

Resilient Sustainable Communities: Integrating Hazard Mitigation & Sustainability into Land Use



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Executive Summary

This report was prepared for the Federal Emergency Management Agency (FEMA) and the Environmental Protection Agency (EPA) to address the challenge of integrating hazard mitigation and local land use plans. This is a critical issue because the lack of integration leaves communities exposed to, and ill-prepared for, the social, economic and environmental threats posed by natural hazards. FEMA and the EPA requested that a case study be conducted that analyzed the integration of hazard mitigation and local land use plans of the City of Syracuse and surrounding Onondaga County in New York State.

The problem arises when land use plans do not adequately account for the risk of natural hazards and, therefore, provide no guidance for sustainable development within hazard zones such as a floodplain. Integrating hazard mitigation and local land use plans through sustainability can lead to a resilient, sustainable community that is less vulnerable to and can recover more quickly from the impacts of natural hazards. This integration also improves environmental performance.

A deeper analysis of this issue and a proposed method of integration can be found in the three sections of this report: (1) Gap Analysis; (2) Methodology; and (3) Sustainability Strategies Resource Guide.

The gap analysis focuses on omissions, overlaps and conflicts between Onondaga County's hazard mitigation plan and two local land use plans. Generally, the report concludes that the land use plans largely overlook the risk of riverine flooding that is detailed in the hazard mitigation plan. Given the limited time available for this project, the analysis centered around a single geographic boundary, the Creekwalk in Downtown Syracuse. Additionally, the analysis dealt solely with one hazard, riverine flooding, within this area. The Creekwalk falls within FEMA's 100-year floodplain; both the county and city envision this area as a vibrant, economic center. The risk of flooding in an economically important part of the city highlights the importance of integrating hazard mitigation and land use. Moreover, the example of the Creekwalk underscores the importance of sustainability in decreasing vulnerability and enhancing the resilience of economic development in the floodplain.

Based on this analysis, the report makes the following recommendations:

- Encourage pre-disaster preparedness
- Cross Reference Plans
- Facilitate coordination of stakeholders

The report also provides a pair of tools for government officials who want to pursue the integration of hazard mitigation and land use planning through sustainability. The first is methodology – a step-by-step guide – for harmonizing these two different types of plans. The second is a Sustainability Strategies Resource Guide, which offers innovative strategies for reducing the risk of riverine flooding. The guide includes the following:

- Mitigation strategies aimed at deflecting the severity of a major flood event;
- Green infrastructure strategies to combat periods of heavy rainfall, riverine flooding, storm water runoff, and sewage overflow;
- Funding sources for implementing mitigation and sustainability strategies;
- Streamlining the development process of future land use and development plans to ensure the use of strategies in current or planned development or redevelopment.

While the report is based on Syracuse and Onondaga County, it provides information and tools that any municipality can use to for planning resilient, sustainable communities.

Gap Analysis

Background: Identification of Relevant Plans

Onondaga County: Multi-Jurisdictional All-Hazards Mitigation Plan

The *Onondaga County: Multi-Jurisdictional All-Hazards Mitigation Plan* (“Hazard Mitigation Plan”), by the Syracuse-Onondaga County Planning Agency (“SOCPA”), anchors the analysis of the relationship between hazard mitigation and land use, as it identifies hazard risks in the county and the city

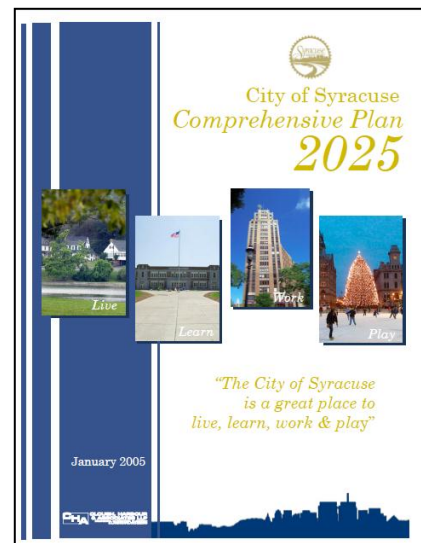
A hazard mitigation plan is required by FEMA in order for the county to qualify for federal funding for pre-disaster mitigation projects and post-disaster recovery. The primary purpose of the plan is to assess historical and future potential hazards, and to identify hazard mitigation measures to reduce the damage from natural hazards in the region (Tetra Tech EM Inc., April 2010 with December 2011 Revisions). In other words, the plan is to offer a comprehensive approach to minimize hazard risks by identifying appropriate policies and actions (FEMA, Multi-Hazard Mitigation Planning). The Hazard Mitigation Plan is an important resource for increasing a community’s awareness of the area’s hazard risks.

City of Syracuse: Comprehensive Plan, Land Use and Development Plan

Under the direction of former Mayor Matthew Driscoll, the City of Syracuse developed the *City of Syracuse Comprehensive Plan 2025* (“Comprehensive Plan”). The Comprehensive Plan’s purpose is as follows:

“Comprehensive planning provides a community with the opportunity to guide future growth and development through the identification of key policies and goals of its residents with respect to public health, safety and general welfare. The purpose of a comprehensive plan is to provide a guide for all major decisions in pursuit of what the City wants to become in the future. The implementation of this plan, starting with its adoption and proceeding with recommendations such as preparing a future land use plan and amending the City’s zoning ordinance, will provide the legal authority to direct development in a prescribed manner.” (Syracuse, 2005)

As a component of the Comprehensive Plan, Syracuse is in the process of developing a *Land Use and Development Plan*



(“LUDP”). The purpose of this component of the plan is to revitalize and strengthen the city by revamping its zoning and development regulations. Relevant goals of the revamping of zoning and develop regulations are to “make urban, walkable design the norm” and to “promote environmentally sustainable land use patterns, transportation options and site plan and construction practices.” By pursuing this development strategy, the City hopes to attract residents back to Syracuse after decades of experiencing an urban exodus and an increase of urban sprawl within the County. The LUDP states that this population transfer is “critical to sustainability efforts related to open space protection and rising energy and transportation costs.” The plan also emphasizes the importance of addressing the high levels of pollution found in Onondaga Creek and Onondaga Lake.

Onondaga County: Sustainable Development Plan

The *Onondaga County Sustainable Development Plan* (“Sustainable Development Plan”) was developed by SOCPA. With a focus on land use and sustainable development, the document addresses the primary challenges of the region including a shift away from a traditional industrial economy as well as a loss of open space, inefficient infrastructure and urban sprawl. The plan states its purpose as follows:

“With a focus on land use and sustainable development patterns, this plan directs County policy and informs our local governments, stakeholders, and residents. The Sustainable Development Plan is a platform to challenge our current approach to development and provide a framework from which sustainable development decisions can be made.” (Onondaga County, June 2012)

The vision for the Sustainable Development Plan is to be a living document that can be “sustained over time and react to changing conditions, technologies and practices” (Onondaga County, June 2012).



Analysis

Identification of Hazards

The Hazard Mitigation Plan identified flooding as the most common type of natural hazard in New York State (Tetra Tech EM Inc., April 2010 with December 2011 Revisions). Flooding within the County occurs most frequently during the spring months as a result of heavy downpours and ice-melt. Such heavy downpours and ice-melt routinely result in the overflow of numerous creeks and streams in the region.



FEMA has recently updated the floodplain map, resulting in an expansion of the designated floodplain (FEMA Floodplain Changes in Onondaga County (2012)). Within Syracuse, the special flood hazard areas, as defined by FEMA, are concentrated around the city's system of waterways, in particular: Harbor Brook, Ley Creek, Meadow Brook, Onondaga Creek, and Onondaga Lake. Flooding is a growing concern across the County, with an increase in documented cases of flooding occurring in recent years (Tetra Tech EM Inc., April 2010 with December 2011 Revisions). The Hazard Mitigation Plan states that urban areas are particularly vulnerable to flooding because of impervious surfaces, such as roads and buildings. There is evidence that the increase in flooding can partially be attributed to urban sprawl and climate change.

This analysis focuses on the risk of flooding because of its frequency, as well as the associated economic and social consequences that flooding would have on the City's economic development. The Hazard Mitigation Plan identifies flooding as a hazard that "pose[s] a significant threat to the county" (Tetra Tech EM Inc., April 2010 with December 2011 Revisions). Moreover, the Plan analyzes the impact on general building stock with respect to the 100 and 500-year flood events. The analysis accounted only for the 100-year flood.¹

*The replacement value of buildings and contents that are exposed to the 100-year flood event is estimated to be **one quarter** of Syracuse's annual budget.*

At the county level, over \$2.7 billion of buildings/contents are exposed to the 100-year flood event. The exposed buildings account for more than 4% of the county's total general building stock inventory. In Syracuse, the replacement value of buildings and contents that are exposed to the 100-year flood event is estimated to be over \$167 million, (\$68 million in commercial buildings, \$90 million in residential buildings, and approximately \$9 million in "other" damages)—or one quarter of the city's \$667 million annual budget (Tetra Tech EM Inc., April 2010 with December 2011 Revisions).

A flood of this magnitude would also jeopardize the safety and well-being of residents and threaten large communities in Syracuse. Nearly 28,000 residential buildings are located within the 100-year floodplain. The Hazard Mitigation Plan estimates that a 100-year flood event in Syracuse would displace about 12,000 residents, or 8.2% of the total city population (Tetra Tech EM Inc., April 2012 with December 2011 revisions). These estimates are all based on historical flood information and the current state of population and buildings in the city. All of these assumptions are subject to change.

Integration of Climate Risk Information

ClimAID, a synthesis report on Responding to Climate Change in New York State, issued by the New York State Energy Research and Development Authority, discusses the state's vulnerability to climate change. The occurrence of flooding in New York State, and Onodaga County in particular, has the potential to deviate from historical trends as a result of climate

¹ Since the current scientific studies, with their conservative calculations, do not predict a significant increase in the occurrence of 500-year floods and because the difference in calculations between potential damage from the 100 and 500 year floods is minimal.

change. The report indicates that intense precipitation and extreme snowstorm events are likely to increase in Onondaga County and surrounding areas (Columbia University, 2011).

While these projected future changes in precipitation patterns resulting from climate change have the potential to increase flooding within Syracuse and the County, there are a number of other factors that interact with precipitation to cause flooding. Most important for our analysis, is the trend of increasing impervious surfaces, reduced vegetative cover and compacted soils that inhibit the ability of soil to store water. According to the study, these anthropogenic factors directly impact the effect that intense precipitation events have on streamflows and subsequent flooding. Since the future trends of urban sprawl and the manner of urban development are unknown, the ClimAID study states that “the question of whether flooding will increase with climate change remains inconclusive (pg. 86)”.

Assessment of Hazard Risk in Strategic Development Areas

While the Hazard Mitigation Plan emphasizes the economic and social concerns of flooding, the focus of the land use plans is on the revitalization of Syracuse and Onondaga County in general. The Comprehensive Plan points to the Lakefront and Downtown in Syracuse as areas that “support distinct economic development opportunities (Syracuse, 2005).” These areas are also highlighted in the SDP’s discussion of various Character Areas, which represent the traditional industries and businesses that are a driver in the County’s development. The “Urban Core” Character Area includes Downtown Syracuse and the Syracuse Lakefront. The Sustainable Development Program’s goal for the Urban Core is to strengthen and support Syracuse as a “nationally recognized regional center of jobs and commerce, culture, education and innovation” (Onondaga County, June 2012).

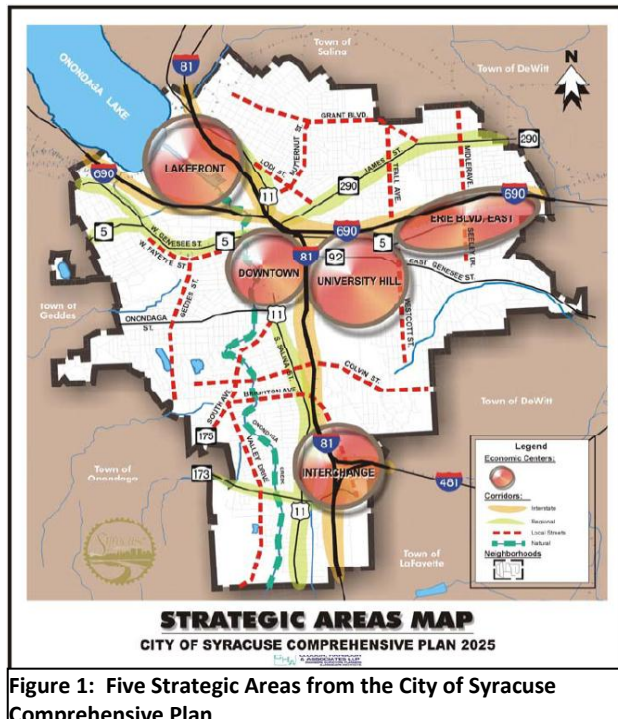


Figure 1: Five Strategic Areas from the City of Syracuse Comprehensive Plan

The goal for the City is to increase the number of retail businesses and residential housing units within the boundaries of Downtown. The Comprehensive Plan envisions Downtown Syracuse as a desirable, mixed-use section of the city that will attract young professionals. The City hopes that the revitalization of Downtown and the presence of a new, young demographic will lead to population growth in the city and the region.

The vision for the Lakefront area in the Comprehensive Plan is for “a premier tourism resort destination” encompassing retail, entertainment, recreation and regional transportation. The Lakefront is home to Destiny USA, one of the largest shopping centers in the nation, which attracts an estimated 20 million visitors per year, (Destiny USA, 2012). The Lakefront is to connect with

the Downtown via the Creekwalk, the area along Onondaga Creek. The Creekwalk is to be developed with restaurants, retail and recreational activities, giving people access to the waterfront.

According to the Hazard Mitigation Plan, there is a documented history of flooding in both the Lakefront and Downtown.

The Onondaga Creek and I-81 corridors, both of which connect the Lakefront to Downtown, have experienced significant flooding. I-81 is particularly vulnerable to flooding between Exit 19 and Exit 20 near Clinton Street and Salina Street. And Onondaga Creek, especially, frequently overflows and floods as a result of heavy downpours and ice-melt. Moreover, the Creekwalk and areas that extend beyond it fall within FEMA's updated floodplain map (FEMA Floodplain Changes in Onondaga County (2012)).

According to the City's website, development along the Creekwalk will incorporate green infrastructure strategies to improve the water quality of Onondaga Creek, including vegetated swales, pervious pavement and rain gardens (City of Syracuse). These green storm water infrastructure strategies may also contribute to reducing the risk of flooding. But the specific Creekwalk development plans make no mention of this dual benefit. It is unclear, therefore, if the extent to which Syracuse plans to use green storm water infrastructure measures will make for an effective way to reduce flood risk.

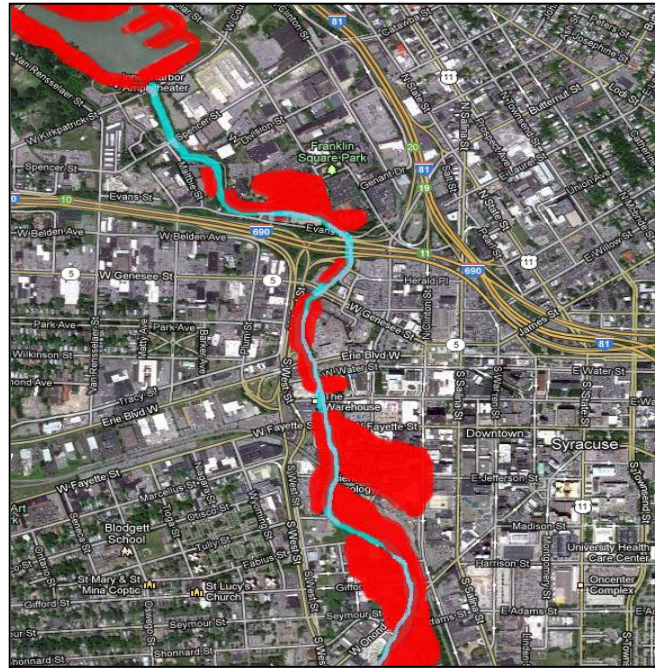


Figure 2: Syracuse Creekwalk. Red shows the floodplain. Blue shows Onondaga Creek

Comparison of the Hazard Mitigation Plan and Syracuse's Comprehensive Plan

While flooding poses a threat to some strategic areas of development in Syracuse, the Comprehensive Plan's only mention of flooding discounts the severity of the risk. It states that "very few areas within the City need to be concerned about the impacts of flooding should the right mix of weather conditions prevail and very few wetlands exist within the City's boundaries."



The Land Use Development Plan (LUDP), which is a component of the Comprehensive Plan, and is meant to guide development, most closely addresses flooding. The LUDP sets a goal to "promote environmentally sustainable land use patterns, transportation options, site plans, and construction practices" (Pg. 37 LUDP). In doing so, the LUDP cites strategies that could reduce flood risks, although they are nominally about improving water quality. Again, there is no explicit mention of the additional benefits these strategies offer for flood mitigation. Some strategies outlined in the LUDP that offer this dual benefit of improving water quality while also reducing flood risk associated with property damage or loss include:

- IV.1.1 Write the zoning code to allow for community gardens and urban agriculture at tiered, increasing intensities and size in most zoning districts (Pg. 37 LUDP)
- IV.2.1 Adopt landscaping standards for large parking lots that reduce impermeable surfaces, encourage increased tree-canopy cover, and screen parking from the pedestrian realm. (Pg. 37 LUDP)
- IV.3 Streams, wetlands, and steep slopes should be mapped within the next three years and inappropriate impacts of development should be restricted through a protective zoning overlay. (Pg. 38 LUDP)
- IV.4 Connect the city's open space network. Coordinate green-infrastructure and parks projects to create a connected ecosystem and recreation network. (Pg. 38 LUDP)

Comparison of the Hazard Mitigation Plan and Onondaga County Sustainable Development Plan Draft

The Onondaga County Sustainable Development Plan—Draft (SDP) outlines a framework for “settlement patterns that will foster sustainability and provide a region of opportunity for future generations” (A New County Sustainable Development Plan). The SDP is based on three main objectives: economic feasibility, social equity, and environmental stability. The SDP acknowledges that flooding is a problem in the county and the development of its open spaces such as wetlands and floodplains only compounds the problem.

According to the SDP, wetlands and floodplains provide important ecosystem services such as flood and storm water control, wildlife habitat, water quality protection, pollution treatment, and groundwater recharge (Onondaga County, June 2012). The SDP makes the point that it is important to protect wetlands and floodplains because “when land is developed, these natural processes [the land’s ability to absorb, store and slowly release water] are compromised, resulting in increased runoff ... and increasing the potential for flooding.” (Onondaga County, June 2012).

Water quality measures in the SDP are outlined to reduce the detrimental effects of storm water runoff on water quality in the area. These measures include new investments in water and sewer infrastructure, pipeline network, municipal sewer lines, the Onondaga County Consolidated Sanitary District, and the number of wastewater pumping stations, implementation of the “Save the Rain” program, limiting combined sewer overflow events, and the preservation of wetlands and floodplains.



While some of these measures can also be considered sustainability strategies that reduce the risk of flooding, the SDP only discusses their water quality benefits. These measures also reflect recommended flood reduction strategies in the hazard mitigation plan.

The “Save the Rain” program is the leading initiative in developing green infrastructure in the use of environmentally sustainable solutions to reduce storm water pollution. In 2011 alone,

Onondaga implemented more than 50 green infrastructure projects through the program. The “Save the Rain” program also encompasses three additional green programs that help homeowners and local businesses participate in capturing storm water using green technology:

the Green Improvement Fund, which offers financial incentives to private land owners for the installation of green infrastructure such as pervious pavement, rain gardens, green roofs, etc.; the Rain Barrel Program, which distributes free rain barrels to homeowners in Syracuse; and the Urban Forestry Program, which has developed a strategy for tree plantings in neighborhoods throughout Syracuse (Onondaga County, June 2012).

By failing to acknowledge the fact that some of these green technologies can be used to improve water quality while also performing the role of flood mitigation, the SDP misses an opportunity to achieve its purpose of “a platform to challenge [their] current approach to development.”

Conclusion

Flood risk reduction and economic development appear as disparate and unrelated pursuits in the plans discussed above. The Creekwalk, whose development accounts for a key strategy in the development of Syracuse, is located in the floodplain. Similarly, areas of the Lakefront and Downtown are either in the floodplain or have a history of flooding.

The Sustainable Development Plan and the Comprehensive Plan, which are to guide land use in the county and the city, largely overlook the risk of flooding. It is only in recommending the implementation of green storm water infrastructure to improve water quality that these plans make an indirect, but unspoken, contribution to flood risk reduction. The plans demonstrate the disconnect between hazard mitigation planning and local land use planning.

The analysis of these plans served as the foundation for creating a methodology, which is found below, that any community can use to integrate hazard mitigation into land use planning efforts. Coupled with the recommendations of encouraging pre-disaster preparedness, cross referencing of plans, and the facilitation of coordination of stakeholders, this report can serve as a key resource for future land use planning.

Methodology

Integrating Hazard Mitigation into Land Use

By integrating hazard mitigation and land use, communities contribute to their sustainable development. The methodology below outlines the steps that local planners and other government officials can take to incorporate hazard mitigation policies into development plans.

The first step is to identify relevant plans that should address hazards and the impact they have on issues such as transportation, economic development, and sustainability. Planners then have to identify hazards that could affect both current and future development, and prioritize these hazards based on social, economic, and environmental risks. During this phase, it is imperative to incorporate climate data into risk assessment. Historical climate information is no longer a reliable predictor of the future, so planners should gather projected climate data to determine future development and how to address this development accordingly in plans.

As the negative effects of hazards have the greatest impact on strategic development areas, it is necessary to assess the risks hazards pose to these specific areas. Climate information should be used to enhance the risk assessments of these areas; and the results of these assessments should be used to identify conflicts between hazard mitigation and other planning, or failures to account for hazards in land use plans. Integration can be better achieved by ensuring that plans are cross-referenced; and that communication and coordination takes place among those who plan for hazard mitigation and those who plan for land use. In the final phase of this process, hazard mitigation and land use blend together through the implementation of sustainability strategies, whose effect is to allow for development that is less vulnerable and more resilient to hazards and which improves environmental performance. To determine the most suitable sustainability measures, planners must first prioritize these strategies by comparing their service lifecycles with those of planned development projects, as well as with the probability of hazards over time. Planners must then perform a cost-benefit analysis of high priority sustainability measures to account for avoided damage from hazards and improved environmental performance.

FEMA provides two computer software programs to help local officials determine the most beneficial sustainability measures:

- Benefit-Cost Analysis (BCA) Tool
- Hazards-United States (Hazus)

BCA is applied to determine the costs and benefits of sustainable mitigation measures compared to the cost of damage. Costs are defined as expenses needed for mitigation measures and damage-related reparations and benefits are typically defined as avoided

damage. The FEMA BCA Tool is available for download on the Internet and provides guidelines and software modules for a range of major natural hazards. The tool also allows users to address multiple hazards in a single BCA module run.

Another assessment tool that can be used to determine potential damage and beneficial mitigation approaches is Hazus, a nationally applicable standardized methodology that contains models for estimating potential losses due to natural disasters. This system graphically illustrates the limits of identified high-risk locations, using Geographic Information Systems technology to estimate physical, economic, and social impacts of disasters.

While the phases of the methodology organizational process help to provide short-term direction on integrating hazard mitigation into planning, the most important aspect of the methodology is to transform long-term planning documents into those that address hazard mitigation and incorporate sustainable measures. In turn, this integrative planning will decrease vulnerability and create resilience to promote the sustainable development of a community.

Phase 1

Identify Relevant Plans

- Select hazard mitigation, land use, and related plans that ought to account for hazards (e.g. transportation, economic development, and sustainability).
- Review each plan's structure, goals, and time horizon.
- Briefly summarize each plan.

Phase 2

Identify Hazards and Associated Risks

- Use the hazard mitigation plan to identify hazards that could affect current and future development.
- Prioritize hazards based on social, economic, and environmental risks (Risk = Probability x Magnitude of Impact).
- Identify local factors that contribute to hazard events.

Phase 3

Integrate Climate Risk Information

- Gather available climate projections pertaining to local hazards.
- Account for climate risk information to assess any changes in the probability of future hazard events.
- Consider the timing of any changes in the probability of future hazard events.
- Reprioritize hazards based on new assessment of risk and any changes in time horizons.

Phase 4
Assess Hazard
Risk in
Strategic
Development
Areas

- Identify strategic development areas.
- Understand historic risk information (frequency, intensity and damage) for each area.
- Integrate climate risk information to produce a new risk assessment of the hazard for each strategic development area.
- Compare the risk assessment to plans for strategic development areas.
- Identify conflicts between hazard mitigation and other plans (e.g. land use), or any failure to account for the hazard in future plans.

Phase 5
Integrate
Hazard
Mitigation into
Other Local
Planning

- Cross-reference hazard mitigation, land use and other local plans to ensure that each account for the other.
- Establish regular communication and coordination among local government officials who work on hazard mitigation, land use, and other types of local planning.

Phase 6
Implement
Sustainability to Bridge
the Gap Between
Hazard Mitigation and
Local Planning

- Identify sustainability measures for current and future planning that reduce hazard risks and improve environmental performance.
- Prioritize sustainability measures by comparing their service lifecycle with those of planned development projects and the probability of hazards over time.
- Perform a cost-benefit analysis of high priority sustainability measures, accounting for avoided damage from hazards and improved environmental performance (e.g. water quality).
- Integrate the most suitable sustainability measures in development projects.



A Resource Guide for Sustainable Flooding Mitigation

M.S. in Sustainability Management, Integrative Capstone Workshop Fall 2012



Introduction

This resource guide identifies strategies that are available for managing the risk of urban riverine flooding and improving environmental performance. This guide organizes strategies into three categories: 1) infrastructure, both green and the built environment, 2) policy, and 3) economic.

Inherently sustainable strategies are needed in order to reduce the risk to urban flooding. The implementation of these strategies has three objectives: 1) reduce community vulnerability to flooding, 2) increase resilience, and 3) improve environmental performance. In addition, these strategies tend to reduce the risk of flooding at a lower cost than comparable grey infrastructure projects such as new drainage systems and levies.

Cities have long developed near water. Be it shoreline or riverbank, proximity to water has provided communities access to drinking water and efficient ways to conduct commerce. But the proximity to water also holds the risk of flooding. Moreover, economic development forces have exacerbated the risks by degrading wetlands, reducing the surface area that can absorb water, disrupting the natural flow of water, and by extending building in the floodplain.

Ceasing or reversing such economic development is difficult, or even infeasible. It is, therefore, paramount to implement strategies that not only allow for short-term economic gain, but that safeguard communities over the long-term.

In order to assist local land use planners in choosing sustainable strategies listed in this resource guide, as well as to develop the framework when reading the strategies, a list of selection criteria has been provided.

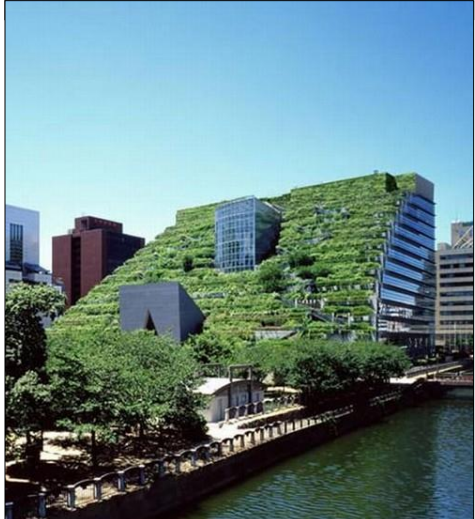


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Selection Criteria

When considering which strategies to employ to mitigate the risk of flooding, land planners need to place sustainability first and foremost. Symmetry, in the form of cost benefit analysis, is needed between financial accessibility and the most effective strategies for vulnerability reduction. Stability needs to be in place between economic development and community protection. Level consideration needs to be incorporated into social aspects that affect additional costs to citizens/business owners and forced protection of their life and property. Balance further needs to be achieved in the implementation of any appropriate strategy. Municipalities are better served by slow and steady implementation of strategies and improvement of resilience than an attempt to implement every idea at once. Many of the strategies in this guide may already be in place or on the planning board. Other choices need to be implemented as they fit into, or help positively modify, the municipality's Master Plans. This section intends to assist local municipalities in developing the decision-making framework for choosing sustainable strategies.

Selection Criteria

Local Hazard History Considerations:

- Specifically, what areas & assets are vulnerable to flooding?
- Historically, what impacts has flooding had on the specified location?
- Historically, what costs of damage have been associated with flooding?
- What are the potential impacts from flooding?

Geographical Considerations:

- What obstacles does the geography of the location present?
- What opportunities does the geography of the location present?
- Does the location have any topographical studies conducted that report on the drainage basin?

Infrastructure Considerations:

- What current infrastructure is in place to address flooding?
- Does current infrastructure have the capacity (i.e. big enough, strong enough, well-maintained) to deal with flooding?
- What affordable additional infrastructure would help reduce vulnerability to flooding?

Selection Criteria

Social/Population Considerations:

- In what way does population density interact with flooding?
 - How many residential properties are located within the floodplain?
 - Do residents within the floodplain have flood insurance?
 - What portion of residential population within the floodplain qualifies as low-income?
- Historically, has the community accepted the impacts of flooding as part of life in the location?
- How important are the past and potential impacts to the community at large?
- What is the community's perspective on the most important factors in an effort to reduce vulnerability to flooding?

Existing Effort Considerations:

- What has been done thus far by all agencies and organizations in the specific location to address flooding?
 - What are the local organizations?
 - What are their stated goals and/or missions?
 - To what extent has what has been done worked or demonstrated potential?
- What local planning documents currently exist?
 - Do the documents account for mitigation measures for flooding?
 - What is the last time these documents were updated?
- What county-wide or state-wide planning documents currently exist?
 - Do the documents account for mitigation measures for flooding?
 - What is the last time these documents were updated?

Selection Criteria

Development Considerations:

- What development plans currently exist (economic or community quality of life improvement) that would be at risk should flooding occur?
 - Are these plans slated for development within the floodplain?
- What zoning regulations apply to development in the floodplain?

Cross-Jurisdictional Considerations:

- Does flooding cross municipal boundaries?
- If so, do the abutting municipalities share a concern about flooding?
- Do the abutting municipalities have a history of co-operation, disagreement or mutual disregard?
- Is there historical information about previous flooding occurrences in that area?

Community Goals Considerations:

- Are there specific changes city planners would like to make in the at-risk area regardless of flooding?
 - Are these changes commercial-focused?
 - Are these changes industrial-focused?
 - Are these changes residential-focused?

Selection Criteria

Administrative & Financial Considerations:

- What is the locations planning budget?
 - What portion of the budget is allocated towards:
 - Planning
 - Development Services
 - Emergency Management
 - Environmental Services
 - Public Works
 - Transportation
 - Infrastructure
 - Parks & Recreation
- What funding opportunities address the mitigation of flooding within the specific location?
- What funding opportunities address the mitigation of flooding within the county?
- What funding opportunities address the mitigation of flooding within the state?
- What federal funding opportunities address the mitigation of flooding?
- Are municipal administrative changes (i.e. more staff, dedicated department) needed to reduce the risk of flooding?

External Reference/Case Study Considerations:

- What have other similar communities done to reduce vulnerability and enhance resilience to flooding?

Green Infrastructure & The Built Environment

According to The Conservation Fund, “Green Infrastructure is strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions, and provide associated benefits to human populations.” Green infrastructure, in other words, is the natural integration of woodlands, wetlands, grasslands, meadows, rivers, and lakes, working together as nature originally intended. By incorporating green infrastructure into the built environment, we can foster a more symbiotic relationship between human beings and nature.

Green Roofs

What is a Green Roof?

Green roofs take a non-traditional design approach by depositing layers of vegetation and pervious materials across impervious rooftop areas. Green roofs may be commonly referred to as “living roofs” because of the subsequently formed rooftop ecosystem.

How does it work? Water is stored in the various pervious materials, rooftop vegetation then absorbs the water, and water is returned to the atmosphere through transpiration & evaporation.



For Further Information

[Green Roofs & Sustainable Cities](http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson%20on%20Green%20Roofs): *This website provides a general overview of the rationale, effort, benefits, & risk of green roofs*
[http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson on Green Roofs](http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson%20on%20Green%20Roofs)

[Best Management Practices](http://www.hudsoncountynj.org/Data/Sites/1/dept/planning/documents/greenfeatureschecklist.pdf): *This document provides the best management practices for implementation & maintenance.*
<http://www.hudsoncountynj.org/Data/Sites/1/dept/planning/documents/greenfeatureschecklist.pdf>

[Case Study: NYC](http://www.nasa.gov/pdf/665642main_NASA_and_Green_Roof_Research_Revised_9_6_2012.pdf): *A study by Nasa on the benefits of green roofs and their ability to control storm water runoff*
http://www.nasa.gov/pdf/665642main_NASA_and_Green_Roof_Research_Revised_9_6_2012.pdf

Sustainability Benefits

- Reduces runoff by absorbing rainwater
- Provides building insulation, reducing energy costs
- Enhances biodiversity by creating a habitat for wildlife
- Reduces the heat island effect, reducing costs of climate change adaptation
- Improve air quality by reducing ground level ozone
- Vegetative layering protects shell of roof, increasing the life span of roof materials
- Increases property value

Bioswales



Sustainability Benefits

- Protects environmentally-sensitive areas
- Low Impact Development Approach
- Contributes to the protection of biodiversity
- Enhances local water quality
- Reduces the amount of storm water runoff

What are Bioswales?

Bioswales -- large vegetated open conduits -- are alternatives to conventional storm sewers. In addition to improving water quality and filtering storm water runoff, bioswales absorb low flows of storm water, and direct superfluous flows directly to surface waters.

Bioswales have moderately sloped sides that are designed to maximize the time water spends in the vegetated channel, allowing for the storm water to purify by way of infiltration back into the ground water supply.

For Further Information

Performance: *Study measuring storm runoff, pollutant loading, and tree growth*
http://www.fs.fed.us/psw/publications/mcpherson/psw_2011_mcpherson005.pdf

Standards: *Department of Environmental Protection in the City of New York provides standards and illustrations for the various forms of bioswales*
http://www.nyc.gov/html/dep/pdf/green_infrastructure/bioswales-standard-designs.pdf

Design: *Compilation of Best Management Practices on the design and use of bioswales by the Department of Environmental Quality in the State of Oregon*
<http://www.deq.state.or.us/wq/stormwater/docs/nwr/biofilters.pdf>

Rain Gardens

What are Rain Gardens?

Rain gardens are shallow vegetated areas that collect storm water runoff from impervious surfaces. This strategy reduces inundation of water into the sewer system while purifying the polluted water and recharging the ground water supply. This reduction occurs because the deep roots of the plant species located in the gardens absorb and filter the storm water runoff.

For Further Information

Design: *Background, design, benefits, and impacts on rain gardens compiled by the Environmental Protection Agency*

http://www.epa.gov/oaintrnt/stormwater/edison_rain_garden.htm

Decentralized Storm water Management: *A case study that examines how storm water management decentralized at the watershed level may positively impact ecosystem services*

http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=158068

Performance: *A systematic analysis of hydrologic performance in regards to rain garden size*

http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=219767



Sustainability Benefits

- Reduces storm water runoff
- Utilizes native species
- Reduces irrigation demands
- Increases property value

Infiltration Trenches

What are Infiltration Trenches?

Infiltration trenches are long, narrow, and shallow pits filled with rocks that collect storm water runoff. The runoff is stored in the void between the rocks allowing the water to filter slowly into the surrounding soils.

For Further Information

Background Information: *Description, Design, Advantages, Construction, and Maintenance information*

http://www.metrocouncil.org/environment/water/bmp/CH3_STInfilTrenches.pdf

Costs: *Costs summary for infiltration trenches and sand filters*

http://www.waterboards.ca.gov/losangeles/board_decisions/basin_plan_amendments/technical_documents/2005-006/05_0328/LAR%20Metals%20Appendix%20III_032805.pdf

Best Management Practices: *Examines the role of infiltration trenches on the hydrologic performance in regards to the size of the watershed*

http://www3.villanova.edu/vusp/Outreach/Pdf/Thesis/Benford%20HANS_THESIS_2009_05_07.pdf

Sustainability Benefits

- Reduces storm water runoff
- Improves local water quality
- Provides ground water supply recharging



Pervious Pavement

What is Pervious Pavement?

Pervious pavement replaces traditional impervious pavement. This strategy allows for the purification of storm water that falls onto parking lots through infiltration into the ground water supply. Pervious pavement may include: grass, pervious concrete, pervious asphalt, or interlocking concrete pavers.

Storm water runoff moves through several layers of bedding into soil after passing through the pervious surface. This surface typically consists of porous pavement that is placed over a pervious layer of crushed stone and gravel, and a thin filtering fabric. The open spaces between the crushed material act as storage for the runoff.

For Further Information

[Background Information:](http://www.stormh2o.com/SW/Articles/Porous%20Asphalt%20Pavement%20With%20Recharge%20Beds%2020Year%20228.aspx) *Information on the history, design, cost, construction, maintenance and water quality associated with pervious pavement*
[http://www.stormh2o.com/SW/Articles/Porous Asphalt Pavement With Recharge Beds 20 Year 228.aspx](http://www.stormh2o.com/SW/Articles/Porous%20Asphalt%20Pavement%20With%20Recharge%20Beds%2020Year%20228.aspx)

[Fact Sheet:](http://www.cleanwatermn.org/Documents/MS4%20toolkit%20files/Good%20Housekeeping/Porous%20Pavement/porouspa.pdf) *Explains the design & installation, advantages & disadvantages, performance, costs, and maintenance associated with pervious pavement*
<http://www.cleanwatermn.org/Documents/MS4%20toolkit%20files/Good%20Housekeeping/Porous%20Pavement/porouspa.pdf>



Sustainability Benefits

- Reduces impervious areas
- Reduces storm water runoff
- Multifunctional structure

Green Streets



What are Green Streets?

Two aspects of street design relate to storm water and its impacts: the pattern of the street and how the street is constructed (width, materials, etc.) The design of green streets involves creating a network of well-connected streets that support multiple transportation modes, and which also improve drainage.

Storm water runoff is reduced by: 1) decreasing street widths, 2) implementing boulevard islands, 3) installing rotary & parking lot islands, 4) incorporating bioswales, 5) planting trees & installing groundcover planters along sidewalks, sidewalk tree and groundcover planters, and 6) retrofitting street materials for improved drainage.

Sustainability Benefits

- Reduces storm water runoff
- Improves water quality
- Enhances property value
- Provides for community connectivity
- Cost-effective alternative to conventional storm water systems

For Further Information

Background Information: *Comprehensive website providing examples, design principles, and general background information*

<http://www.lowimpactdevelopment.org/greenstreets/background.htm>

Policy: *Policies on green street implementation put forth by the City of Portland*

<http://www.portlandonline.com/bes/index.cfm?a=154231&c=45379>

Municipal Handbook: *EPA's handbook on how to manage storm water through green infrastructure, with special attention on green streets*

http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_green_streets.pdf

Native Landscaping

What is Native Landscaping?

Native landscaping is the use of vegetation that is indigenous to the region of a development or redevelopment site.

For Further Information

Background Information: *Considerations for the social, environmental, and economics aspects of using native landscaping*

http://www.epa.gov/greenacres/conf12_04/conf_knwldge.html

Landscaping Guidance: *Provides general landscaping guidance for best management practices for storm water management strategies*

http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/MarylandStormwaterDesignManual/Documents/www.mde.state.md.us/assets/document/sedimentstormwater/Appnd_A.pdf

Case Studies: *Compilation of several case studies of developments that have utilized native landscaping techniques*

<http://www.epa.gov/greenacres/toolkit/chap5.html>



Sustainability Benefits

- Reduces storm water runoff
- Reduces irrigation demand
- Contributes to the protection of biodiversity
- Little to no maintenance required

Green Parking



What is Green Parking?

Green parking refers to implementing techniques that reduce the presence of impervious areas for automobile parking in order to reduce storm water runoff. Techniques include: 1) using pervious pavement, 2) providing parking options for only compact vehicles and bicycles, 3) using bioretention strategies, 4) coordinating parking below ground or below a green roof structure.

For Further Information

Sustainability Benefits

- Reduces storm water runoff
- Reduces GHG emissions

Resource Guide: *Presents fundamental planning and design concepts, and costs effectiveness of green parking*

[http://www.streamteamok.net/Doc link/Green%20Parking%20Lot%20Guide%20\(final\).PDF](http://www.streamteamok.net/Doc link/Green%20Parking%20Lot%20Guide%20(final).PDF)

Case Study: Little Rock, Arkansas: *Pilot project for the EPA's Office of Solid Waste and Emergency Response that utilized storm water best management practices and recycled materials*

<http://www.epa.gov/region6/6sf/pdf/files/heiferparkingstudy.pdf>

Buffer Zones

What are Buffer Zones?

Buffer zones are protected areas of land that run adjacent to waterways. In addition to reducing the amount of storm water runoff, buffer zones physically restrict development from encroaching upon hazardous areas located within the floodplain.

For Further Information

Fact Sheet: *Information on vegetated buffer zones with specific reference to post-construction storm water management in new development and redevelopment*
http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool3_Buffers/BufferZones.htm

Planning: *Provides information on how to plan and establish buffer zones to best contribute to the protection of floodplains*

https://www.hs-magdeburg.de/fachbereiche/f-wasserukreislauf/personal/professoren/luederitz/download/mehr/10_03.pdf

Case Studies: *6 case studies that examine how vegetated buffers can contribute to reducing flooding impacts*

<http://www.epa.gov/owow/wetlands/pdf/Flooding.pdf>



Sustainability Benefits

- Reduces storm water runoff
- Contributes to protecting biodiversity
- Improves local water quality

Cisterns & Rain Barrels

What are Cisterns & Rain Barrels?

Rain barrels and cisterns rely upon gravity to reduce storm water runoff. Rain barrels are placed beneath roof downspouts, outside of a building, to store storm water runoff for future agricultural irrigation use. Cisterns utilize the same method as rain barrels but store volumes of water that are significantly larger. Additionally, water recovered from cisterns may be utilized for non-potable water purposes.

For Further Information

Cistern Case Study: Eugene, Oregon: Residential project exemplifies the using cisterns for rainwater harvesting and allowing for natural infiltration

http://www.oconline.org/our-work/rivers/rivers-files/stormwater-case-studies/LID_CaseStudy_RainwaterRes.pdf

Rain Barrel & Cistern Design: Information on how to design, construct, and locate these storm water mitigation strategies

<http://www.wellwater.bse.vt.edu/files/RainCisterns.PDF>

Rain Barrel Case Study: Newark, Delaware: Project that provided free rain barrels to homeowners in order to collect rain water

http://www.wr.udel.edu/publications/ChristinaBasin/cbwrareport/cbwrareport_appendix_d.pdf

Sustainability Benefits

- Reduces storm water runoff
- Reduces GHG emissions
- Cost-effective

EPA's Green Infrastructure Communities

Anacostia River Watershed

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-3.pdf>

Austin, Texas

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-6.pdf>

Chelsea, Massachusetts

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-1.pdf>

Denver, Colorado

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-8.pdf>

Jacksonville, Florida

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-4.pdf>

EPA's Green Infrastructure Communities

Kansas City, Missouri

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-7.pdf>

Los Angeles, California

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-9.pdf>

Northeast Ohio Regional Sewer District

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-8.pdf>

Onondaga County, New York

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-2.pdf>

Puyallup, Washington

For More Information:

<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Region-8.pdf>

Policy Strategies

Many useful strategies to reduce vulnerability and increase resilience to flooding are dependent upon policy decisions that affect the built environment. These policy decisions are choices the city must make, balancing economic factors such as costs to the city (tax money) and/or costs directly to the public. The policy decision suggestions that follow, by adjusting the way local governments consider risk, can help communities reduce vulnerability to natural hazards as well as improve their ability to recover.

Policy Strategies

Mixed Land Use Zoning

Mixed land use is a zoning policy intended to decrease density in the floodplain while increasing density in alternate locations within the same municipality. Increased density through compact development practices decreases the amount of impervious surface areas contributing to storm water runoff. Mixed land use additionally contributes to community connectivity by locating basic services within easy access to the population.

Smart Growth: www.smartgrowth.org

Design Principles: <http://www.healthyplaces.org.au/site/>

Increased Depression Drainage

Every municipality demonstrates places where water collects, even in moderate rains. These areas need to be addressed first when storm drain upgrades are considered. Examples include areas beneath railroad and/or highway bridges and low areas of roadways. These areas are often too low to permit gravity drainage. Subsequently, these areas must either be pumped to a storm drain, or to another outlet (stream or creek or wetland), or prevented from accumulating water.

Drainage:

<http://encarta.msn.com>

Building Design Requirements for Structures in Risk Areas

Flooding mitigation techniques established by the National Institute of Building Sciences Whole Building Design Guide include: 1) elevating the building so that the lowest floor is above the flood level, 2) incorporating dry flood-proofing by making the building watertight, 3) implementing wet flood-proofing by requiring uninhabited portions of the building to be resistant to water damage, 4) relocating the building, and 5) incorporating floodwalls into site design to keep water away from the building.

Design Guide: <http://www.wbdg.org/>

National Flood Insurance: <http://www.fema.gov/national-flood-insurance-program>

Pre-Storm Reservoir Drawdown

In anticipation of a major rain event, reservoir levels can be reduced to enable the impoundment to capture runoff, preventing contribution to rising river volume. In addition, this process can be a cost effective way of controlling unwanted invasive water plants.

Method:

<http://www.ecy.wa.gov/programs/wq/plants/management/drawdown.html>

Policy Strategies

Wetland Construction

Where geography allows, or where previously existed, wetlands can be created in order to allow the areas to hold a greater volume of runoff. Wetlands are also positive contributors to environmental performance as they create wildlife habitat and water filtration as well as aquifer recharge areas. While wetland construction, or reconstruction, is usually in response to water quality issues or habitat creation, wetlands also serve as effective flood control and aquifer recharge systems.

A Handbook of Constructed Wetlands:
www.water.epa.gov

Require pervious pavement for all new roadway and parking applications

In order to reduce storm water runoff by temporarily storing it before it infiltrates into the subsoil, pervious pavement needs to replace traditional pavement. There are various types of pervious surfaces, including pervious asphalt, pervious concrete, and grass or pervious pavers. Pervious pavement should be sited on low to medium traffic areas, such as residential roads, overflow and special event parking, driveways, utility and access roads, emergency access roads, fire lanes and alleys.

Pavement Alternatives: <http://www.eugene.gov/DocumentCenter/Home/View/4576>

Community Education of Risks

Community acceptance of intermittent risk is a difficult hill to climb. When a community is educated about the risk, they are more likely to accept changes to reduce vulnerability. These changes may include building code upgrades, increased taxes within floodplain areas, as well as zoning changes limiting the location of new structures. It is important that the community understand that a little money spent now will save greater costs later. While it is a cliché, the “ounce of prevention” applies here.

Flood Education:
http://www.em.gov.au/Documents/AJEM_V23_Issue2.PDF

Convert Available Land in Floodplain to Parkland or Other Direct Grade Exposure

Municipalities should convert floodplain land into parkland or other open areas, as the risk of flooding damage is significantly reduced when no people or personal property are in danger. This conversion further enhances environmental performance, protects wildlife, and supports community pride and involvement.

Parks & Recreation: <http://cloud.tpl.org/pubs/ccpe-fromrecreation-re-creation-article.pdf>

Policy Strategies

Require Specific Percentages of Open Land & Farmland Surrounding New & Existing Structures in the Floodplain

Open space and farmland can absorb water, reducing the collection of surface water, and promoting tree and understory growth. This policy approach further provides increased woodland carbon sequestration and aquifer recharge.

Community Benefits:

<http://www.njkeepitgreen.org/documents/CommunityBenefitsOpenSpace.pdf>

Limit New Development in the Floodplain

New development in the floodplain should have limits placed upon structure location and siting. New development should be designed to decrease surface runoff and prevent increase in flood elevations as per 100 year flood. Certain floodplain designations require structures to meet standards that ensure there is no increase in flood levels due to their positioning or grading. While these are federal standards, local municipalities are permitted to enact more stringent rules.

Floodplain Construction Requirements in New York State:

http://www.dec.ny.gov/docs/water_pdf/floodplainconstruction.pdf

Identify Collection Convergence & Flow Rate Acceleration Points

By performing in-depth GPS or other topographical surveys, municipalities are best able to determine their storm water infrastructure challenges and opportunities. Increases in storm water drainage infrastructure, both in drain location and capacity, can be more efficiently implemented with this data. These technological studies also enable a community to track storm water flow and volume at primary locations.

GPS Inventory:

<http://proceedings.esri.com/library/userconf/proc01/professional/papers/pap818/p818.htm>

Analyze & Classify Historical Frequency & Volume of Floods with Property Damage

While the history of flooding in any given geographic area is not a predictor of future flooding, there is a relationship between flood level history and extent of damage. Tracking the history of rainfall and flooding supports the distribution of funds for risk avoidance strategies.

Historical Flood Frequency:

<http://nora.nerc.ac.uk/8060/1/BaylissRepN008060CR.pdf>

Policy Strategies

Increase Gutter and Downspout Capacity, and Direct Runoff to Areas Other Than General Surface Flow

The primary purpose of most on-site practices is to manage runoff from rooftops, driveways and sidewalks. Rooftop runoff, while not free of pollutants, generally has low pollutant concentrations compared to other urban sources. Practices that store rooftop runoff, such as cisterns and rain barrels, are the simplest of all of the on-lot treatment systems. Cisterns and rain barrels can be particularly valuable where rainfall is infrequent, and reuse for irrigation can save homeowners money. Down spouts can be disconnected from the storm drain system and rainfall can instead be collected and stored on site.

California Storm Water Handbook:
www.cabmphandbook.com

Provide Opportunities for Community Involvement in Development Decisions

A critical aspect of hazard mitigation policy in relation to land use planning is community involvement. If the community does not support the strategies of the land use planners the resistance becomes an almost insurmountable obstacle. Successful sustainable communities integrate mitigation strategies that take into consideration all public and private stakeholders.

Public Participation in Natural Hazard Planning:
<http://archone.tamu.edu/epsru/pdf/03-07A.pdf>

Require Flood Proofing Certificate for all New or Refurbished Buildings in the Floodplain

FEMA floodproofing certification both protects a structure and lowers insurance rates. Applications for both residential and non-residential certification are available from FEMA.

FEMA Floodproofing Certificate:
<http://www.dnr.ne.gov/floodplain/flood/Non-ResidentialFloodproofingCert-81-65.pdf>

Increase Storm Drain System Capacity

If not engineered correctly, storm drain systems can be undersized and therefore unable to handle severe storm events such as those that might be associated with a 100-year flood. Expansion of existing storm drain systems is very expensive unless potential expansion is taken into consideration during initial design and construction.

Design:
<http://www.wsdot.wa.gov/publications/manuals/fulltext/M23-03/HydraulicsManual.pdf>

Policy Strategies

Community Flood Warning Systems

According to the Susquehanna Flood Forecast and Warning System, “Enhanced flood forecast and warning systems use hydraulic computer models and weather and climate data from advanced weather satellites and Doppler radar to extend lead time for seeing trouble.” The early warnings allow the residents in the flood risk area to evacuate, and allow municipalities to engage strategies such as reservoir drawdowns and sandbag protection of homes and businesses. The most efficient and effective systems combine resources from a number of federal and state agencies and commissions such as The National Weather Service, State Weather Services and local monitoring groups. Early flood warning systems enhance resilience by giving municipalities and individuals time to move themselves and their belongings to safety.

Susquehanna River Basin Commission. Flood Forecast and Warning System:

www.srbc.net

Financial Strategies

Financing strategies for sustainability include: cost-sharing, private sector funding, blended funding, and cross-jurisdictional support at the local, state, and federal level.

Cost-Sharing: Subsidization, by different entities (both private & public) for project expenses.

Private Sector Funding: Funding that is provided by the part of the economy that is managed by individuals and companies for a profit. Private sector funding is neither state, nor government- controlled.

Blended Funding: Funding that includes pooling money from various financial sources, removing requirements and regulations so that there is a single fund.

The references in this section provide information on sources of funding for actions that contribute to smart growth, low-impact development, green infrastructure, and general community development. The financing strategies in this section cover examples of some, but not all, of these types of financing.

Financial Strategies

Citigroup Community Development

Citigroup is committed to achieving financial inclusion and economic empowerment for underserved individuals, families and communities. By working with nonprofit organizations and public agencies across the U.S., Citigroup forges sustainable business solutions and partnerships to help develop communities.

<http://www.citigroup.com/citi/citizen/community/index.html>

Conservation Security Program (CSP)

Provides technical and financial assistance to soil, air, water, and energy conservation. The program aims to maintain conservation stewardship and implement additional conservation practices that provide added environmental enhancement, while creating powerful incentives for others to meet those same standards of conservation performance.

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/alphabetical/csp/>

Financing Alternatives Comparison Tool (FACT)

Identifies the most cost-effective method to fund a wastewater or drinking water management project. Provides a comprehensive analysis that compares various financing options for projects by incorporating financing, regulatory, and other important costs.

http://water.epa.gov/grants_funding/cwsrf/fact.cfm

Flooding Mitigation Assistance Program (FMA)

FEMA provides grants through the FMA Program to assist with the planning and implementation of flood mitigation projects that include measures to reduce flood losses by elevation, acquisition, or relocation of National Flood Insurance Program (NFIP)-insured structures.

<http://www.fema.gov/flood-mitigation-assistance-program>

Financial Strategies

The Governors' Institute on Community Design

The Governors' Institute on Community Design® advises governors and state leaders as they seek to guide growth and development in their states. The Institute brings together leading practitioners and academicians in the fields of government, design, development, and regional economics to help each state's executive team make informed choices as they shape the future of their states.

<http://www.govinstitute.org/>

Green Infrastructure Funding Resources

List of federal funding resources for green infrastructure projects that contribute to smart growth and sustainable communities.

http://water.epa.gov/infrastructure/greeninfrastructure/gi_funding.cfm

Living Cities: The National Community Development Initiative

An innovative collaboration of 22 of the world's largest foundations and financial institutions. In nearly 20 years Living Cities members have collectively invested almost \$1 billion, helping shape federal funding programs, redirecting public and private resources, and helping communities to build homes, stores, schools, community facilities and more.

<http://www.livingcities.org/>

Morgan Stanley

Morgan Stanley makes investments in environmentally sustainable building projects. Additionally, the firm partners with community development organizations and local governments to create financing models that support environmentally focused building improvements.

<http://www.morganstanley.com/globalcitizen/environment.html>

Financial Strategies

Partnership for Sustainable Communities

Coordinates federal housing, transportation, water, and other infrastructure investments to make neighborhoods more prosperous, allow people to live closer to jobs, save households time and money, and reduce pollution. The partnership agencies incorporate six principles of livability into federal funding programs, policies, and future legislative proposals.

<http://www.sustainablecommunities.gov/aboutUs.html>

PNC Bank

Provides community development lending and investing. The lending financing options are in collaboration with local, state, and federal agencies. Investing is through the PNC Community Partners, Inc. that provides strategic investments to high-impact development projects.

<http://pnccommunityinvolvement.com/communityDevelopment.htm>

Private Financing: Bank of America

Bank of America is a leader in investing in smart growth practices in communities across the country. Their most notable investment is a \$350 million dollar program to revitalize a portion of downtown Charlotte through: brownfields redevelopment, infill projects, and mixed-use development.

<http://www.nh.gov/oep/resourcelibrary/referencelibrary/s/sprawl/documents/gettosg2.pdf>

Section 108 Loan Guarantee Program

Section 108 is the loan guarantee provision of the Community Development Block Grant (CDBG) program. Section 108 provides communities with a source of financing for economic development, housing rehabilitation, public facilities, and large-scale physical development projects

http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/108

Financial Strategies

Surdna Foundation

The Surdna Foundation seeks to foster sustainable communities in the United States—communities guided by principles of social justice and distinguished by healthy environments, strong local economies, and thriving cultures.

<http://www.surdna.org/about-the-foundation/mission-and-history.html>

Sustainable Communities Regional Planning Grants, Combined with Sustainable Communities Partnership

Supports metropolitan and multijurisdictional planning efforts that integrate housing, land use, economic and workforce development, transportation, and infrastructure investments.

http://portal.hud.gov/hudportal/HUD?src=/program_offices/sustainable_housing_communities/sustainable_communities_regional_planning_grants

The Building Blocks for Sustainable Communities Program

Provides technical assistance to communities using various smart growth tools that have demonstrated results and widespread application. Tools include: walking audits, rural and small town zoning evaluations, and complete streets assessments.

www.epa.gov/smartgrowth/buildingblocks.htm

The Ford Foundation Fellowship for Regional Sustainable Development

The Fellowship provides hands-on training, peer knowledge exchange, research and examination of working models on a wide-range of sustainability issues, such as: infrastructure, land use, environmental stewardship, housing, social inclusion, workforce development, education, immigration; and inner-city challenges.

http://www.acce.org/uploadedFiles/Education_and_Events/Ford_RSD_Fellowship/Final2009RSDbrochure.pdf

Financial Strategies

The Forum for Responsible and Sustainable Investment

This forum seeks to advance investment practices that consider environmental, social and corporate governance criteria to generate long-term competitive financial returns and positive societal impact

<http://www.sustainablecommunities.gov/aboutUs.html>

The Foundation Center

Lists information on over 70,000 grants and provides essential information for assistance on grant application. Paid subscriptions allows access to all of the foundation's resources online.

<http://foundationcenter.org/>

The Smart Growth Implementation Assistance Program

Provides technical assistance to state, local, regional, and tribal governments aiming to develop in ways that protect the environment, efficiently use resources, provide economic opportunities, and enhance quality of life.

www.epa.gov/smartgrowth/sgia.htm

The Transportation, Community, and System Preservation Program

Comprehensive initiative of research and grants that examines community development patterns and identifies strategies to encourage private sector development patterns, as well as investments that support these goals.

<http://www.fhwa.dot.gov/tcsp/>

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