain, but may be the result of reduced subsurface fluid extraction activities across the region (Morton et al., 2003).

Current scientific methods allow modern subsidence trends to be evaluated on short time scales (less than 100 years) using tide gauges and benchmark re-leveling data and long time scales (greater than 100 years) using age-depth relationships of organic peat sediments. Although preliminary relative sea-level rise trends have been documented for many of the gauges using standardized regression analysis, the tide gauges with recently extended records require updating to achieve completion. Records provided by National Oceanic Atmospheric Administration/National Ocean Service stations need to be incorporated into the database to provide comprehensive estimates of relative sea-level rise.

Longer-term, time-dependent estimates of subsidence rates are provided by radiocarbon-dating and analysis of peat sediments comprising the wetlands. These peats, assumed to have been deposited at (or near) sea level, are encountered in the subsurface of the Louisiana coastal plain. The ages of these organic materials and their current depth allows an estimate of the rate of subsidence to be made. The ages are typically less than

5,000 years old, but may be as old as 10,000 years. Their present depths indicate long-term, average subsidence rates of 0 to 20 mm/yr. A comparison of relative sea-level changes indicated by multiple peat samples within a single core will potentially provide insight to acceleration or deceleration of relative sea level within the time scale of measurement provided by the varied age of the sampled peats.

Compaction and consolidation of the uppermost few hundred meters of deltaic sediment is commonly cited as an important contribution to subsidence. However, precise calculations of compaction rates require data that are not available for much of the Louisiana coastal plain, and generally have not been pursued rigorously until a recent USGS study conducted by Timothy Meckel. Other methods for estimating compaction in other coastal environments arrive at compaction rates in the range of 1 to 10 mm/yr.

Meckel's study attempts to simulate sedimentation and compaction that may have occurred in the coastal plain over the last few thousand years with computational methods based on physical principles. These efforts incorporate geotechnical data from five fundamental depositional environments within the Louisiana coastal plain. The results of this study are currently under peer review prior to publication.

Compounding Louisiana's subsidence problem, there is a predicted increased rate of global sea level rise. Current rates indicate ~1-2 mm rise per year. The combination of subsidence and global sea-level rise for Louisiana results in a rate of relative sea level rise of about 1 cm per year or 3 feet per century, the highest rate of any coastal region in

the world. The rise in global sea level of 19 inches by 2100 predicted by IPCC (2001) would effectively double the current rate. An improved understanding of the dynamics of subsidence and how it changes across the deltaic plain can be used to develop models that will project the effects of future rises in sea level and their potential impacts on future coastal restoration projects.

Two other major challenges remain for researchers responsible for providing the scientific data used to formulate public policy regarding wetland loss and coastal restoration in Louisiana. The first is to generate subsidence estimates for coastal plain areas that are not immediately adjacent to benchmarks and tide gauges where subsidence rates have been determined previously. The second challenge is to develop accurate computer models to forecast rates of future subsidence and areas of wetland loss.

Conclusion

In conclusion, complex geologic and other natural processes have changed the shape of the low-lying Mississippi River delta plain and the City of New Orleans for thousands of years. Recent human activity and development in the region have increased the complexity of the problem. Most scientists recognize land subsidence as the primary geologic process driving Louisiana's coastal land loss. However, storm events like Hurricanes Katrina and Rita play a significant role in modifying the landscape through erosion and flooding. Continued subsidence will result in increased exposure of the people, land, and infrastructure in the region to storm events.

Thank you for the opportunity to present this statement for the record.

***Note**: The information in this testimony is based on scientific research by USGS and other scientists reported in the scientific literature. In particular, contributions have come from Dawn Lavoie (USGS), Robert Morton (USGS), Shea Penland (University of New Orleans), Harry Roberts (Louisiana State University), Denise Reed (UNO), James Coleman (LSU), Jack Kindinger (USGS), John Barras (USGS), Virginia Burkett (USGS), Del Britsch (U.S. Army Corps of Engineers), as well as my own research. Complete references and copies of the scientific papers referred to in this testimony are available by request.

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