

## **5.0 MITIGATION OPTIONS**

This section of the St. Lucie County LMS outlines a menu of mitigation options available to reduce the risks posed by natural disasters.

### **5.1 MITIGATION DEFINITION AND INTRODUCTION**

Mitigation activities are those activities that aim to reduce the risks from natural and man-made hazards in a community. Mitigation is not a “one size fits all” process; a successful risk reduction activity in one community may not work in another. Several factors play a role in the decision on which mitigation activities to pursue including – frequency and severity of the hazard, the community’s ability to address the problem, ease of implementation, costs and benefits, availability of funding, and a local champion to spearhead the activity, among others. There are several different types of mitigation activities that a community can undertake to reduce the risk posed by natural and man-made hazards. FEMA has identified six broad categories of mitigation actions including prevention, property protection, public education and awareness, natural resource protection, emergency services, and structural projects.

### **5.2 MITIGATION CATEGORIES**

The following definitions were included in the FEMA How To Guide 3: Developing the Mitigation Plan (FEMA, 2003b).

- Prevention – Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses.
- Property Protection – Actions that involve the modification of existing buildings or structures to protect them from a hazard, or removal from the hazard area.
- Public Education and Awareness – Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them.
- Natural Resource Protection – Actions that, in addition to minimizing hazard losses, also preserve or restore the functions of natural systems.
- Emergency Services – Actions that protect people and property during and immediately after a disaster or hazard event.
- Structural Projects – Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

### **5.3 MITIGATION OPTIONS BY CATEGORY**

The following mitigation options are categorized using the categories identified above. While these lists are not comprehensive, they serve to provide examples of what can be done to reduce risk.

*Prevention.*

- planning and zoning;
- building codes;
- capital improvement programs;
- coastal zone management regulations;
- density controls;
- design review standards;
- easements;
- environmental review standards;
- floodplain development regulations;
- forest fire fuels reduction;
- open space preservation;
- performance standards;
- shoreline setback regulations;
- special use permits;
- stormwater management regulations;
- subdivision and development regulations; and
- transfer of development rights.

*Property Protection.*

- acquisition;
- construction of barriers around structures;
- elevation;
- relocation;
- structural retrofits;
- storm shutters; and
- shatter-resistant glass.

*Public Education and Awareness.*

- outreach projects;
- real estate disclosure;
- hazard information centers; and
- school-age and adult education programs.

*Natural Resource Protection.*

- best management practices;
- dune and beach restoration;
- forest and vegetation management;
- sediment and erosion control;
- stream corridor restoration;
- stream dumping regulations;
- watershed management;
- forest and vegetation management; and
- wetland restoration and preservation.

*Emergency Services.*

- warning systems;
- emergency response services; and
- protection of critical facilities.

*Structural Projects.*

- channel maintenance;
- construction of dams/reservoirs;
- construction of levees and floodwalls;
- construction of seawalls/bulkheads; and
- construction of safe rooms.

#### **5.4 MITIGATION OPTIONS BY HAZARD**

The following mitigation options broken down by specific hazard, were found mainly in North Carolina Emergency Management's Tools and Techniques: An Encyclopedia of Strategies to Mitigate the Impacts of Natural Hazards (North Carolina Division of Emergency Management, 2002) and FEMA's How to Guide: Integrating Human-Caused Hazards into Mitigation Planning (FEMA, 2002). They represent only a small fraction of the total possible mitigation options available to a community. For additional resources on mitigation options, see **Appendix B**.

*All Hazard.*

- acquisition and land banking;
- citizen outreach programs;
- community awareness programs;
- development impact tax/improvement tax;
- floating zones;
- home inspection programs;
- purchase of development rights;
- smart growth principles;
- structural retrofit;
- subdivision ordinance; and
- tax abatement, subsidies, low-interest loans, and other incentives.

*Drought.*

- contingency planning;
- fire breaks;
- housing code;
- new construction;
- water conservation programs
- monitoring and warning programs;
- drought tolerant vegetation; and
- wildland fire mitigation.

*Erosion.*

- beach nourishment;
- dune protection and shoreline setbacks;
- green infrastructure;
- structural relocation;
- open space preservation;
- revetments for beach management; and
- vegetation.

*Flooding.*

- acquisition;
- elevation;
- floodplain management plans
- floodproofing;
- flood insurance education;
- stormwater management;
- green infrastructure;
- porous pavement;
- retention ponds;
- sewage treatment plant retrofit; and
- tie downs.

*Hurricane.*

- acquisition;
- floodplain management plans;
- floodproofing;
- shuttering;
- enhanced building codes;
- preparedness outreach;
- tree and limb maintenance;
- mobile home parks storm shelter;
- safe rooms; and
- stormwater drain maintenance.

*Thunderstorm.*

- drainage system maintenance;
- impervious surface limits;
- tree and limb maintenance;
- encourage flood insurance;
- mobile home parks storm shelter;
- stormwater drain maintenance; and
- traffic light and other traffic controls.

*Tornado.*

- mobile home parks storm shelter;
- protecting natural environmental features;
- warning systems;
- enhanced building codes;
- safe room;
- tie downs;
- traffic lights and other traffic controls;
- utility lines; and
- windproofing.

*Wildland Fire.*

- fire breaks;
- fuel loads;
- housing code;
- new construction;
- open space acquisition;
- BEHAVE Fire Behavior Prediction and Fuel Modeling System;
- prescribed burns;
- tree limb removal; and
- wildland fire mitigation planning.

*Terrorism.*

- site planning and landscape design;
- architectural and interior space planning;
- structural engineering;
- mechanical engineering;
- electrical engineering;
- public education;
- drills;
- fire protection engineering;
- security; and
- parking.

**Table 5.1** displays various mitigation activities by both mitigation category and hazard. Only select hazards are compared in the table.

## **5.5 MITIGATION OPTIONS ADDRESSING SPECIAL ISSUES**

This section identifies several risk reduction strategies for three special issues of relevance in St. Lucie County – Repetitive Flood Loss Properties, Barrier Islands, and the CRS.

Table 5.1. Mitigation options by category and hazard.

Category	Mitigation Alternatives	Hazard			
		Flood	Hurricane	Tornado	Wildland Fire
Prevention	building codes	X	X	X	
	coastal zone management regulation	X	X		
	density controls	X	X		X
	design review standards	X	X	X	X
	easements	X	X		X
	environmental review standards	X	X	X	X
	floodplain development regulations	X	X		
	floodplain zoning	X	X		
	forest fire fuel reduction				X
	hillside development regulation				X
	open space preservation	X	X		X
	performance standards	X	X	X	X
	shoreline setback regulation	X	X		
	special use permits	X	X		X
	stormwater management regulations	X			
	subdivision and development regulations	X	X	X	X
transfer of development rights	X	X		X	
Property Protection	acquisition of hazard-prone structures	X	X		X
	construction of barriers around structures	X	X		
	elevation of structures	X	X		
	relocation out of hazard areas	X	X		X
	structural retrofits	X	X	X	
Public Education and Awareness	hazard information center	X	X	X	X
	public educational and outreach programs	X	X	X	X
	real estate disclosure	X	X	X	X
Natural Resource Protection	best management practices	X	X		X
	dune and beach restoration		X		
	forest and vegetation management	X			X
	sediment and erosion control regulations	X	X		
	stream corridor restoration	X			
	stream dumping regulations	X			
	urban forestry and landscape management	X			X
wetlands development regulations	X	X		X	
Emergency Services	critical family protection	X	X	X	X
	emergency response services	X	X	X	X
	hazard threat recognition	X	X	X	X
	health and safety maintenance	X	X	X	X
	post-disaster mitigation	X	X	X	X
Structural Projects	channel maintenance	X	X		
	dams/reservoirs	X			
	levees and floodwalls	X	X		
	safe rooms/shelters		X	X	
	seawalls/bulkheads		X		

Source: Federal Emergency Management Agency's (FEMA's) How To Guide 3: Developing the Mitigation Plan (FEMA, 2003b).

### **5.5.1 Repetitive Flood Loss Properties**

FEMA has placed special emphasis on addressing repetitive flood loss properties through the mitigation planning process; therefore, it is important to identify strategies to lower the number of repetitive loss properties within the County. The following are examples of actions that can be taken to lower or eliminate both the number of repetitive loss claims and properties in the County.

- acquisition;
- building codes; detention basins;
- drainage culverts;
- drainage system maintenance;
- dune protection and shoreline setbacks;
- elevation;
- firebreaks;
- floating zones;
- floodplain management plans;
- floodproofing;
- moratoria;
- real estate disclosure requirements;
- relocation;
- sewage lift stations; and
- stormwater drainage maintenance.

### **5.5.2 Barrier Islands**

Geologic and meteorological processes associated with barrier islands create a number of potential hazards. The following actions are examples of mitigation activities that can be implemented to protect the people, buildings, and infrastructure on barrier islands before and during natural hazard events.

- acquisition;
- beach management plans;
- beach nourishment;
- carrying capacity;
- dredging;
- dune protection and shoreline setbacks;
- floating zones;
- groins;
- jetties;
- offshore breakwaters;
- revetments;
- roadway realignment;
- sand dunes;
- sand scraping;
- seawalls and bulkheads; and
- coastal sediment trapping and vegetation.

### 5.5.3 CRS Projects

Participation in the CRS program can help to lower flood insurance premiums for residents within St. Lucie County. The more flood mitigation actions that are initiated, the lower the premiums will be. The following subsection outlines example mitigation activities that qualify for potential premium-reducing CRS points.

- *310 Elevation Certificates* – elevation;
- *330 Outreach Projects* – audits of small business, community awareness programs, education and training, home inspection programs, and notification of location of hazards;
- *340 Hazard Disclosure* – real estate disclosure requirements;
- *400SH Special Hazard Areas* – beach management plans, dune protection and shoreline setbacks, sand dunes, sediment trapping vegetation, and wetland preservation and riparian habitat protection;
- *410 Additional Flood Data* – hazard identification, mapping hazards, risk assessment, and vulnerability assessment;
- *420 Open Space Preservation* – acquisition and comprehensive plans;
- *430 Higher Regulatory Standards* – building codes, government expenditure limitation in high hazard areas, moratoria, sewage lift station, and sewer manholes;
- *430 LZ Low Density Zoning* – development density;
- *450 Stormwater Management* – grassy swales, impervious surface limits, onsite sediment retention, performance or impact zoning, retention ponds, stormwater management, and vegetation;
- *510 Floodplain Management Planning* – floodplain management plans, hazard mitigation and post-disaster reconstruction, porous pavement, and stormwater basins;
- *520 Acquisition and Relocation* – acquisition, capital facilities plans, commercial parks, critical facilities, emergency shelters, parks, public housing, public records, relocation, safe site, and school facilities;
- *530 Retrofitting* – dikes, levees, floodwalls and berms, elevation, floodproofing, public housing, public records, public school buildings, retrofit of fire stations and police stations, and sewage treatment plan retrofit;
- *540 Drainage System Maintenance* – drainage culverts, drainage system maintenance, retention ponds, and stormwater drain maintenance;
- *610 Flood Warning Program* – capability analysis and disaster warning;
- *620 Levee Safety* – dikes, levees, floodwalls, and berms; and
- *630 Dune Safety* – dams and reservoirs.

### 5.6 MITIGATION IN DEPTH

As the Community Profile (**Section 2.0**) indicated, the Treasure Coast region has and will continue to experience increased population growth. Population growth has a major impact on how and where development takes place in the County. As new development moves outward from the urbanized core and corridors, the potential for natural hazards to impact life and property increases. Because growth issues are so prevalent in the County, select development related mitigation activities have been identified and are described below. These activities are provided as examples only, and they are not reflective of the broad spectrum of mitigation options available. The mitigation activities and the accompanying information were developed from North Carolina Division of Emergency

Management in the Tools and Techniques document (North Carolina Division of Emergency Management, 2002).

## **5.6.1 Floating Zoning**

### **5.6.1.1 Definition**

Floating zones are written into the zoning code but “float” above the map until triggered by a set of conditions. Unlike overlay zones, floating zones replace the existing code for the places in which they are implemented. Once certain conditions (usually development-related) are met, the ordinance becomes affixed to a particular site. Floating zones are typically used when a community knows that it wants to apply a set of regulations to certain uses (such as a shopping center), but is waiting for events to decide the location for those uses.

### **5.6.1.2 Implementation**

One of the best uses of floating zones is to reduce the density in areas that have been hit by a natural disaster. For example, areas where structures have suffered, on average, a certain degree of damage could anchor a floating zone that reduces the allowable density in that area. The damage zones where these regulations would be applied could be identified during the recovery phase.

### **5.6.1.3 Critique**

Since one or several lots are subject to different regulations than their neighbors, floating zones are often attacked as being a form of spot zoning. While the location of floating zones can be subject to special interests and politics, they are usually based on facts, as opposed to speculated future needs.

## **5.6.2 Impact Fees/System Development Charges**

### **5.6.2.1 Definition**

Impact fees require new developments to share in the financial burden that their arrival imposes on a town. These assessments are typically one-time, up-front charges (although some jurisdictions allow payments over time) against new development to pay for off-site improvements. The fees also can be set up to allow new development to buy into existing services with excess capacity. Impact fees are typically based on ratios that show what services the average new resident will require.

### **5.6.2.2 Implementation**

Every impact fee must meet a three part legal test. First, the need for improvements funded by the fee must be created by the new development. Second, the amount charged the new development must be proportionate to the cost of its use. Third, all revenues must be spent in proximity to the new development and within a reasonable period of time. If any of these are not met, the community may face legal action. Communities should have a comprehensive plan and capital improvements program in place to defend their use of impact fees or exactions.

Impact fees can be linked to environmental impact analyses in order to charge proportionate fees for projects that will have broader or lesser impacts. While there are several methods for analyzing impacts (checklists or spreadsheet models, for example), most look only at individual project impacts. An alternative is a cumulative impact assessment, which looks at the total effect of all development in a particular environment. This approach might allow planners to estimate the combined effects of several potential developments on reducing the flood storage capacity of a single watershed. The fee in this case would go toward mitigating increased flood heights, perhaps by creating flood storage elsewhere in the floodplain.

### **5.6.2.3 Critique**

Impact fees can be applied to a wider variety of services than either exactions or special assessment districts. Unlike land dedications, these can be payments that cover the full costs of needed improvements. They are typically used in place of negotiated exactions because they take less time and are more predictable and equitable. Impact fees do not help with maintenance costs.

## **5.6.3 Porous Pavement**

### **5.6.3.1 Definition**

Substitute porous or open-grid pavement for impervious pavement to limit the amount of stormwater runoff that contributes to localized flooding.

### **5.6.3.2 Implementation**

Pavement will ideally be pervious enough to absorb rainfall but with pores small enough not to clog with debris or cause problems for pedestrian traffic. Some brands of asphalt or concrete that lack the finer sediment of conventional cement hold promise. Several websites containing photographs and/or useful information regarding porous and open-grid pavement include

- [http://www.gcpa.org/pervious\\_concrete\\_pavement.htm](http://www.gcpa.org/pervious_concrete_pavement.htm); and
- <http://www.greenbuilder.com/sourcebook/PerviousMaterials.html>.

### **5.6.3.3 Critique**

Reservations apply to the use of open-grid, or open-cell, pavement: it is treacherous for those with mobility challenges (and those in high heels) and also is expensive to install. However, open-grid pavement is appropriate for limited-use access routes or overflow parking lots.

## **5.6.4 Transfer of Development Rights (TDR)**

### **5.6.4.1 Definition**

Like Purchase of Development Rights (PDR), TDR programs treat development as a commodity separate from the land itself. The local government first awards each property owner in a sending area a set of development rights based on the value or acreage of land. Sending areas contain land the local authority seeks to protect. The government

then establishes a receiving area for these rights that is a preferred site for development. Landowners in the sending area are typically prohibited from developing their land; however, they can sell their rights to developers in the receiving areas. Developers who acquire these development rights can build to higher densities than would otherwise be permissible.

#### **5.6.4.2 Implementation**

TDR could be used for mitigation purposes by designating high hazard areas as sending zones. The development rights for parcels within this zone would be targeted at a receiving zone located outside the hazard area. The zone would need to have sufficient room to accommodate the sending rights. In jurisdictions with limited available space, the program could be aimed at redevelopment rather than new development. Alternatively, the community could completely downzone itself. Both options could help create a market for development rights.

One way to ensure that people participate in the program is to make it mandatory; although, the legality of mandatory TDR programs is currently under challenge. In a mandatory program, the marketability of the rights would have to be guaranteed. One way to do so would be to create a municipal land bank that would purchase the rights and resell them when demand was sufficient to generate value. Suitable receiving areas outside the hazard area must be available for TDR to be successful. TDR can be used to achieve a variety of associated community goals, including promoting compact development with less impervious surfaces and preserving agricultural, rural, or open spaces. Since TDR can be applied to areas of a community, rather than individual parcels, it can be more thoroughly effective than acquisition or cluster development techniques.

#### **5.6.4.3 Critique**

TDR is a complex system, which makes it difficult for planning staffs to implement and for landowners to understand and accept. It is frequently unpopular with residents in the receiving zone, who are subject to development that exceeds the apparent zoning limits. Perhaps most importantly, a region must have a significant amount of development pressure to make the rights marketable.

#### **5.6.4.4 Example**

Collier County, Florida, began a TDR program in the 1980's to protect 40,000 acres of coastal barrier islands, mangroves, salt marshes, and beaches. These areas were designated as sending zones. The receiving zones were already set for multi-family housing, but could be built to a higher density using the development rights. Parcels for which the development rights have been sold must be protected by a restrictive covenant or by donation to the County or a conservation organization. A moratorium was placed on the program when the transfer resulted in density concentrating in only one receiving site and overwhelming it.