

New Orleans: Preserving the wetlands to increase climate change resilience

Climate change impacts addressed	Sea level rise Storms and hurricanes
Spatial scale	Town or city
Response type	Action plan
Themes driving the initiative	Response to current climate Adaptation to future climate Biodiversity conservation
Factors of success	External collaboration

Summary

Following the disastrous failure of structural flood defences during Hurricane Katrina in 2005, the State of Louisiana and the City of New Orleans have undertaken steps to increase the resilience of the city to sea level rise, hurricanes and river flooding. An approach utilising many lines of defence has been adopted, involving structural and non-structural defences. One of the key protection measures is the conservation and restoration of wetlands as a buffer zone between the sea and the city. Detailed actions aimed at the promotion of wetlands are included in the New Orleans Masterplan under the headings of green infrastructure and city resilience. Inclusion of wetland conservation and restoration activities in the New Orleans Masterplan signals a significant change of flood-defence tactics in the region from an emphasis on levees and floodgates to the incorporation of more natural solutions. The focus on wetlands as a natural buffer responds to the calls of research emphasising the importance of wetlands in flood protection.

Case study location

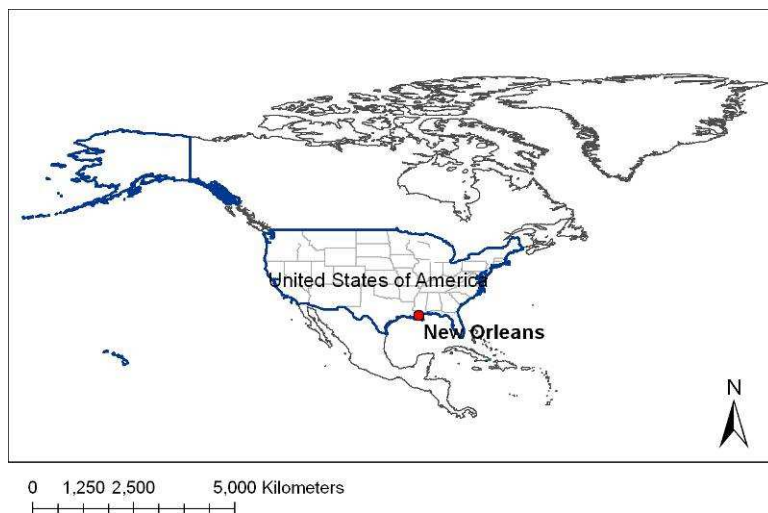


Figure 1. Location of New Orleans in the USA

New Orleans is a major port in the United States, and the largest city and metropolitan area in the state of Louisiana. It is located in southeastern Louisiana, on the Gulf of Mexico. The city straddles the Mississippi River. New Orleans is famous for its cuisine and music – it is the birthplace of jazz. New Orleans currently (2010) is home to about 255,000 people, which is about half of the population in 2005 pre-Hurricane Katrina.

The Gulf of Mexico is characterised by the frequent occurrence of hurricanes. A major hurricane has hit

the Gulf Coast every year since 1994, with 26 named storms and 14 hurricanes occurring in 2005⁽¹⁾. According to the Federal Emergency Management Agency, New Orleans is the US's most vulnerable city to hurricanes. The city is at high risk because of its low elevation. Most of its area is currently between 0.6 to 5m below sea level ⁽²⁾, and the city is surrounded by water from the north, east and south (Figure 2).

Hurricane Katrina in 2005 had a devastating impact on the city, causing the failure of the levees and floodwalls that protect it and creating the worst civil engineering disaster in American history. As a result of the hurricane, 80% of New Orleans was flooded, and across Louisiana 1,500 people lost their lives, 900,000 people were displaced, 16,000 businesses were flooded and forty schools were destroyed, with majority of the losses and damage occurring in New Orleans itself ⁽³⁾.



Figure 2. Location of New Orleans in relation to Mississippi River and Lake Pontchartrain ⁽⁴⁾

Louisiana's coastal zone was formed by sediments deposited during a series of 16 major Mississippi River deltaic episodes that have occurred over the past 7,000 years, which have created a region of coastal wetlands covering over 13,000 km² ⁽⁵⁾. These wetlands represent 30% of the total coastal wetlands in the US, and at the same time account for 90% of coastal wetland loss nationally ⁽¹⁾. It is estimated that Louisiana has lost more than 3,000 square miles of its coast in the last 70 to 80 years alone, at a rate of nearly 62 km²/year ⁽⁶⁾. This loss is caused by coastal erosion due to levees along the Mississippi River. The levees have prevented some flooding, but also prevent the river from depositing its sediment. This key element of natural coastal land building processes has therefore been severely impaired. Construction of artificial channels for oil and gas drilling and other commercial activities (most notably the Mississippi River Gulf Outlet) also destroyed wetland areas ^{(1), (7)}. Hurricanes also damage wetlands. Indeed, around metropolitan New Orleans, where wetlands have historically formed a critical storm surge buffer, the loss of coastal marshes as a result of Hurricane Katrina was so great that it represented about 50 years of projected wetland loss ⁽¹⁾.

The climate of New Orleans is humid subtropical (Köppen climate classification *Cfa*), with short, generally mild winters and hot, humid summers. New Orleans has always faced the risk of flooding from three sources: the Mississippi River, heavy rains, and hurricane storm surge, the last of these posing the greatest threat of catastrophic flooding in New Orleans. Global sea level rise and the risk of stronger, more frequent hurricanes as a result of climate change may also be contributing to increased risk ⁽⁷⁾. Climate change is projected to increase sea level by 3-10mm per year in the next 50 years. This, combined with the subsidence of the Louisiana's deltaic coast, may amount to sea levels in the Gulf of Mexico being between 60-180cm higher over the next century than they are today ⁽¹⁾. Projecting forward the current land loss rate, by the year 2050 Louisiana will have lost a further one million acres of coastal wetlands. In addition, the sea will continue to advance inland by as much as 33 miles during this period, transforming previously productive wetlands into open water and leaving New Orleans more exposed to sea flooding and hurricanes ⁽¹⁾.

However, wetlands play an important role in mitigating the severity of hurricanes. They do this by decreasing the area of open water for wind to form waves, increasing the drag on water motion and hence reducing the amplitude of storm surges, reducing direct wind effect on the water surface, and directly absorbing wave energy. It has been estimated that every 4.3 km of wetlands can absorb one foot of storm surge. This means that a storm tracking from the south of New Orleans could have its surge reduced by 3.66 m if it has crossed 80 km of marsh before reaching the city ⁽²⁾. Hence, protection and restoration of wetlands can be seen as an important adaptation mechanism to the reducing risk of flooding from hurricanes.

Development of the initiative

Key aims

Current plans are to restore as much of the wetlands as quickly as possible. This will involve a combination of restoration of natural delta building, marsh creation from use of dredged material, water control structures, and hard structures (e.g. levees and floodgates). The interior marshes have been prioritized for conservation and restoration because of the ecological services they provide, combined with the storm surge protection they offer to densely populated areas including New Orleans ⁽¹⁾.

Themes driving the initiative

Adaptation to hurricanes and sea level rise

A major lesson of Hurricane Katrina is that New Orleans cannot simply rely on bigger or better levees, gates, and pumps for flood protection. The city must adopt a strategy that addresses multiple lines of defence (Figure 3), some of which will require continued advocacy and vigilance, and some of which the city and its citizens can take charge of themselves. The multiple lines of defence range from restoration of coastal wetlands, development of hard infrastructure, and non-structural strategies such as land use and building codes, and enhanced emergency preparedness ⁽⁷⁾.



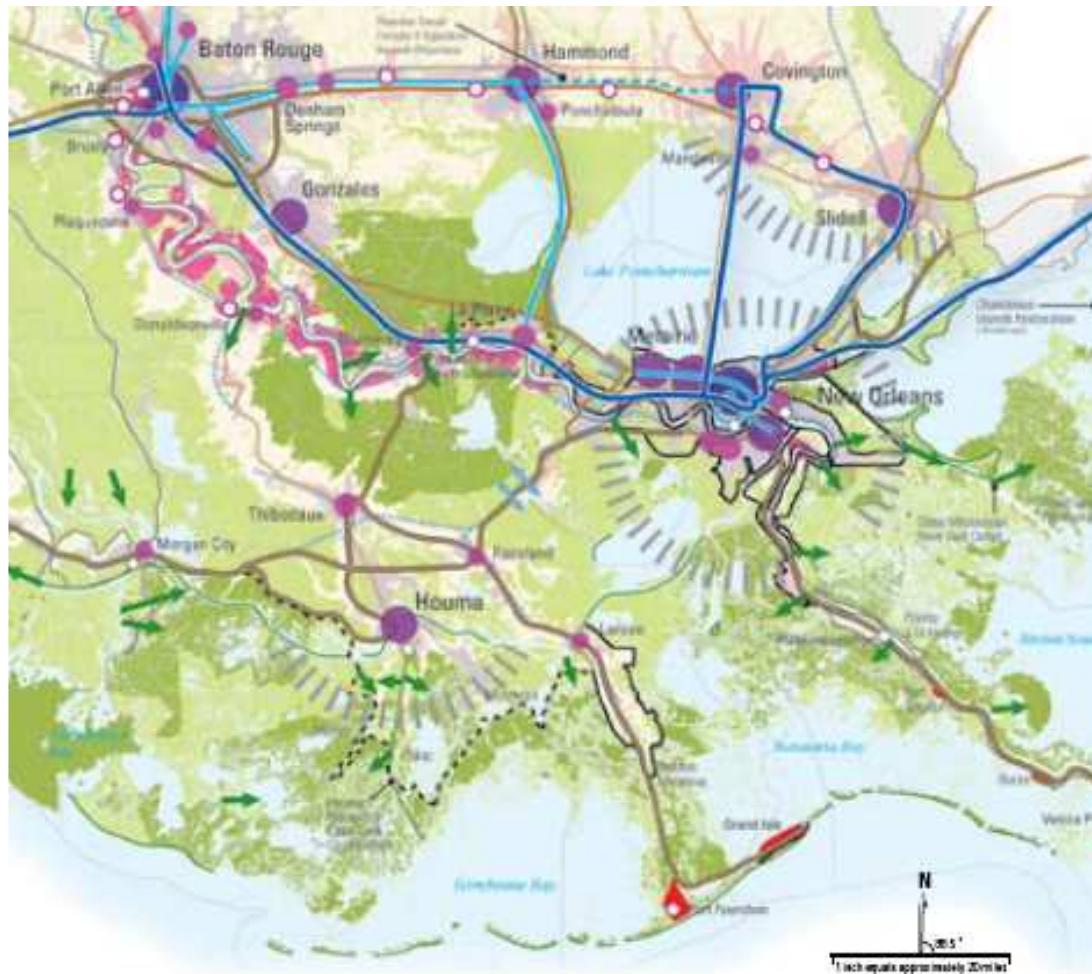
Figure 3. Multiple lines of defence against hurricanes, flooding and sea rise, including wetlands ⁽⁷⁾

National and state legislation and actions

While the problem of wetland loss was recognised in the 1970s, concerted attempts at restoration did not begin until the 1990s. Initial efforts largely focused on addressing local problem areas, and sought to prevent future losses rather than restore wetlands that had already been lost ⁽⁶⁾. A more inclusive ecosystem restoration plan, "Coast 2050—Toward a Sustainable Coastal Louisiana", was developed in 1998. This was based on the recognition that the natural geomorphic and ecological processes that had created the coast have been severely impaired, and that the reestablishment of these processes is essential. The plan focused on strategies necessary to achieve a greater degree

of coastal sustainability across the region, which requires (amongst other things) the replacement of lost wetland areas ⁽⁶⁾.

Following Hurricane Katrina, the importance of coastal wetlands for hurricane protection in Louisiana became more widely acknowledged. In November 2005, the State of Louisiana Legislature created the Coastal Protection and Restoration Authority (CPRA). It was given the mission of coordinating local, state and federal agencies to achieve comprehensive coastal protection and restoration, particularly through integrating activities in two previously separate areas, wetland restoration and flood control. CPRA prepared a master plan for coastal protection and restoration, although much of this concentrated on improvement and installation of coastal levees with floodgates that could diminish the sustainability of the coastal landscape ⁽⁵⁾. However, wetland restoration and preservation features prominently in the "Louisiana Speaks Regional Plan" (Figure 4) for recovery after the recent hurricanes ⁽⁸⁾.



Landscape Features

- Existing Wetland
- New or Restored Wetland 50-year projection
- Agricultural, Upland Forest or Open Land
- Open Water

Jurisdictional Boundaries

- State Boundary
- Parish Boundary

CPRA Master Plan Features**

- New Levee
- Upgraded Levee
- Existing Levee
- Increased Protection for Major Urban Areas Using Hurricane Protection Systems (Other hurricane protection systems envisioned; see CPRA Master Plan**)
- Shoreline, Barrier Island or Navigable Waterway Restoration/Stabilization
- River Diversion
- Water or Sediment Conveyance

Figure 4. Map presenting planned restoration of wetlands in the "Louisiana Speaks Regional Plan" ⁽⁸⁾

Details of the initiative

The need for protection and restoration of wetlands around New Orleans has been included as a feature of the City Masterplan (Plan for the 21st century: New Orleans 2030) produced in January 2010. Wetland conservation is covered explicitly in two chapters: Chapter 7 (Green infrastructure: parks, open space and recreation) and Chapter 12 (Resilience: living with water and natural hazards).

Chapter 7 of the New Orleans Masterplan ⁽⁷⁾ focuses on green infrastructure issues. The first goal on the list of priorities aimed at the maintenance and enhancement of green infrastructure networks refers to “**protection of remaining wetland areas inside and outside the levee system**”. The related strategies for decision makers are to:

- **Ensure that land use and zoning categories for wetlands and coastal areas promote wetland preservation:** The state of Louisiana does not specifically define wetlands for regulatory purposes, but it does define a coastal zone in which jurisdiction is based on elevation and hydrologic characteristics. Although the entire City of New Orleans is part of the regulated coastal zone, the entire city within the levees is designated as “fastland” for which there is no regulation relating to wetlands. Establishment of a land use category and zoning categories for natural areas within the levees will enhance existing programs aimed at wetland preservation. This will encourage the protection of even isolated wetland areas within the city.
- **Establish regulations and enforcement systems to protect wetlands.** A city wetlands protection ordinance would allow the City to define wetland areas for protection and regulation. This would help to create a system, whereby development activity within a specified distance of wetland areas would have to meet certain requirements. Further, where there is existing development close to wetlands or coastal areas, a regulatory system should ideally be established to review proposals leading to alteration of wetlands with mitigation requirements enforced should the proposal be allowed to proceed.
- **Seek conservation solutions for wetlands through permanent protection or acquisition by conservation organisations.** Natural areas in private hands can be protected through voluntary conservation servitudes (easements). Here the property owner retains title to the property but agrees to permanently give up the development rights on the land. In return they receive a payment through a government programme, or a reduction in taxes on the land. Conservation servitudes such as this are part of the Louisiana Coastal Wetland Reserve Program, which works with farmers to restore lands to wetlands, making a payment for the agricultural development rights in return for establishment of a conservation servitude on the land. Although wetland property owners in New Orleans are not farmers, this program could provide a precedent for how a similar scheme could be administered in the city.

Chapter 12 of the New Orleans Masterplan ⁽⁷⁾ focuses on “Resilience: living with water and natural hazards”. The main goal related to wetlands is to “**expand the coordination and implementation of coastal restoration efforts**” in New Orleans. The actions include measures such as:

- **Improving coordination in coastal restoration matters between the City of New Orleans and other state, local, and federal agencies.** The permitting process for development activity in a wetland or coastal area is extremely complicated. Closer coordination and better defined protocols would lead to more informed decisions and a quicker process for both developers and concerned members of the community.
- **Securing funding for and support the implementation of locally driven coastal restoration efforts.** Wetlands restoration projects have the potential to receive substantial funding as carbon sequestration projects. A “cap and trade” system allowing carbon polluters

to offset their emissions with carbon sequestration or mitigation projects appears to be an imminent possibility in the US. The Obama administration has signalled its strong support for such an initiative by including anticipated revenue streams from a cap and trade system in their 2010 budget proposal. The City should work closely with the Louisiana Coastal Protection and Restoration Authority (CPRA) to identify the specific mechanism by which coastal restoration activities can become eligible in this scheme. This would allow them to be marketed to interested parties, and for local projects of an appropriate scale and cost to be identified and undertaken by local governments.

- With the assistance of the New Orleans Redevelopment Authority (NORA), **facilitate the acquisition of “paper subdivisions”** (subdivisions of small lots that were created prior to modern subdivision regulations and that have never been developed) in undeveloped areas to assemble land for conservation and coastal restoration projects. The Office of Environmental Affairs should work closely with CPRA and the New Orleans Redevelopment Authority to identify critical coastal restoration projects that require the assembly and consolidation of these paper subdivisions. The City could then acquire and land bank these properties in order to facilitate restoration projects in the future.
- Include in the city’s GIS property database a legal inventory of property and parcel boundaries outside of the hurricane protection system in Orleans Parish. Determining property ownership outside of the levees is frequently difficult and can as a result be a hindrance to coastal preservation and restoration efforts.
- **Ensure consistency between the CPRA plan, the City’s Master Plan, the City’s Coastal Management Plan, and the City’s land use regulations** in coastal restoration policies, phasing, funding, and recommendations. All of these documents have an important role in guiding how the city’s wetlands are managed, protected, and restored and should therefore be integrated.
- **Update the Coastal Management Plan**, which dates from 1985.
- **Create a new local wetlands protection ordinance** that is specific to wetlands and that reflects development constraints and challenges in these areas. While both federal and state agencies can potentially be involved in permitting activities in coastal and wetlands areas, they do not have the power to supersede local land use regulations. Local ordinances, zoning and subdivision regulations represent the first line of defence in protecting the health of New Orleans’ wetlands.
- **Create an improved inventory of wetlands in Orleans Parish** to inform land use policies and coastal restoration efforts. This should involve working with state government, the Army Corps of Engineers, and universities in the region to compile an updated inventory and detailed digital maps of wetlands in Orleans Parish.

Implementing the initiative

The New Orleans Masterplan was completed in January 2010. The development of the document started in 2008, and involved an extensive public consultation process. The implementation of the Masterplan has been designed around a series of actions with clearly assigned responsibilities, time scales and resources (Table 1).

Table 1. Implementation schedule of the New Orleans Masterplan ⁽⁷⁾

Strategies	Actions			
	How	Who	When	Resources
Ensure that land use and zoning categories for wetlands and coastal areas promote wetland preservation.	Include in the new Comprehensive Zoning Ordinance	City Planning Commission	2010-2014	Comprehensive Zoning Ordinance rewrite contract
Establish regulations and enforcement systems to protect wetlands.	Enact a City wetlands-protection ordinance defining wetlands, prohibiting drainage of wetlands, and regulating impacts within a defined distance of wetlands.	Environmental Affairs; City Attorney; City Council	2010-2014	Staff time
Seek conservation solutions for wetlands through permanent protection or acquisition by conservation organisations	Discuss options with environmental organisations	Environmental Affairs; Trust for Public Land	2015-2019	Staff time; federal or non-profit funding
Expand the coordination and implementation of coastal restoration efforts in Orleans Parish	Streamline policy coordination and wetlands permitting among the state, ACE and local government	Environmental Affairs	2010-2014	Staff time
	Update the Coastal Management Plan	Environmental Affairs	2010-2014	Federal, state or non-profit funds
	Explore the potential of funding local wetlands protection and restoration projects	Environmental Affairs	2010-2014	Staff time
	Ensure consistency between the CPRA plan, the Bayou Sauvage Master Plan, the City's Master Plan and land use regulation	City Planning Commission, Louisiana Coastal Protection and Restoration Authority; Environmental Affairs	2010-2014	Staff time
	Create a local wetlands protection ordinance	Environmental Affairs, City Council	2010-2014	Staff time
	Create an improved inventory of wetlands in Orleans Parish to inform land use policies and coastal restoration efforts	Environmental affairs	2010-2014	Staff time; state capital restoration funds
	Resolve any property and subdivision issues in areas outside the levees through a property inventory and acquisition of paper subdivisions	Environmental Affairs; Office of Technology; City Planning Commission; New Orleans Redevelopment Authority	2015-2019	State coastal restoration funds

The implementation of the plan will involve several challenges. These include raising public awareness about related issues including the realities of environmental hazards and their probability / risk, the use of wetland mitigation options after 40 years of reliance on levees, and securing adequate funding on an accelerated basis for further coastal restoration efforts ⁽⁷⁾. Systematic planning interventions in coastal Louisiana are further complicated by mismatches between the natural boundaries of the problem and the scales at which regulatory and planning authorities operate. For example, New Orleans as a municipal land use authority has planning and regulatory jurisdiction over only a small fraction of the coastal area. Further, the official regional planning commission created by the Louisiana legislature for the five parishes around New Orleans has no regulatory authority. Also, it does not have sufficient geographic coverage to deliver effective coastal ecosystem planning in the area ⁽¹⁾. This requires collaboration with state and national bodies ⁽⁷⁾, including the Louisiana Office of Coastal Protection and Restoration (OCP), Louisiana Recovery Agency, Federal Emergency Management Agency (FEMA), and the U.S. Environmental Protection Agency. The U.S. Army Corps of Engineers are also important

stakeholders. They are well positioned to maintain and protect the coastal system at a larger scale and to regulate activities that impact coastal waters and wetlands, although they may not have the mandate to intervene in land use matters involving private property. Furthermore, the U.S. Army Corps of Engineers still favour structural 'hard infrastructure' measures such as levees and pumps to coastal management issues ⁽¹⁾, which may jeopardise plans to restore coastal wetlands ⁽²⁾.

Building the evidence base

A study carried out in 2009 reported that upstream dams and reservoirs result in only half the sediment necessary to create coastal marshes reaching the delta area in comparison to 100 years ago and unless Louisiana launches major projects within the decade, coastal erosion will advance so rapidly that it will reach a point where there is no realistic way to stop it. It was also stated that sea levels are rising at three times the rate of 100 years ago ⁽⁷⁾. This study, in addition to the damage caused by Hurricane Katrina and in conjunction with the national USA climate projections, has provided a wake-up call for decision-makers in New Orleans.

Monitoring and evaluation

No specific targets have been set in the Masterplan regarding monitoring the restoration of wetlands.

Sources of funding

Table 1 highlights the resources needed to complete the actions, and indicates funding sources required. The Gulf of Mexico Energy Security Act, signed into law in December 2006, gives Louisiana and other Gulf Coast states 37% of the revenues from newly opened oil and gas tracts. Louisiana has constitutionally dedicated all these revenues to coastal restoration and protection. Along with other anticipated revenue streams, this could provide approximately \$1 billion per year over the next 30 years for these purposes ⁽⁵⁾. Additional funding measures include the dedication of recent state surplus funds to coastal restoration projects, the creation of the federal Coastal Impact Assistance Program of 2005, and the inclusion of \$1 to 2 billion for coastal restoration in the 2007 federal Water Resources Development Act (WRDA). These funding sources are supporting a wide variety of coastal restoration initiatives, such as freshwater diversion projects that direct Mississippi River sediment to rebuild marshlands. Estimates of the total cost of coastal restoration in Louisiana run as high as \$45 billion ⁽⁷⁾.

Stakeholder engagement

Collaboration with key stakeholders

The lead authority on development of the Masterplan was the City of New Orleans. The approval of the Masterplan by the City Planning Commission and the City Council provided the political engagement and support. The development of the Masterplan was based on existing regulations and legislation developed by national and state level bodies including the Louisiana Office of Coastal Protection and Restoration (OCPR), Louisiana Recovery Agency, Federal Emergency Management Agency (FEMA), the U.S. Environmental Protection Agency, and the U.S. Army Corps of Engineers. Collaboration with these bodies is crucial for the development and implementation of the Masterplan.

Engaging the public

The Masterplan outlines the strategy for community participation during its development. The crucial elements of this community participation process include:

- A sounding board consisting of a diverse group of New Orleans' population was invited by the City Planning Commission to engage in the planning and zoning process. Due to public interest, this was later structured as an open group enabling other community members to join.
- Groups of knowledgeable people from the public, private and non-profit sectors, including neighbourhood representatives, were invited by the City Planning Commission to work on specific master plan and zoning topics.
- The Masterplan and Comprehensive Zoning Ordinance website was used to make announcements about upcoming public events relating to the plan, as well as to share the results of meetings with the public.
- Press and media were notified of key developments in the Masterplan process. Local news media highlighted several planning events and issues in print and online publications. Other media used to distribute information about the Masterplan included newsletters, event flyers, TV and radio announcements.
- The opinions of residents were gathered through interviews and focus groups, citywide forums and district meetings.
- The draft Masterplan was made available for public review and feedback on the project website, in libraries and other public locations in March 2009 (first version) and September 2009 (second version).

Can it have an impact?

The focus on restoration of wetlands in New Orleans signals a significant change in thinking about protection from flooding, sea level rise and hurricanes in Louisiana. There is a clear shift in emphasis from structural defences to more natural solutions utilising green and blue infrastructure. This is based and was inspired by the Dutch experiences and their strategy of making room for water (see the Netherlands case study). However, the wetland restoration efforts are currently at a policy rather than implementation stage, and the implementation phase is likely to be faced with many challenges (as discussed above).

In addition, the Office of Environmental Affairs in the City of New Orleans is responsible for implementing the 1985 New Orleans Coastal Management Plan, oversight of wetlands restoration and coordination with other agencies. However, this Office has limited capacity to review development proposals, which may have implications for effective protection of wetlands. Moreover, the Army Corps of Engineers' and the state Department of Natural Resources' criteria for permitting small developments in wetlands areas do not take into account the potential effects of cumulative small scale actions ⁽⁷⁾.

The scale of the coastal restoration required poses a major challenge to science and science-based planning to develop the most strategic and effective strategies. These strategies must also minimize the conflicts and maximizing the synergies concerning achieving multiple social objectives within a sustainable coastal landscape. At the same time, substantial uncertainties must be recognized, accepted, and incrementally reduced through a long-term adaptive management approach that promote learning and effective decision-making. This will require substantial improvements in science, engineering, planning, and management capacity, all operating with a sense of urgency and purpose ⁽⁵⁾.

Significant funds have been appropriated to implement coastal restoration and urban mitigation projects, but more is required ⁽⁷⁾. The recent escalating costs of restoration and levee protection along with the decline in the price of domestic oil & gas revenue from Louisiana (which reduces the State's ability to generate matching revenue for coastal restoration and protection projects), is

currently hindering the implementation of the coastal plan. Even with adequate funding and access to land, the construction of more robust levees and wetlands will likely take at least a generation to implement ⁽¹⁾.

A future opportunity for supporting the restoration of wetlands may lie in climate change policy because of wetland's exceptional role as "carbon sinks." With the establishment of a cap and trade system of carbon credits, the New Orleans wetlands will become valuable as sources of carbon credits because they act as excellent vehicles for carbon sequestration ⁽⁷⁾.

Key messages

- The New Orleans Masterplan provides an example of a strategy aimed at increasing the resilience of the city to climate change and associated extreme weather events. Green and blue infrastructure is identified as one of the measures of increasing resilience to hurricanes and floods
- The detailed implementation plan outlines the necessary collaboration, resources and timescale required for every action.
- The New Orleans Masterplan openly acknowledges learning from experiences of The Netherlands in learning to live with water rather than trying to stop it.

Contact organisation

City of New Orleans Planning Team and Goody Clancy (the team leading the Master Plan / Comprehensive Zoning Ordinance consultant team): nolamasterplan@goodyclancy.com

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