

Arch Creek Basin Miami-Dade County, Florida

May 22–27, 2016



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Addressing Climate Vulnerabilities and Social Equity
with an Adaptation Action Area Framework

May 22–27, 2016

About the Urban Land Institute

THE MISSION OF THE URBAN LAND INSTITUTE is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide. ULI is committed to

- Bringing together leaders from across the fields of real estate and land use policy to exchange best practices and serve community needs;
- Fostering collaboration within and beyond ULI's membership through mentoring, dialogue, and problem solving;
- Exploring issues of urbanization, conservation, regeneration, land use, capital formation, and sustainable development;
- Advancing land use policies and design practices that respect the uniqueness of both the built and natural environments;
- Sharing knowledge through education, applied research, publishing, and electronic media; and

- Sustaining a diverse global network of local practice and advisory efforts that address current and future challenges.

Established in 1936, the Institute today has more than 39,000 members worldwide, representing the entire spectrum of the land use and development disciplines. Professionals represented include developers, builders, property owners, investors, architects, public officials, planners, real estate brokers, appraisers, attorneys, engineers, financiers, academics, students, and librarians.

ULI relies heavily on the experience of its members. It is through member involvement and information resources that ULI has been able to set standards of excellence in development practice. The Institute has long been recognized as one of the world's most respected and widely quoted sources of objective information on urban planning, growth, and development.

Cover photos: ULI panel

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About ULI Advisory Services

THE GOAL OF THE ULI ADVISORY SERVICES program is to bring the finest expertise in the real estate field to bear on complex land use planning and development projects, programs, and policies. Since 1947, this program has assembled well over 600 ULI-member teams to help sponsors find creative, practical solutions for issues such as downtown redevelopment, land management strategies, evaluation of development potential, growth management, community revitalization, brownfield redevelopment, military base reuse, provision of low-cost and affordable housing, and asset management strategies, among other matters. A wide variety of public, private, and nonprofit organizations have contracted for ULI's advisory services.

Each panel team is composed of highly qualified professionals who volunteer their time to ULI. They are chosen for their knowledge of the panel topic and screened to ensure their objectivity. ULI's interdisciplinary panel teams provide a holistic look at development problems. A respected ULI member who has previous panel experience chairs each panel.

The agenda for a five-day panel assignment is intensive. It includes an in-depth briefing day composed of a tour of the site and meetings with sponsor representatives; a day of hour-long interviews of typically 50 to 75 key community representatives; and two days of formulating recommendations. Long nights of discussion precede the panel's conclusions. On the final day on site, the panel makes an oral presentation of its findings and conclusions to the sponsor. A written report is prepared and published.

Because the sponsoring entities are responsible for significant preparation before the panel's visit, including sending extensive briefing materials to each member and arranging for the panel to meet with key local community members and stakeholders in the project under consideration, participants in ULI's five-day panel assignments are able to make accurate assessments of a sponsor's issues and

to provide recommendations in a compressed amount of time.

A major strength of the program is ULI's unique ability to draw on the knowledge and expertise of its members, including land developers and owners, public officials, academics, representatives of financial institutions, and others. In fulfillment of the mission of the Urban Land Institute, this Advisory Services panel report is intended to provide objective advice that will promote the responsible use of land to enhance the environment.

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About the Urban Resilience Program

THE URBAN LAND INSTITUTE'S Urban Resilience Program works to help communities prepare for increased climate risk in ways that allow not only a quicker, safer return to normalcy after an event, but also an ability to thrive going forward. Through careful land use planning, wise investment in infrastructure, and smart building design, the value created in our cities can be protected, and they can be more prepared to face adverse events.

Resilience has taken on many meanings in many different contexts. The Urban Land Institute has joined a number of partner organizations to create a shared definition of resilience: the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. Implied in that definition is the ability not just to recover and bounce back, but also to bounce forward. Central to this concept is investment in infrastructure that will provide cobenefits, both enhancing resilience to climate risk and improving quality of life, environmental performance, and economic opportunity.

The Kresge Foundation has provided generous funding support to ULI's resilience work, including the delivery of a series of Advisory Services panels to assess how cities can better prepare for changes deriving from global climate change. Those changes range from rising sea levels and exacerbated drought and air temperatures to more extreme conditions, such as floods and wildfires.

The objective of such panels is to offer advice and guidance to communities that will assist in their formulation of plans and policies and that will, in turn, create stronger responses to and recoveries from such events.

For more information on ULI's Urban Resilience work, visit uli.org/resilience.

For more information on ULI's Advisory Services program, visit uli.org/programs/advisory-services/.

Acknowledgments

THE URBAN LAND INSTITUTE wishes to thank Miami-Dade County for sponsoring this panel, particularly the chief resilience officer, Jim Murley. Kimberly Brown, Katie Hagemann, Nichole Hefty, Lisa Klopp, and Mark Woerner ensured the panel's access to critical information and perspectives and facilitated an excellent and seamless week of work. Thanks as well to the city of North Miami, whose staff members actively participated in the panel. Thank you for inviting the panel into your community to share your challenges and to work toward solutions.

The panel would also like to thank the Kresge Foundation for its generous support of ULI's Urban Resilience Program, which has made these panels possible.

The panel also extends its thanks to the 70 stakeholders from Arch Creek Basin and the larger Miami-Dade County community, who participated in the panel through the interview process. This group of interviewees included elected officials, local business owners, community members, and government staff members. Throughout the week, the ULI panel was continually impressed by Miami-Dade's commitment to resilience, active community groups, and efforts to improve the county.

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Introduction and Executive Summary

MIAMI-DADE COUNTY IS AMONG the U.S. regions most vulnerable to sea-level rise. With about \$416 billion of at-risk assets across 84 coastal miles, the region is extremely exposed and was referred to as “ground zero” for at-risk assets in a 2014 Senate hearing (www.homeland-securitynewswire.com/dr20140507-miami-ground-zero-for-risks-associated-with-sea-level-rise). These assets are not just bricks and mortar. The county is home to 2.6 million people and a rich multicultural fabric of local traditions, languages, food, and arts. These communities face many vulnerabilities arising from the effects of global climate change, such as flooding, storm surge, and high-intensity wind patterns.

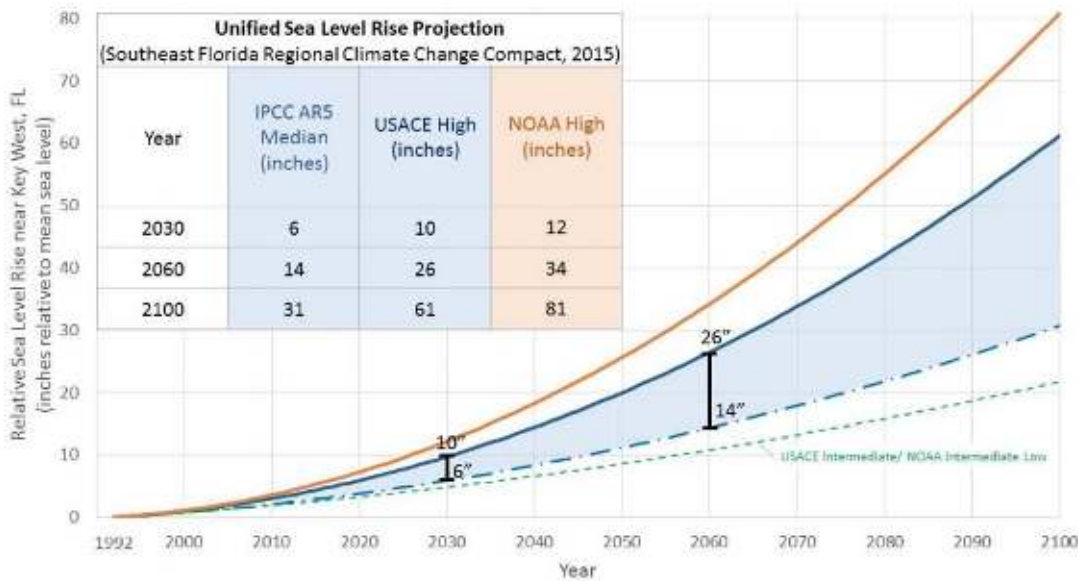
Miami-Dade is also one of the nation’s least-affordable housing markets and faces severe income inequality. Day-to-day realities for low-income families are extremely difficult, without even considering long-term vulnerabilities and exposure to sea-level rise, flooding, and storm risk. “Climate gentrification” is also a concept of increasing concern, with fears that low-income, high-ground neigh-



A resident’s photo of flooding in the Arch Creek area.

borhoods may become unaffordable as residents of the city’s coastal and low-lying neighborhoods seek to relocate to avoid their areas’ inherent risks.

Resilience is a community’s ability to prepare, plan for, absorb, recover from, and more successfully adapt to adverse events, including the impacts of climate change. The concept is a growing focus in Miami-Dade County, particularly given the increased recognition of the threat of sea-level rise. Beyond addressing environmental risks,



Sea-level rise projections for southeast Florida, including data from the Intergovernmental Panel on Climate Change, U.S. Army Corps of Engineers, and the National Oceanic and Atmospheric Administration.



Panelists familiarize themselves with the waterfront community of Sans Souci Estates (above) and Arch Creek Estates (right).



community resilience is strongly correlated with social equity and social cohesion, considering the ability of both the individual and the community to cope with the impacts of climate change and other shocks such as economic downturns. A resilient planning solution therefore must not only protect the city's built and natural environment but also ensure that vulnerable communities can access resources and strengthen the social networks that both enrich life every day and offer lifelines during extreme events.

Today's Miami-Dade is awash with policy makers, professionals, and citizen groups committed to addressing the effects of climate change and safeguarding local residents. Active community groups are well versed in climate-related challenges and provide resources to neighborhoods and households in need. The county has been a national leader in developing new tools for mitigation and participating in frameworks to address climate risk, such as the South Florida Regional Climate Compact. Furthermore, as a founding member of ICLEI (Local Governments for Sustainability, founded in 1990 as the International Council for Local Environmental Initiatives), a signatory to the Compact of Mayors, and the first county to appoint a chief resilience officer, Miami-Dade has many resources and supporters to encourage resilience and implement policies accordingly. The county's recent designation, along with the cities of Miami and Miami Beach, as one of the Rockefeller Foundation's 100 Resilient Cities recognizes the county's commitment to resilience and offers another opportunity to learn from best practices and leverage resources to improve local resiliency.

Adaptation Action Areas, or adaptation areas, are one new policy tool intended to address climate risk at the local level, especially from coastal flooding and sea-level rise. The Florida state government passed legislation in 2013 that enabled local governments to designate specific adaptation areas, and Miami-Dade County followed with a resolution in 2016 to begin designating them. Through Adaptation Action Areas, local governments can catalyze infrastructure investments, prioritize capital improvement projects, and tackle implementation processes on a more manageable scale. The ULI Advisory Services panel sought to develop a resilience strategy for Arch Creek Basin, which has the potential to be a pilot for the use of Adaptation Action Areas in Miami-Dade County. By addressing Arch Creek Basin's long-term vulnerabilities and using the Adaptation Action Area framework, the panel sought to create a blueprint replicable elsewhere in the county and beyond.

Study Area

Arch Creek Basin is a 2,838-acre multijurisdictional drainage basin and has the potential to be Miami Dade County's first pilot Adaptation Action Area. Located in the northeastern region of Miami-Dade adjacent to the coastal region of Biscayne Bay, the site includes lands from the municipalities of North Miami, Biscayne Park, North Miami Beach, and Miami Shores, as well as unincorporated county land. The area is economically diverse and could potentially become the site of a new commuter-rail station connecting residents to regional economic opportunities. The range of populations in need within the Arch Creek Basin gives



Chronic flooding and repetitive losses (indicated by yellow dots) affect properties in Arch Creek Basin, many of which overlap with the contours of the historic creek (green).

Miami-Dade the chance to address social and community resilience alongside environmental concerns, putting social equity at the forefront of the climate action agenda.

The original form and functions of the natural Arch Creek drainage basin have been largely modified and degraded: the area is now largely developed with residential, commercial, and institutional uses. Development has crept across the full study area, aside from a few community green spaces, such as Arch Creek Park, home of the historic Arch Creek natural limestone bridge. The large area of low-lying impervious surfaces, including roads, parking lots, and roofs, has led to routine, localized flooding that becomes severe during storm events. The area is also vulnerable to tropical storm surge and high-tide events.

The Federal Emergency Management Agency (FEMA) has classified the entire Arch Creek Basin as “highly vulnerable to flooding,” and 67 percent of the site is in a Special Flood Hazard Area. Much of the area is at risk day to day because of low elevations, making them vulnerable to regular nuisance flooding as well as flooding from adverse events and seasonal high tides. The basin has 78 properties that have experienced “repetitive” losses, seven of which have experienced “severe repetitive” losses; numerous property owners have unsuccessfully applied for FEMA buyouts. Many streets lie below high-tide levels, and most subdivisions were developed before today’s grade requirements, which call for streets to be located on or above the ten-year maximum water level. Given that stormwater



A regional map, including Miami Beach to the east and downtown Miami to the south.

management systems in this county proceed via infiltration, sea-level rise and high levels of groundwater have reduced the drainage capacity of stormwater systems, especially in low-elevation and coastal regions.

Focus Areas

Within the study area, the panel focused on three specific areas, considering what long-term planning and development strategies would provide the most resilient outcomes. These sites all represent challenges and opportunities found elsewhere in south Florida, so strategies could be incorporated into Adaptation Action Area policies elsewhere.

The three focus areas are as follows:

- A future commuter-rail station at the intersection of Florida East Coast Highway and NE 125th Street, close to downtown North Miami. The panel considered this site and the half-mile radius surrounding it to adhere to the urban center designations within the county’s Comprehensive Development Master Plan. This entire site is on relatively high ground for the study area, along



MIAMI-DADE COUNTY

Focus area 3: Arch Creek Estates, a community that has experienced regular flooding, where some residents have resorted to applying for FEMA buyouts.



ULU

Focus area 1: The site for a future commuter-rail station in North Miami, which will present an opportunity for transit-oriented development.



MIAMI-DADE COUNTY

Focus area 2: Aerial view of the Sans Souci Estates, single-family homes along residential canals developed with cut-and-fill techniques.

the ridge on which Henry Flagler built the original Florida East Coast Railway.

- The waterfront community of Sans Souci Estates, a 1950s-style single-family subdivision. The area includes residential canals developed through cut-and-fill techniques, more than 80 percent of which were carried out before the requirements of the FEMA Flood Insurance Rate Map.

- The Arch Creek Estates neighborhood, a low-income and mixed-income area at a low elevation that experiences routine flooding. The vast majority of the housing units in Arch Creek Estates were constructed before the county's flood criteria and the FEMA Flood Insurance Rate Map. Properties that have experienced repetitive losses from flooding are clustered, many along the contours of the historic Arch Creek.

Panel Assignment and Questions

The panel sponsor, Miami-Dade County, tasked the panel with addressing overall resilience planning approaches within Arch Creek Basin and specific interventions in the three focus areas, considering the Adaptation Action Area framework. Key to the assignment was identifying implementation and funding mechanisms to carry out any actions.

In briefing the panelists, the county asked the following strategic questions:

1. The identified study area is a drainage basin, rather than a political subdivision, such as a city or county. How can resilience planning efforts cross these jurisdictional boundaries and address how to best move and manage water?
2. Some neighborhoods within the study area were built in low-lying areas or created by dredge-and-fill policies that formed inland canals. In light of today's knowledge about sea-level rise and enhanced storm events, what opportunities exist to incrementally move toward a more sustainable development pattern in the study area?
3. As the area adapts to reduce flooding risks, how can housing affordability concerns also be addressed simultaneously? Particularly in areas with very low elevations, redevelopment and elevation will be required to effectively address these risks. How can that redevelopment improve access to quality affordable housing?
4. In the wake of a strong tropical storm, communities within this focus area would have varying abilities to respond and be resilient. How can those vulnerabilities be addressed before such an event? What policies could be put in place to reduce these disproportionate impacts?
5. A proposed commuter-rail station is located in the geographic center of the study area. Through a climate adaptation lens, what opportunities exist to implement more sustainable design and land use for the area



Miami-Dade County municipal vehicle.

- around the proposed station site and connections to the new site?
6. What capital or operational improvements are needed to make the area more resilient? How and what best practices can be used to manage and enhance the identified green and open spaces within the study area. What “green infrastructure” should be planned and implemented, particularly along waterways and shorelines?
 7. How should the county, multiple cities, and other taxing authorities best manage implementation and funding of a plan for this multijurisdictional drainage basin?

The Panel's Primary Recommendations

The panel proposed a long-term vision that would increase the resilience and preparedness of Arch Creek Basin, enhance social equity, and create opportunities for all of Arch Creek Basin's residents. The panel's recommendations fall into four main categories:

- Building social resilience in the community, especially among vulnerable populations;
- Encouraging a more resilient and connected development pattern at the future transportation hub on high ground;

- Managing water by restoring some of Arch Creek Basin's historical, natural systems; and
- Using the Adaptation Action Area framework to address governance, financing, and implementation.

Building Social Resilience

Social inequity is a major problem in Miami-Dade County, and climate change is likely to further exacerbate the economic and opportunity divide. Social resilience must therefore be a priority for Miami-Dade County in climate action planning, and community groups and low-income residents need to be actively engaged in planning efforts. Miami-Dade County is already home to many active community and civic groups focused on addressing climate change and supporting populations of all income levels. The panel recommends leveraging this civic infrastructure to enhance social resilience, especially among the more vulnerable populations within the Arch Creek Basin. Neighborhood climate workshops, information dissemination in multiple languages, and resident participation on the Adaptation Action Area Steering Committee would address social equity in building community resilience. As part of a longer-term, more capital-intensive effort, the panel recommends building a Resilience Resource Center that can serve as a support center and gathering place year-round and a recovery assistance center after storms or floods.

Encouraging a More Resilient and Connected Development Pattern

A critical panel recommendation is the development of higher-density housing along the Coastal Ridge, especially at the proposed transit site. The panel strongly supports the construction of the Tri-Rail Coastal Link and transit station at NE 125th Street, which could then support a transit-oriented development (TOD), designed to be an exemplar of resilient development and include housing for the vulnerable. As well as providing greater mobility for study area residents, the transit station provides a logical location for housing on high ground, within downtown North Miami and along NE 125th Street. This new development should be designed to be mixed use, walkable, and mixed

income, creating a unique sense of place and economic development opportunities for downtown North Miami.

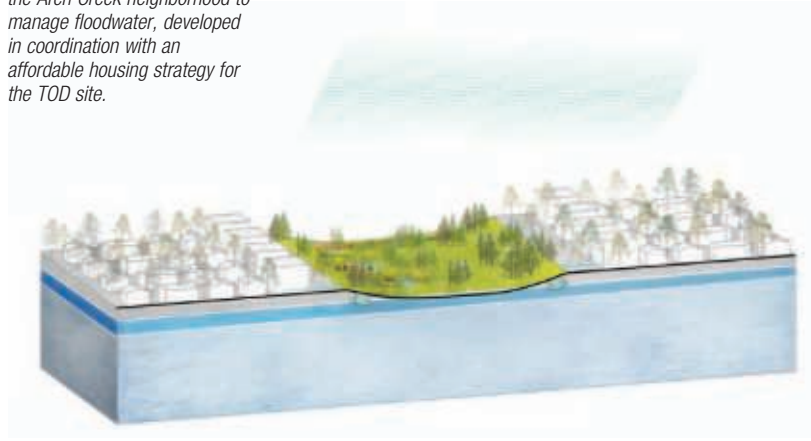
Beyond market-rate residential, office, and retail uses, a new mixed-use development hub must provide affordable housing options for low-income and vulnerable populations within the Adaptation Action Area, particularly those living on at-risk sites. Social equity and affordability must be considered from the conception of the TOD development project, putting funding and policies in place to ensure long-term affordability for owners and renters. This new housing could offer an attractive and safer option for those choosing to relocate from frequently flooded parts of Arch Creek while keeping families within their communities. In fact, those choosing to relocate from vulnerable parts of Arch Creek Basin should receive first right of refusal on the affordable units integrated into the TOD. Over the long term, the relocation of residents from flood-prone sites to a new, high-ground site would enable land assembly needed to create new green spaces.

Managing Water and Restoring Natural Systems

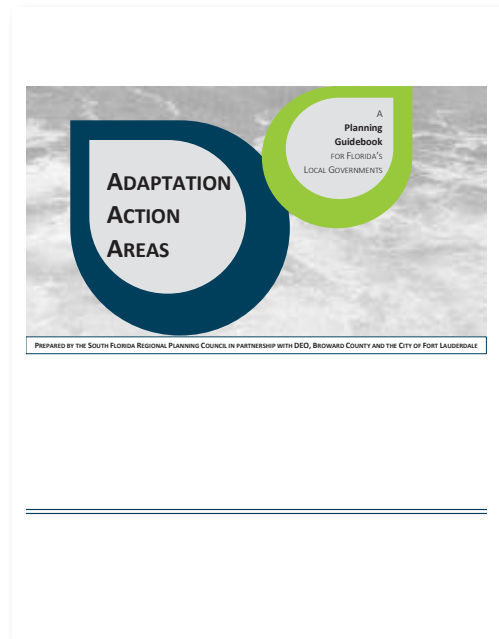
Arch Creek Basin is naturally configured to collect, absorb, and manage floodwaters, and the most flood-prone areas follow the historic contours of the land in the lowest-lying areas. The panel recommends both restoring some of Arch Creek's historic function and implementing short-term, smaller-scale water management actions. Household-level efforts, such as using rain barrels, capturing roof runoff, and increasing the tree canopy, can help improve social cohesion and green space within vulnerable communities while better managing rainfall. Longer-term actions that could partially restore the natural flows of the Arch Creek Basin should be coupled with approaches to allow relocation of flood-prone properties and residents.

The signature long-term action is the creation of a large-scale park, the "city slough," that would allow increased flood storage, minimize flood-pump dependency, and create new, active recreation areas. The slough would be implemented over time in concert with the alternative safe housing strategy, through the acquisition and

A city slough park concept would create green space within the Arch Creek neighborhood to manage floodwater, developed in coordination with an affordable housing strategy for the TOD site.



Florida state and municipal governments outlined the feasibility of an Adaptation Action Area framework through a series of policy papers and reports.



assembly of persistent flood-prone properties. The panel also recommends protecting coastal properties through the construction of “mitigation atolls” in Biscayne Bay that would provide some buffering against storm surges while enhancing stormwater storage and water quality functions.

Implementing a Pilot Adaptation Action Area

The Adaptation Action Area framework provides a unique opportunity to implement large-scale resilience planning efforts across jurisdictional boundaries, with Arch Creek Basin serving as a pilot for southeast Florida. The panel recommends using the Adaptation Action Area framework for the Arch Creek Basin by establishing an Adaptation Area Steering Committee within the South Florida Regional Planning Council. This steering committee should include representation from all municipalities within the adaptation area as well as individual local residents. The panel further recommends that comprehensive and capital plans for all the municipalities in Arch Creek Basin be amended to conform to the action area recommendations.

To generate the resources to implement the panel’s recommendations and other resilience needs within the Adaptation Action Area, the panel recommends starting with locally available channels, including the development of a robust capital plan, as recommended by the Miami-Dade Sea Level Rise Task Force. Funding from the North Miami Community Redevelopment Agency (CRA), creation of new Community Development Districts for flood-prone coastal properties, and creation of a land assembly fund to assist with acquisition of flood-prone properties should also be explored.

Economic Context

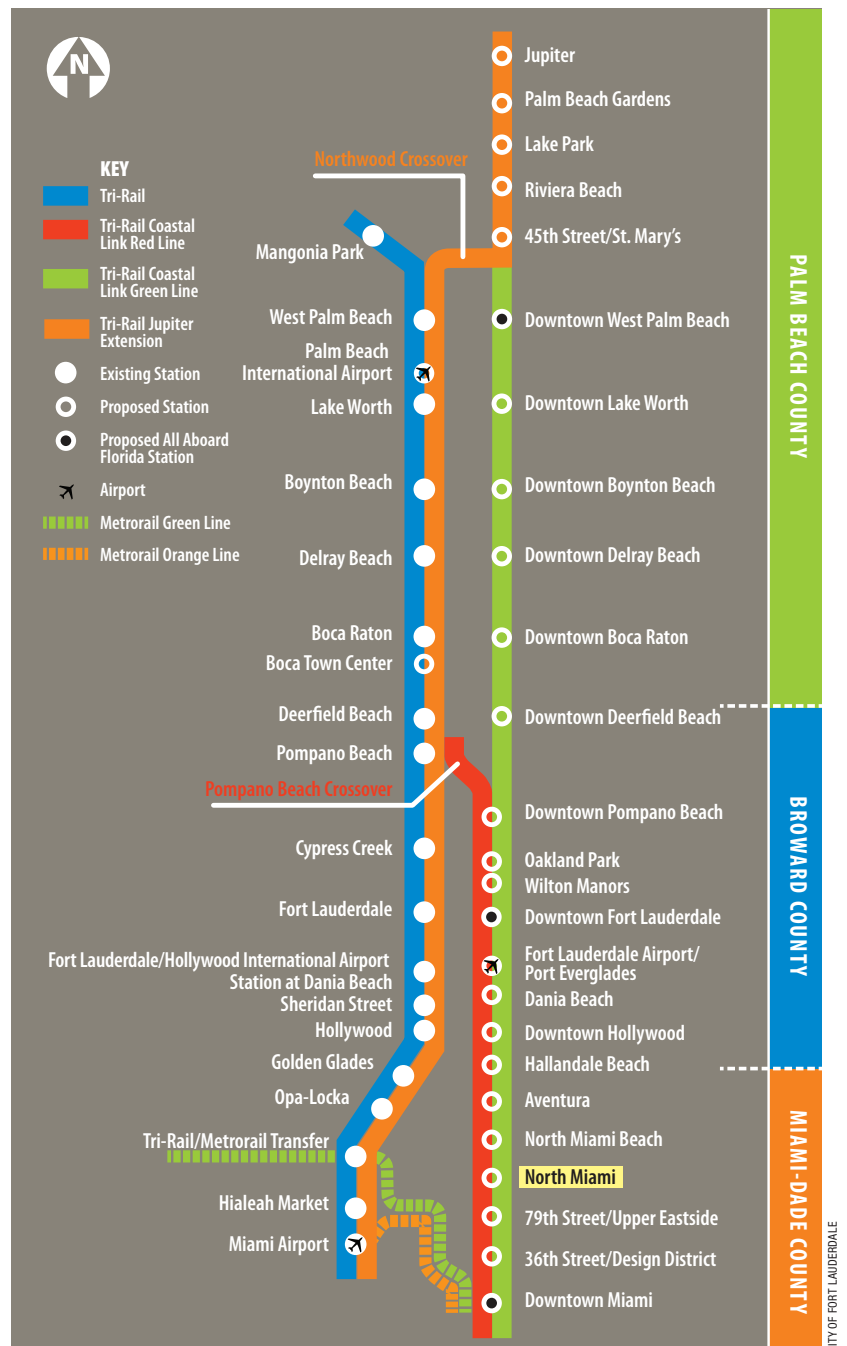
ARCH CREEK BASIN IS LOCATED near the most densely populated areas in the state of Florida, within Miami-Dade County and adjacent to Broward County to the north. The business districts of Miami and Fort Lauderdale are within a 30-minute commuting distance. The international oceanfront resort destinations of Bal Harbour and Miami Beach are moments away to the east across Biscayne Bay. In addition to proximity to these large and often affluent regional markets, labor pools, and economic hubs, the area is well served by nearby regional highway arterials (Interstate 95 among others), Miami International Airport, and freight rail.

The proposed Tri-Rail Coastal Link and planned station stop at 125th Street in downtown North Miami would create an important new commuter-rail connection between

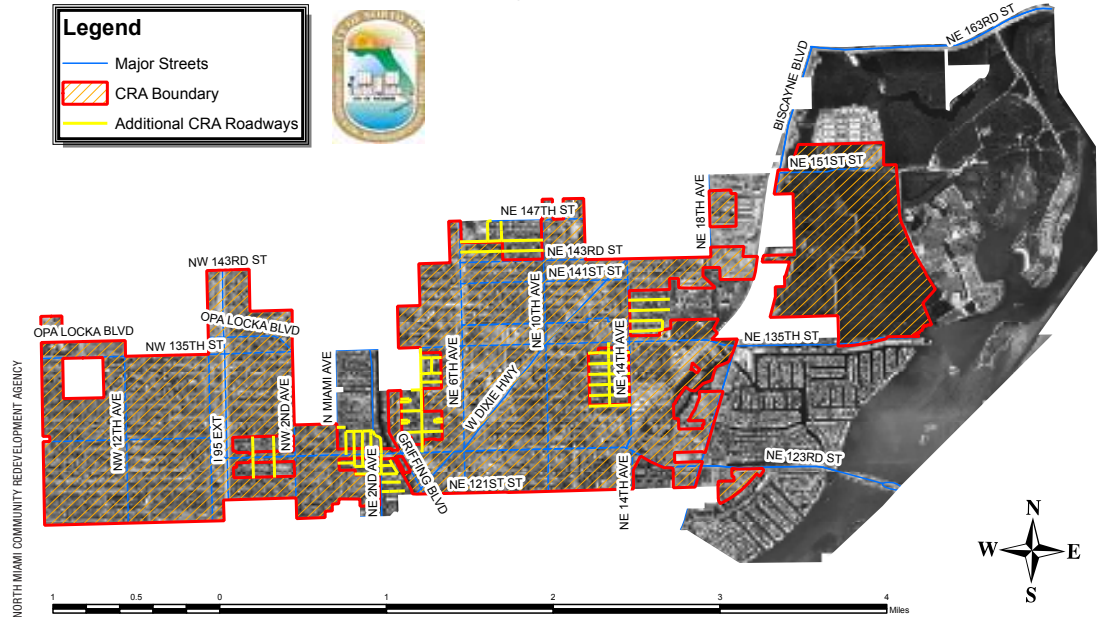
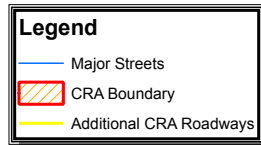
The proposed Tri-Rail Coastal Link map includes planned improvements, such as the new rail station in North Miami (highlighted at lower right), that will increase connectivity throughout the region.

Key Issues

- Strategic location in terms of market access and connections
- Existing economic anchors and institutions, including universities
- Predominantly single-family residential development, with plans to prioritize high-density, mixed-use development in the future
- Limited real estate and economic investment in comparison with the Miami region
- Struggling local communities, with high percentages unemployed or underemployed, or living below the poverty line
- Proposed new commuter-rail station



North Miami CRA Boundary



North Miami designated about 60 percent of the city's land to be redeveloped through the CRA. New roadways and mixed-use developments will be prioritized.

downtown Miami, Fort Lauderdale, and Palm Beach. The new BrightLine express passenger intercoastal high-speed rail planned to Miami and Palm Beach in 2017 has facilitated the development of the Tri-Rail Coastal Link passenger rail. This enhanced regional and local connectivity will offer a major opportunity for North Miami.

North Miami, within which much of the Arch Creek Basin is located, has a population of about 61,500 people living within its ten square miles. The area around Arch Creek Basin, and throughout the city of North Miami, is predominantly single-family residential, with just 4 percent of land in commercial uses and 3 percent for light industrial uses. The city's 2016 Comprehensive Plan Update identifies population growth and constrained development potential as the policy basis for potential annexation of unincorporated nearby lands. The plan prioritizes higher-density, mixed-use development along the downtown area's main arterials of NE 125th Street, W. Dixie Highway, and Biscayne Boulevard and identifies the potential for a TOD node near the intersection of NE 125 and the Florida East Coast Railway. Development incentives for future growth are expected to occur through the CRA, an independent government agency established in 2005 by the city of

North Miami and Miami-Dade County. The designated Community Redevelopment Area comprises some 3,250 acres, about 60 percent of the city.

Economic anchors in the area include Florida International University (FIU), Johnson & Wales University, and Barry University; Channel 2 (a PBS television station); Whole Foods Market and Publix supermarket; a Catholic Health Services nursing facility; and the North Miami municipal government. A cluster of film and entertainment labs and studios that are well regarded by the entertainment industry are also located in North Miami.

Despite its locational strengths, in 2014 a significant percentage of the local population was either underemployed or unemployed, with 14.2 percent unemployed. Moreover, in 2014 more than 26 percent of the population lived below the poverty line, and more than half is housing-cost burdened, including 48 percent of homeowners and 67 percent of renters. Access to economic opportunity for local residents needs to be increased, which encompasses increasing transportation connections to job centers, augmenting the number of employment opportunities within

North Miami, and addressing the need for job training to prepare more local residents for skilled employment.

Overall, the neighborhoods in the Arch Creek Basin have seen a limited amount of new development investment relative to the Greater Miami area, which has witnessed explosive growth. One recent exception is Solē Mia Miami in North Miami, a 183-acre, \$4 billion mixed-use development by Oleta Partners LLC, which is a partnership between the LeFrak Organization and Turnberry Associates. The project's location on a brownfield site takes advantage of an underused site, and the former landfill creates higher-elevation land. With 4,390 residential units and up to 1.4 million square feet of commercial office, retail, and hotel, the complex will create construction and permanent jobs through a jobs placement and training agreement with the local community. An increased demand for local goods and services is also likely to benefit the small business community of North Miami. The additional population can be expected to make use of the proposed new commuter-train service, particularly the proposed station stop at 163rd Street near the Solē Mia main entrance at 151st Street.

The Tri-Rail link and associated commuter-rail station will offer new opportunities in this extremely automobile-dependent region. Currently, a lack of transit options increases the cost burden for low-income families, who must have cars to access employment. The street grid also offers limited connections and evacuation routes,



The site for the proposed Tri-Rail Coastal Link station is surrounded by a low density of uses, providing an opportunity for housing and economic development.

with few east–west routes linking to the north–south arterials, making all of the population vulnerable in the face of storms and floods. Some of the evacuation corridors themselves are also vulnerable to flooding, largely from storm surge. This transportation pattern not only puts the community at risk but also undermines growth and social mobility.

Beyond improved transportation, the area is in need of more economic opportunities and the land use strategies to support them. Currently, the study area has a limited economic base, leaving small businesses vulnerable. The universities located in the study area report that few students would stay in this immediate area upon graduation. In short, the area is largely a bedroom community that relies on jobs elsewhere.

Landforms and Infrastructure Context

THE NATURAL AND BUILT CONDITIONS of Miami-Dade County's land use pattern pose complex and unusual constraints to devising resilience strategies. Many of the earliest interventions to the natural environment increased the vulnerability of public infrastructure and private property in the region.

Arch Creek Basin and its surroundings are underlain by the Miami limestone formation, including some of the lowest-lying terrain in the United States. The pattern visible in the Florida Keys exists at a slightly higher elevation in and around North Miami. During relatively recent geologic history, coral reefs have deposited limestone of varied textures and heights. Much as the keys emerge from surrounding open ocean areas, the north-south ridge of tougher, resistant limestone forms a higher-elevation spine standing above adjacent plains and sloughs occupied by moist or wet areas. However, the "high ground" in North Miami is not very high by most standards, barely standing above forecast rising sea levels and suggesting that North Miami may resemble the keys within a few generations.

Key Issues

- Porous bedrock and a shallow water table that underlie the entire region
- Freshwater supply threatened by saltwater intrusion
- Extreme high tides and storm surge that cause coastal flooding today
- Sea-level rise that threatens to inundate large areas more often in the future
- Water management practices that must balance flood and water supply needs
- The area's overtaxed drainage network



The "spine" created by deposited limestone in the Florida Keys is higher than surrounding terrain and therefore makes an attractive area for infrastructure.

The bedrock in the area is highly porous and permeable to horizontal flow as well as to infiltration from above. The water table is very shallow and has been viewed as a troublesome factor for development and agriculture. The notable exception is the different texture of much of the ridge formation, which serves as a more effective, though incomplete, barrier to flow horizontally and vertically. One of the first and largest infrastructure-scale interventions in the south Florida landscape was the development of the canal system now operated by South Florida Water Management District. The system achieved its goal of draining land to ease constraints to chosen land uses, but several new problems were inadvertently created. These problems,



Arch Creek still exists as a creek (left), surrounded by vegetation able to infiltrate surging water. However, much of the creek has been channelized in an effort to collect and control stormwater (right).

combined with sea-level rise, pose new threats to current and future habitation. As sea levels rise and rainfall patterns shift and intensify, the functionality of the drainage system deteriorates, thereby increasing the difficulty of keeping flood-prone areas dry.

Water, Water Everywhere and Not a Drop to Drink

Water dominates the patterns and processes surrounding and affecting Arch Creek Basin, and climate change has already begun to alter conditions, not only during shocks such as hurricanes, but also in day-to-day conditions where streets flood and saltwater corrodes equipment, impeding routines and adding costs. New planning efforts have systematically addressed how to plan for future trends to more effectively invest resources to avoid or minimize excessive ongoing costs and reliability issues. Adaptation Action Areas present one opportunity for cross-jurisdictional planning and management of water.

The regional supply of freshwater is perhaps the area's most fragile and vulnerable resource. Drinking water is drawn from wells west of metropolitan areas as well as from wells underneath the urban area, but adequate supply depends on holding seawater at bay. At current sea levels, intrusion of salty or brackish water threatens the security of long-term wellhead zones. With future sea-level trends, the situation worsens. Without proper stewardship, the freshwater that floats above the denser salty groundwater becomes increasingly jeopardized. Most of the approaches to slow or reverse the inland movement

of saltwater in Miami-Dade County involve efforts to raise water levels in the Biscayne aquifer. Many of the other typical approaches to prevent intrusion of saltwater (such as floodgates) are difficult or impossible to apply in south Florida because of the porous bedrock, which allows water to percolate from below.

Replenishment of freshwater is understood to be a necessary priority, but implementation so far has been spotty. Miami-Dade County has the lowest rate of treated water reuse in the entire state, which otherwise leads the nation in beneficial applications of treated effluent. The county currently uses reverse osmosis to treat water extracted from the brackish Floridan aquifer for use as potable water. North Miami hosts the sole reuse site at the FIU campus, a demonstration of best practices that could be expanded upon elsewhere. Drinking water may of course be provided through technological solutions such as desalination, though costs of doing so—in terms of financial burden and carbon emissions—are high.

Climate Change as Forcing Factor on Flooding

Coastal flooding has long been recognized as a hazard to local residents. The most extreme events feature storm surges during hurricanes, bringing damaging high water onto adjacent low-lying lands, often combined with high-energy waves of even greater height. Recent models of maximum storm surge in northern Biscayne Bay predict 15.5-foot water elevations, not including additional waves. As occurred during Hurricane Katrina, high storm surges

A resident's photos depict floods that are damaging area public spaces, infrastructure, and property.



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can penetrate far inland where terrain is low and few barriers exist, up to a mile or more. South Florida has been lucky to be spared from major storm surge effects for 25 years, and the track of Hurricane Andrew in 1992 affected Homestead, not the denser urban fabric of Greater Miami.

“King tides” governed by lunar action and other factors affect many parts of Greater Miami routinely, including Arch Creek Basin. Recently, unanticipated high tides and flooding resulted from Atlantic Ocean current (Gulf Stream) fluctuation. These high-water events put pipes, pumps, and other structures in contact with corrosive salty water they were not designed to withstand, in addition to causing flooding. Beyond specific high-water events like these, chronic flooding creates many nuisance issues that stress the daily operation and maintenance of public and private investments. The presence of floodwaters above ground is more obvious than the equally insidious penetration of salt-water through porous limestone, which compromises fresh groundwater. As sea-level rise progresses, the frequency and depth of flooding will increase, as will its effects, including a likely increase in insurance rates.

In addition to ocean-driven flooding, flood impacts in Arch Creek Basin stem from rainfall, which pools in areas that lack drainage. Many areas do have drainage, such as pump systems; however, the sites are so low that they are difficult to drain. Flooding therefore affects streets and



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hinders access. In many cases, roadbeds that experience inundation lasting more than 48 hours have been found to be structurally compromised. Flooding also affects buildings, including homes, with disproportionate impacts to socioeconomically disadvantaged neighborhoods. The primary areas that have experienced repetitive losses in Arch Creek Basin follow the ancient contours of Arch Creek and Biscayne Creek. Though the creeks are largely built over, the basins along both creek alignments are still the lowest-lying areas. Various measures to detain, pump, and infiltrate rainwater exist in Arch Creek Basin, though as sea-level rises and rainfall intensity increases, water has nowhere to go. Conversely, using these basins to again perform their natural functions of collecting and infiltrating rainfall and runoff creates opportunities to enhance resilience.

Transportation and Mobility Context

IN MIAMI-DADE COUNTY, transportation has long been linked to the dominant north–south landforms, and all ensuing development has been set in motion by that pattern. Following the natural high terrain made passage easier, meant development was less costly, and mainly avoided constraints of surface water and groundwater.

Arch Creek Memorial Park illustrates the historic alignment of transportation modes. The ancient Tequesta Indian tribe used Arch Creek’s natural limestone bridge as a passage point on the ridge-top trail, as did the Seminoles more recently. The Flagler rail developers selected the same alignment, and the Flagler rail line ran immediately to the west of the natural bridge. Soon after, Biscayne Boulevard was developed slightly to the east with similar north–south orientation. Arch Creek Bridge then collapsed in the 1970s; perhaps decades of heavy rail traffic hastened its demise. Although it has been replaced with an artful reconstruction, its destruction is emblematic of the fragile local transportation system.



Arch Creek’s historic natural limestone bridge, which collapsed after a long history of heavy traffic and has since been rebuilt as a testament to historic Arch Creek.

Today’s Miami-Dade County has a primarily north–south transportation pattern, with pinch-point nodes. A positive of this development pattern is that transit, bike paths, and other support can easily align with the existing infrastructure. However, should an adverse event compromise any spot on the north–south alignment, all modes could be affected. A diversified network offers a more resilient approach, providing residents and visitors with ample routes out and an integrated north–south and east–west system.

Key Issues

- Dominance of north–south transportation routes and their potential fragility at peak times
- Lack of integration of different transportation methods
- Predominance of automobile transportation
- Mismatch between road and rail elevations
- Lack of water-based transportation despite opportunities to enhance connectivity
- Real and perceived poor levels of transit service

Resilience encompasses both agile community development and operational effectiveness during a critical disruption. A major hurricane would be the worst-case example, in terms of disruption and harm to a community. A large-scale evacuation relying on the north–south routes could be problematic, with the auto-dependent transportation pattern contributing to already extreme congestion and putting households without cars at risk. Resilience planning in Miami should support transportation management that would generate enhanced mobility and multimodal travel opportunity, to improve links, decrease traffic day to day, and facilitate worst-case evacuations.

Though Miami-Dade County has an extensive transit system, it falls short of serving its users well. A Brookings Institute study notes that the system ranks fifth in the nation for extent of coverage, but a mere 87th for level of service. During disaster events, mobility plays a critical role in whether people can evacuate and how many personal belongings they may be able to take. The disproportionate impacts of disasters on poor, aged, and physically handicapped residents have played out in recent disasters from Katrina to Sandy and many others. Vulnerable populations can best be served by robust transit options combined with specially organized modes of transportation, such as school bus fleets. Whether under daily operations or critical disaster response conditions, access and mobility need to be managed to serve all segments of the community. Informal jitney-type transport exists in the area and was highly effective in the aftermath of Hurricane Andrew, being more adaptable and responsive than public systems.



Major traffic buildup along northbound I-95 at rush hour.

Demographic Context

DESPITE THE ECONOMIC GROWTH and opportunity in the broader region, the Arch Creek Basin area exhibits tremendous social inequalities and economic disparities, as is the case across Miami-Dade County. Accordingly, the theme of social equity has been woven into all the panel's recommendations. To achieve a more resilient Arch Creek Basin, the area's low-income residents must be protected from climate vulnerability, with support offered in terms of both affordable housing and awareness-raising social programming.

An FIU report confirms the many difficulties that local disadvantaged communities are facing:

- According to FIU's Distressed Neighborhood Index, 31 percent of North Miami's residents are below the poverty line, and 37 percent of Little Haiti's residents are also below the poverty line.
- Poverty is defined as a household living on an income of less than \$25,000 per year, a level that remained unchanged between 2010 and 2014.
- Miami-Dade is also one of the nation's least affordable markets, ranking third for cost-burdened households, with families who pay more than 50 percent of their

income in housing costs representing 51.3 percent of all households in Miami-Dade County. In 2014, 33.5 percent of all households in North Miami paid more than 50 percent of their income toward housing costs.

- After adjusting for inflation, Miami-Dade households earn less than they did in 2000, or a median income of \$42,926 (2014). Researchers find that the income situation is worsening.
- The highest-income residents earn \$40 for every \$1 earned by Miami-Dade's low-income households. That income gap is among the widest in the United States.
- A typical family of four in Miami-Dade County must earn at least \$48,166 to pay for basic needs, including housing, health care, child care, food, and transportation.

Percent Individual Poverty by Census Block Group



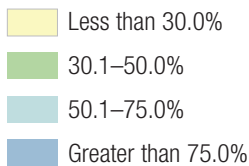
- Less than 15.6%
- 15.6–21.1%
- 21.2–41.4%
- 41.5% or greater

Income disparities are prevalent throughout Miami-Dade County, as shown by this map using the American Community Survey 2014 five-year data. High percentages of individual poverty agglomeration are indicated in red and orange.

Key Issues

- Social inequality and economic disparities within the study area and broader Miami-Dade County
- Unaffordable housing market
- Disproportionate impact of climate stresses on low-income communities
- Strength of local community organizations
- Need for tangible action as well as long-term planning

Cost-Burdened Renters: Gross Rent as a Percentage of Household Income



This map indicates cost-burdened households within the study area. An unaffordable housing market coupled with a low median income leaves many renters in the county struggling to pay for their homes.



- According to the United Way's ALICE (Asset-Limited, Income Constrained, Employed) index, an additional 29 percent of families living above the poverty line are still struggling.

Mobility for Mobility

The aforementioned indicators demonstrate the urgent need to address questions of social and economic equality throughout Miami-Dade County. Yet these indicators of distress are more pronounced in certain areas of the county, including within Arch Creek Basin. For example, over 50 percent of children live in poverty in distressed neighborhoods close to the study area, such as 79th Street in Liberty City, not far from affluent neighborhoods along Biscayne Bay.

Increasing research demonstrates that location affects a whole host of performance indicators related to mental health, school performance, and public health. According to research by Raj Chetty and Nathaniel Hendren analyzing data from the Moving to Opportunity program of the U.S. Department of Housing and Urban Development (HUD),

neighborhood can determine an individual's earning potential and life chances. All else being equal, low-income boys who grew up in low-income areas earn about 35 percent less on average than otherwise similar low-income children who grew up in areas with increased mobility. Children who move before the age of ten to a low-poverty neighborhood with better schools have a much better chance of escaping poverty than their peers who remain in neighborhoods of concentrated poverty. Neighborhoods of opportunity offer greater economic mobility, especially transit-oriented, walkable, urban places that offer access to better jobs, better schools, and better health outcomes.

Community Climate Risk and Resilience

Vulnerability to the effects of climate change is unequal, and the poorest people face the widest assortment of climate-related stresses. In Miami-Dade County, low-income residents are growing increasingly concerned about flooding, insurance, displacement, and overall gentrification, including "climate gentrification," as sea levels rise. However, these communities are frequently not part of decision making focused on climate change.

Beyond Miami, U.S. cities have historically overlooked equity goals as part of their climate and sustainability plans, and even when these issues are included, equity is often treated as a secondary or tertiary issue. "Pursuing Equity and Justice in a Changing Climate," a study published in 2015 in the *Journal of Planning Education and Research* of Climate Action Plans from a sample of 28 medium-sized and large cities, found that although addressing equity is an emerging trend, it was lost among other environmental and economic priorities. The Arch Creek Basin Adaptation Action Area has a chance to lead the way in putting social equity at the forefront of its climate action agenda.

Miami-Dade's active community organizations are at the forefront of social equity and community resilience discussions, and the county has an opportunity to capitalize on this energy and passion. Having groups willing to do the hard work necessary to prepare thousands of people for

climate change is unusual, yet Miami has dozens of groups doing just this. With added support and encouragement from the county, Arch Creek Basin and the larger region could serve as a model for south Florida and beyond.

Social resilience is about practice, not perfection. Many climate plans lay out long-term steps for cities to take to become more resilient, but communities that are already facing continued stresses want to see actions being taken now. A recurring desire from community groups was action: many cited a need to see progress in addressing their current challenges, rather than a longer planning process. Integrating a series of immediate to long-term actions will be an important part of the development of the resilience strategy for Arch Creek Basin.

Recommendation: Build Social Resilience

ARCH CREEK BASIN HAS TREMENDOUS potential as a pilot project for Miami-Dade County and all of south Florida. Not only is it poised to be the county's first Adaptation Action Area, but it also could be an important example of how social equity goals can be embedded in resilience planning. A more equitable Arch Creek Basin will be a more resilient place, and resilience planning will be most successful when building on the social and community structures already in place.

Developing resilience at the community level must be a top priority. First, efforts should ensure that vulnerable populations are able to access precious federal, state, and local resources and that all communities are well informed, respected, and empowered to make better choices for themselves and their families. Local government and community organizations can provide resources to ensure that community members have access to information and must ensure that policies respect their needs.

In the case of Arch Creek Basin, some hard decisions should be made regarding future housing, land use, and development patterns: families living in vulnerable parts of the site who have experienced repetitive flooding losses should consider whether they wish to remain and “live with water” or relocate to safer housing on higher ground. Many smaller-scale efforts also need to be advanced at the community level, such as the implementation of small-scale greening and water-retention projects to alleviate flooding.

The panel has outlined key strategies for advancing social equity as part of the vision for Arch Creek Basin, as discussed in the following sections.



A street in the Arch Creek Estates neighborhood.

Outreach

Outreach and communication activities are an important part of increasing social resilience and could include the following:

- *Make critical information easily understandable and readily accessible for all communities.* A first step in any planning effort is ensuring that all communities have the information they need to make important choices. Because not all local residents have Internet access or the ability to read English, the county should respond with proactive educational efforts, including pamphlets written in multiple languages, such as Spanish and Haitian Creole. Local community groups such as New Florida Majority and Catalyst Miami are well positioned to assist in organizing and educational efforts. For those interested in relocating, as well as those considering how else to make their properties more resilient, local government and community-based organizations can provide financial education and housing counseling.

The long-term resilience of Miami and Arch Creek Basin depends on the decisions of hundreds of thousands of people, and the quality of those decisions will depend on good transparent information, including flood base elevations, impact to insurance, options for buyouts, and so on. Educational materials should not only address climate change threats, but also offer clear information on what residents can do to be more prepared and enhance their community's long-term resilience. Addressing these critical issues will create an environment in which discussion of consequences can take place, as well as strategizing to enhance the probability of safety during future events.

- *Better understand the needs of residents to help inform policy and the development of climate solutions.* Educational efforts should be multifaceted: although the affected communities have much to learn from the county, the county also has much to learn from them. To ensure that policies serve the communities and that critical information will not be lost, public forums, one-on-one discussions, and clear paths of communication with community groups are necessary. Accordingly, community involvement and input is a critical step in the development of a resilience plan for Arch Creek Basin and any Adaptation Action Area.
- *Offer seed funding for community projects.* Many community organizations are currently active in Miami-Dade and have the infrastructure, social connections, and trust to reach the impacted communities. The county, local agencies, and nonprofit or philanthropic groups should offer seed funding to organizations for neighborhood-based engagement and implementation of small-scale, property-based resilience solutions. This will not only enable these organizations to provide extra capacity to test resilience concepts but also empower communities

to be involved in the decision-making process. Funded initiatives could include neighborhood-scale water management, emergency preparedness, education, and capacity-building projects.

- *Fund a county position for community resilience outreach.* Although the county currently does a tremendous amount of informal coordination with groups active in climate change awareness, a position should be funded that focuses explicitly on outreach and building relationships with local communities. Managing the initiatives listed here—including a seed funding program, collation and distribution of information, and community consultation—would be key aspects of the role.
- *Invite community members to sit on key committees.* The city of Miami has shown national leadership by establishing a Sea Level Rise Committee to consider the city's vulnerabilities and explore possible solutions. However, this committee currently lacks representation from the low-income communities that will be particularly impacted. This committee and other relevant communities, working groups, and forums at the county and city levels should invite a representative from the city's most marginalized communities to join, representing their community and ensuring that issues of climate justice and social equity are integrated into the conversation.
- *Consider a design competition or other means of community engagement in the design process.* Going beyond the Arch Creek Basin, a design competition that delves deeper into the design and social challenges for the region could bring public attention to the issue of resilience and provide a collaborative forum to investigate longer-term solutions to a changing climate. Integrating social equity and affordability concerns would also contribute to the national conversation about these



A community garden in Jacksonville, Florida, was made possible through community involvement and outreach.

issues. Rebuild by Design and HUD's National Disaster Resilience Competition offer great examples of interdisciplinary, collaborative projects that have stimulated national debate and offered creative means of developing community-scale solutions.

Housing Policy

Local housing policies and affordable housing funding mechanisms should address climate risk and resilience in the context of broader housing goals. Concrete ways to do this include the following:

- *Include climate risk, resilience, and climate justice in the upcoming HUD Assessment of Fair Housing.* HUD's new Affirmatively Furthering Fair Housing Rule requires recipients of HUD funds to analyze and consider the patterns of segregation, disparity, and inequality in their communities. Governments and agencies must conduct a holistic analysis using HUD-provided national data and local information, including robust community consultation. The end result should be the development of strategies that break down racial and ethnic concentrations of poverty, linked to new funding decisions in a community's consolidated plan.

Given the many ramifications of climate change in Miami-Dade, the topic must be addressed in the upcoming Assessment of Fair Housing. A collective impact strategy will feature a cross-departmental and

cross-jurisdictional approach that may ultimately reorient local government resources.

The city of North Miami recently completed its Consolidated Plan, which means the city has until 2020 to complete its first Assessment of Fair Housing. This provides ample opportunity for the city to develop a holistic strategy and consider joining with Miami-Dade County in a regional assessment of fair housing that will better address the issues of segregation, concentrated poverty, and disparities in resources and infrastructure that do not respect jurisdictional lines. During this planning process, climate gentrification can be included as a lens for developing a fair housing strategy that will affect how HUD funding is deployed.

- *Ensure that housing is added to community benefit agreements (CBAs).* CBAs are an effective tool to ensure that large development projects incorporate benefits and resources for local communities. These CBAs need not be limited to job creation benefits, as recent Miami-Dade CBAs have been. With the high need for affordable and workforce housing, CBAs could include stipulations for affordable and workforce housing. They are a good tool to ensure a mix of housing is provided locally, including housing for low-income families interested in relocating from flood-prone properties.

Children participate in a community workshop about urban development.



Community Actions

Alongside actions by Miami-Dade County and government stakeholders, local community groups and households can help build community resilience in a variety of ways:

- *Hold neighborhood Climate 101 workshops.* Numerous community organizations are already very active in Miami-Dade's affected communities. These groups could initiate a series of workshops that review climate change challenges and solicit community input for on-the-ground solutions. These workshops must be accessible to all: for example, they should be held at locations accessible by transit, at times that accommodate different work schedules, and preferably offer food and child care to encourage maximum turnout. These workshops will also reinforce the social fabric of neighborhoods by gathering people to discuss how they can build resilience in their areas and serve as each other's first responders in emergencies.
- *Continue to develop grassroots leadership.* Groups such as the CLEO (Climate Leadership Engagement Opportunities) Institute and Catalyst Miami are training and developing local leadership within the community. As their work continues, these groups should ensure that leaders are trained in the languages and cultures that make up an ever-more-diverse Miami. These leaders can train others and continue to organize and empower local communities, and ensuring that information provided by the county is used.



FLORENCE BARB HOWE

Household-scale green infrastructure can include rain barrels, which collect rainwater to temporarily reduce flow to storm drains.

- *Support yard-by-yard approaches for stormwater retention.* The integration of green infrastructure at the neighborhood level will be a key aspect of building community resilience in Miami, as explored later in this report. Small-scale solutions, such as rain barrels, rain gardens, and additional street trees, can together significantly reduce chronic flooding. Such measures should also be planned to withstand extreme floods, even though they contribute only an incrementally small reduction to flood impact. Community groups are well positioned to assist with these greening efforts, in terms of both planning and on-the-ground installation. These types of projects, particularly when proposed and sited by a local community, are great candidates for a county seed funding program. Many are suitable for volunteer labor to further expand outreach value and community buy-in and cohesion.

Recommendation: Build on High Ground

WHILE ADDRESSING EXISTING social equity problems, the county must think about how to incrementally move toward a more resilient development pattern, considering the area's inherent flood risks. Arch Creek Basin offers a range of options in terms of elevation and connectivity, and tools offered by the Adaptation Action Area framework could ultimately direct the development of the area.

The Arch Creek Basin long-term master plan envisions transit-oriented development around the proposed new rail station, a strengthened transportation network, and green links along the historic contours of Arch Creek.



Develop a TOD

Within Arch Creek Basin, protection from flooding is more easily accomplished on south Florida's naturally occurring ridge, which has an average elevation of 11 feet. This ridge is the site of Flagler's original railroad, illustrating how Florida's historic development pattern followed the natural landforms. The future commuter-rail station on NE 125th Street will be located on this ridge and will lead to an opportunity for high-density, mixed-use development around it and along the associated axes. With enhanced connectivity between Palm Beach County to the north and downtown Miami to the south, this new development could be a pilot for resilient TOD in Miami-Dade County, including dedicated affordable housing for those interested in relocating from flood-prone areas.

This development has the potential to be a catalyst for solving a number of problems in the study area:

- Economic development and investment potential for downtown North Miami;
- Improved connectivity within the metropolitan area and region;
- Affordable and workforce housing;
- Relocation of residents in flood-prone areas; and
- Improving evacuation routing and capacity.

The county's Comprehensive Plan uses an "urban center" model that encourages mixed-use development with three scales of urban center possible along the Tri-Rail Coastal Link. Of these options, the future NE 125th Street station could best accommodate a Community Urban Center primarily featuring medium- and smaller-sized businesses to serve the nearby community.



The current state of the proposed site for transit-oriented development.



A successful TOD would be a vibrant destination complete with street life, multimodal depots, and mixed-use buildings.

This center is likely to be attractive for all kinds of activities and target groups. Its location next to downtown North Miami has the potential to become a hub for economic development for a larger area, especially given the direct access of NE 123rd Street to the Bay Harbor Islands, with potential for a stronger transit link to the beaches. The proximity of local institutions such as the North Miami Museum of Contemporary Art, Johnson & Wales University, recording studios, and film and theater studios will also add to the potential character of future development. With these competitive advantages, the 125th Street station represents a great opportunity to create a vibrant TOD.

With this development potential comes an opportunity to serve the vulnerable nearby communities. The county can show its commitment to inclusive, resilient development by building affordable housing into the vision from the start and offering a right-of-first-refusal program to residents interested in relocating from vulnerable housing elsewhere within the Adaptation Action Area. Proposed government-owned transit parcels and federal and local funding should be combined to create mixed-use (residential, office, and retail), mixed-income opportunity around the proposed transit center.

Some best practices for vibrant and successful TOD include the following:

- Developing at a higher density to support a mix of uses, including retail, office, and entertainment;
- Developing guidelines for architectural quality within an urban fabric with landscaping, good street furniture, bike-storage facilities, and integrated small-scale park-and-ride facilities;
- Designing a public realm and scale of development that stimulates a walkable and bikable environment;
- Integrating transit with neighborhood-scale support services; and
- Implementing energy-efficient and green systems.

The panel recommends that the county and other actors prioritize the development of a TOD on the high ground around the NE 125th Street station. Strategies to advance the future TOD include the following:

- *Adopt a mixed-use, mixed-income housing strategy within a half mile of the proposed transit station.* An attractive TOD should be a vibrant destination including a range of building types and uses, with retail, offices, residences, and cultural facilities. Locating this development within a half mile of the station will enable a large part of the community to take advantage of the transit proximity and to adopt less car-dependent lifestyles. Designing at a higher density than seen elsewhere in Arch Creek will create a critical mass able to support transit,

Ybor City in Tampa provides an example of successful placemaking for a historic neighborhood. Here, people enjoy the bustling main street during a local festival.



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local retail, and the provision of affordable housing. For example, at its densest point, urban blocks might be up to ten stories tall at a maximum lot coverage of 85 percent and a height of around 110 feet. Further schematic design efforts can develop this scale estimate and create proposals to respond to market demand, create an attractive public realm, and accommodate the desired affordable housing percentage.

- *Design a pedestrian-scaled neighborhood.* Although a TOD will be higher density than the surrounding development in Arch Creek, the development plan must ensure that the ensemble of buildings comes together at a manageable scale for pedestrians. This can be accomplished in a variety of ways, such as the inclusion of ground-floor retail, the integration of small-scale urban green spaces, and the clear separation of public and private space. Miami's form-based code, Miami 21, offers some precedents for achieving context-based, pedestrian-scale development by using a transect-based approach to zoning. This design approach will encourage community members to walk, taking advantage of local businesses and building community ties. Millennials, a critical group in today's real estate market, are attracted to these types of places and can contribute further vitality through their entrepreneurship and use of technology.
- *Emphasize placemaking.* Beyond the design of the built environment, active programming will contribute to the cultural life of the neighborhood and build an identity for

the new district. New development should also seek out synergies with the existing cultural institutions such as the Museum of Contemporary Art, knowledge centers such as Johnson & Wales and FIU, the historic film and recording studios, and the local business community. Business improvement districts and Main Street programs provide good models for revitalizing business districts through a comprehensive approach and can be effective in organizing events that attract new users and residents to a neighborhood. Any approach should ensure that new development complements North Miami's existing downtown and take advantage of existing funding opportunities for revitalization in North Miami. For example, Community Development Block Grant (CDBG) funds could potentially be used to improve streets and sidewalks connecting to those in downtown North Miami.

- *Include a Resilience Resource Center.* As the TOD becomes the community hub within Arch Creek Basin, the county and other stakeholders should invest in a Resilience Resource Center within the heart of the TOD. This center would offer resources related to resilient design, including flood preparedness, green infrastructure, and funding opportunities. Beyond offering comprehensive information, it could operate as an emergency shelter during storm events and a center for poststorm recovery and assistance, including multimodal logistics for supplies and distribution. Sonia Chao, a research associate professor and director of the Center for Urban and Community Design at the University of Miami, has already developed a similar pilot concept, which should contribute to the development of the prototype. For a center like this to be most effective, it should be colocated with other frequently used community facilities, such as a local farmers market and/or offices related to disaster preparedness and recovery administration. Existing community groups should assist with developing programming for the center and promoting it to local residents. Tax increment financing funds from the North Miami CRA could also potentially be used toward climate resilience resources and programming.

Deliver Affordable Housing

The 125th Street TOD offers a great opportunity to provide dedicated affordable housing for at-risk households within Arch Creek Basin, including units of a range of building types and sizes. Accordingly, the panel recommends that the county ensure that the TOD includes dedicated affordable housing for the at-risk households in the area. To ensure success, the county and its development partners must commit to affordable housing and seek out a variety of funding and policy mechanisms for its delivery. The county and development partners must also look at the TOD site holistically, considering any sites that the city of North Miami may already possess or is able to acquire strategically.

The following strategies can be used to deliver affordable housing and public realm improvements:

- *Provide density bonuses for affordable housing within the TOD zone.* Real estate stakeholders should be engaged early and informed of incentives for affordable housing development. Privately developed sites can then profit from an upzoning or area plan that creates incentives for quality, including design, sustainable energy use, and sustainable water use.
- *Work with the CRA.* The CRA could contribute to the development of affordable housing, including rental housing, with priority given to the people of Arch Creek Estate.
- *Use tax increment financing, CDBG, and other funds as appropriate.* The panel recommends increasing the percentage of tax increment financing funds for affordable housing from 10 percent to 20 percent, which would double the amount of funds available for gap financing.
- *Amend Miami-Dade's Affordable Housing Surtax program:* Miami-Dade's housing surtax program provides agencies with funding to deliver housing assistance to low- and moderate-income households. The program currently commits 75 percent of its Documentary Stamp Surtax Program funds to low-income families (meaning families with 80 percent or less of area median income)

and 25 percent to middle-income families, with incomes up to 140 percent of area median income. Beyond considering household income, the program should ensure that the funds supporting first-time homebuyers and the construction of multifamily rental have a preference for Miami-Dade's natural ridge. The surtax program should not fund the development of housing in flood-prone areas.

- *Make additional improvements and investments within the TOD zone to make for more competitive applications for Low-Income Housing Tax Credits.*

Maximize Transportation Resilience

Strategies for maximizing the connectivity and transportation resilience of the TOD include the following:

- *Enhance the emergency evacuation networks.* Arch Creek Basin currently lacks connectivity, with limited east–west routes and frequent traffic congestion along main north–south arterials. Although the county offers an emergency evacuation program with buses, most residents would choose to evacuate by car, using limited routes in and out of the city. Both cars and buses are likely to encounter extreme congestion on these limited routes during an evacuation. The creation of a commuter-rail stop linked to the regional transportation system will offer a valuable alternative, particularly for households without cars. Strengthening the overall east–west transportation routes will also decrease day-to-day congestion and allow residents to be better connected to jobs and other opportunities. The north–south evacuation routes are also currently vulnerable to flooding.
- *Improve overall multimodal connectivity, considering the TOD as a hub.* A 125th Street TOD offers the opportunity to integrate different types of development alongside different transportation nodes. Miami-Dade County should use the 125th Street TOD as a model of integrated transportation planning and build on the opportunities presented by the new commuter-rail system. For example, bike lanes, buses, jitneys or a people mover system should be connected and coordinated with the

Integrating a people-mover system into other transport modalities, such as the system in downtown Miami, is a great way to increase connectivity.



rail hub, to enable residents to live conveniently without a car. Over the long term, connectivity with waterborne transportation should also be a priority.

- **Protect the rail corridor.** The rail corridor is a high-priority investment and should be hardened at higher elevations to ensure long-term use and resilience to storm events and sea-level rise. Currently a significant mismatch exists between most road and rail elevations, and the projected maximum storm surge affecting the study area would immobilize the community and wider region. Some hardening of the rail corridor would support rapid recovery after disaster. High-elevation transit access on new east–west alignments, potentially similar

to the existing people mover in downtown Miami, could provide an option less vulnerable to hurricanes and future sea-level rise effects.

- **Develop additional waterborne transportation options.** Waterborne transportation is common for recreational purposes and, indeed, is a staple of local lifestyles and the resort economy. However, it remains poorly incorporated into the transportation network, for both everyday use and evacuations. Boat speed restrictions (mandated by manatee protection) and the scarcity of public docks together inhibit availability of access points to connect to water taxis, ferries, and the like, as well as attractive travel speeds. Uber has attempted to operate water taxi service during Art Basel, but docks were sparse and rules were interpreted to prevent “commercial use” of public docks. A combination of technology advances, innovative policy updates, and strategic investments in dock facilities could address these barriers, enabling prestorm evacuations, poststorm recovery, and a more flexible and adaptable daily transportation option as sea-level rise affects existing roads. Floating docks and movable dock systems may allow simple pilot projects while facilitating disaster preparedness, response, and recovery.

Recommendation: Restore Natural Systems

A TOD AT NE 125TH STREET would become a new hub for development in Arch Creek Basin, and residents in vulnerable properties could choose to relocate to new affordable properties within the TOD. While crafting the affordable housing strategy for this site, the county should consider how relocations may change the development pattern within the Adaptation Action Area as a whole. As residents decide to relocate, a proactive strategy of reclaiming vulnerable sites for green space would create valuable flood defense for the basin as a whole while providing recreation space for the community.

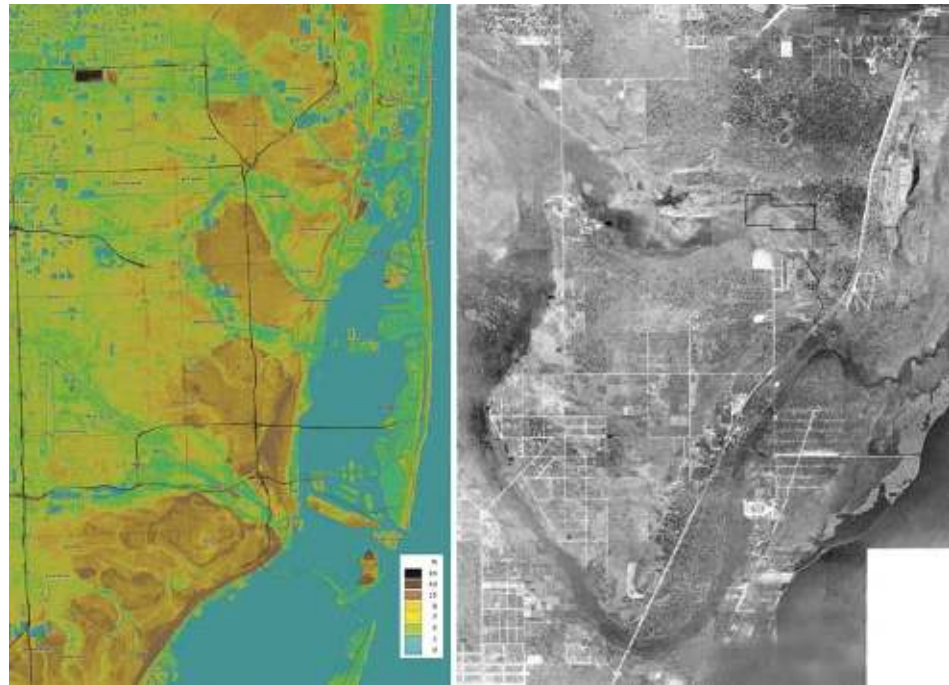
Arch Creek Basin historically held a creek, and many of the properties that have experienced repetitive losses follow the natural contours of the creek's historic bed. If restored, this creek could be used to manage water for the broader neighborhood and increase the area's flood storage capacity.

Rather than continuing to offer new gray infrastructure such as pumps, the county should look to the historic green infrastructure that can naturally manage water and restore the area's ecological function. In short, the county should find a way to help parts of Arch Creek function like a creek again.

A Signature Green Space: The City Slough

Sloughs are low-lying, marshy sites that channel water at a leisurely pace. Characteristic Florida habitats, sloughs can be found throughout the Everglades and connected the Everglades to the Atlantic before Miami was urbanized. These freshwater ecosystems allow slow water movement and provide habitat for a range of species.

In the 19th century, Miami was largely undeveloped, which allowed the natural contours of the land to sustainably

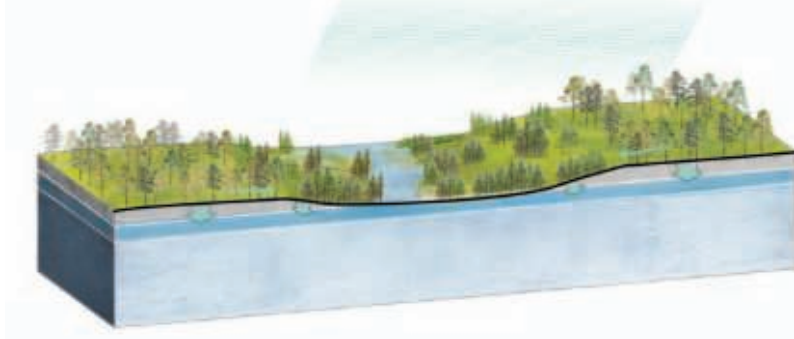


handle the movement of water. Aerial photos of Miami's initial development show Flagler's railroad along the highest ground and natural systems such as Arch Creek continuing to function. However, speculative development in the 20th century ignored these natural geographic considerations, putting people and property in harm's way. Neighborhoods such as Arch Creek Estates sprang up in low-lying areas, with buildings constructed before FEMA elevation requirements were in effect. The impervious surfaces of the roads, roofs, and parking spaces led to decreased water infiltration and water quality, as well as increased flooding risk during routine and exceptional rainfall and storm events.

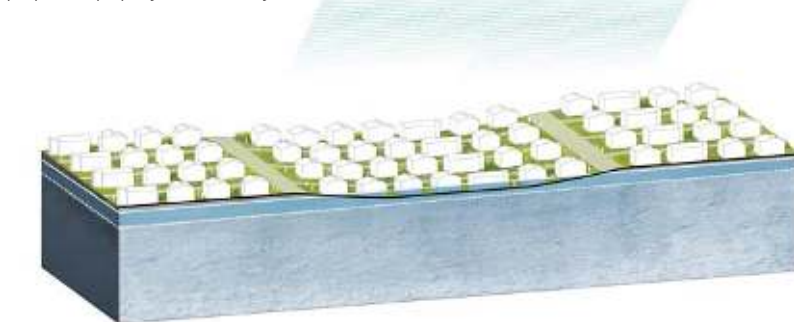
A 21st-century solution would balance the needs of people, water, and nature, creating green spaces in the neighborhood that could make the most of the land's

Aerial photos show Miami-Dade County sloughs' elevation (left) and early development (right) in 1924. Early in Miami's history, development was kept to higher elevations; eventually, however, natural geographic formations were ignored as population grew.

19th-century slough section: nature handles water.



20th-century slough section: development puts people and property in harm's way.



21st-century slough section: a balance of nature, water, and neighborhood.



natural abilities while improving quality of life for local residents. Specifically, transforming the historic creek corridor into a “city slough” over the long term would create a signature green space in Arch Creek that could improve the area’s flood capacity and become neighborhood green space as a focal point around which future development could occur.

A city slough would become the heart of Arch Creek Estates and change the area’s development pattern to a more resilient one, better able to manage the rainfall that is part of south Florida’s seasonal cycle. The historic creek and new surrounding green spaces would have the capacity to absorb and retain stormwater and to improve water quality through natural filtration. The lowest areas would contain water most days, similar to Arch Creek, while slightly higher areas would hold water during substantial rainfall events. Various park and recreation elements are compatible with the combination of features, provided they are planned to withstand periodic inundation. Equally important, a park of this size would provide an active green space for community use and recreation in a neighborhood currently without substantial public green space. Beyond the study area, the city of Miami as a whole lacks accessible community parks: in 2016, the Trust for Public Land Parkscore estimated that 21 percent of the city population did not have a park within a ten-minute walking distance (<http://parkscore.tpl.org/city.php?city=Miami>).

A city slough would be a long-term project, building from voluntary relocations and requiring a proactive land transfer or purchase program. The Adaptation Action Area framework could allow coordination of this work across jurisdictional boundaries, with a management committee potentially housed within the South Florida Regional Council. The slough park would need to be integrated into the larger-scale development and mitigation efforts within the adaptation area. Over the long term, a third party could potentially manage the green space and provide additional opportunities for active programming and ecological development.

Over the longer term, a city slough could also fit within a larger countywide network of green space, blue streets,



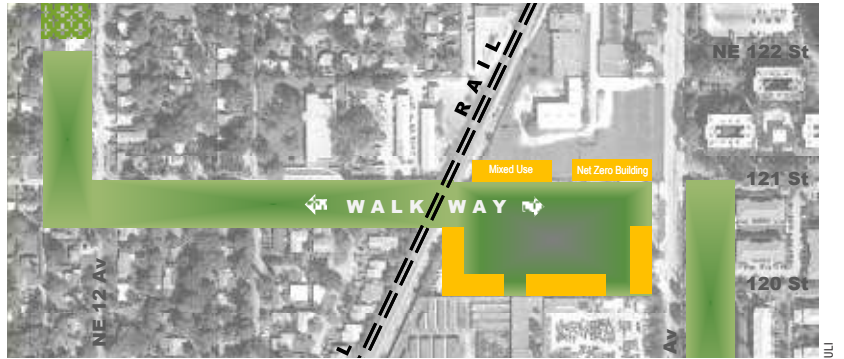
FLORENCE CLIFF

Sloughs are natural water systems that can collect runoff from developed areas.

and flood parks designed to improve ecological function, improve the drainage of high ground, and connect neighborhoods to the water and to natural drainage. To enhance resilience, the county should consider this green network alongside existing and future transportation routes, ensuring that both water and people can effectively move through and out of the city in times of need.

For the design of the city slough, the panel recommends the following:

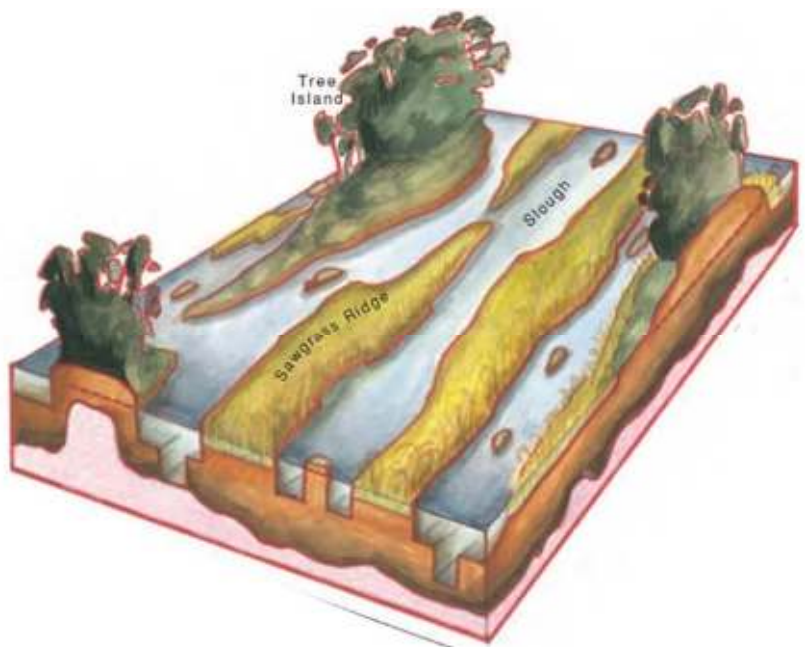
- **Manage stormwater.** The slough should be designed to both create green space and manage stormwater. The incorporation of constructed wetlands, bioswales, rain gardens, and particularly “thirsty” phreatophytic plants would ensure that the slough could retain and channel water during routine and extreme rain events. Vegetation could include native Floridian varieties, such as cypress trees, and species found in the Everglades that are accustomed to regular inundation, such as sawgrasses. County funds could potentially be used for the implementation of some of the flood control and mitigation measures, such as bioswales and wetlands.
- **Reuse rainwater and wastewater.** Beyond managing stormwater, the park should be designed to reuse rainwater. The incorporation of systems and tools such as rain chains and rain gardens could contribute to this goal. The county could also reuse wastewater to irrigate this park landscape and other development on higher ground, as is the practice at FIU’s Biscayne Bay campus.



This concept sketch illustrates that the city slough, or flood park, should be designed for linkage and interface with multimodal transportation, offering safe passageways and opportunities for pedestrians and cyclists.

- **Include mobility links.** Regional transportation opportunities and implications would need to be considered in the design of the slough. The park design should incorporate a smooth connection for the east–west transportation links that are so critical for community and jobs connectivity as well as emergency evacuations. The future development plans for the railroad should also be considered, ensuring safe crossings under railways and roads and incorporating connections to any pedestrian or cyclist infrastructure developed in association with the future Brightline.

A slough includes many natural elements in its makeup.



NATIONAL PARKS SERVICE, SALLY COLBERT



The long-term vision for Arch Creek includes both transit-oriented development and the creation of slough-style green infrastructure. The increased development around the proposed new transit should enable at-risk residents to choose to relocate.

- **Include active, programmed spaces.** The city slough would be an opportunity to both enhance flood protection and provide much-needed recreational space. Programmed activity sites, park sites, and garden sites should be part of the park, alongside areas designed for water management and flood storage. Different types of plantings would populate each zone, with a focus on flowering native trees and shade trees in the programmed spaces. Playing fields can be integrated; multiuse paths, birdwatching, and kayak, canoe, paddle-boat access all appear possible.

Implementation of the City Slough

The panel's recommendations to implement the city slough include the following:

- **Prioritize the development of the slough as part of a long-term resilience strategy, carried out in tandem with the TOD.** The development of the slough is designed to occur in conjunction with the development of additional, higher-density homes at the 125th Street station TOD, as well as along the city slough's edges. Residents from flood-prone areas who are interested in relocating should have the first right of refusal for affordable homes in this development. These residents offered the option to move must have an attractive, well-connected alternative within the community where they already live and work. Some skepticism exists about housing providers' ability to deliver replacement homes, so development at the TOD must be committed to ensure that relocations are an attractive proposition. For the strategy to be achieved, the county and other development players must craft a proactive strategy, creating the mechanisms for buyouts and the implementation of a long-term green-space plan. Ultimately, the city slough will not only play ecological and flood management roles, but it will also offer new and relocated residents a green space that complements the TOD density. Tools from the Adaptation Action Area framework, as well as other approaches such as tax increment financing and land bank tools, could enable the financing and implementation of the green space.

- **Begin on a pilot basis with a three-block transect.** Although envisioned as a long-term project, the city slough could begin on a smaller, pilot basis, potentially at a roughly three-block scale near focus area 3, given that residents from this area are interested in relocating. This "pilot slough" would be a multifunctional flood park, designed to protect the community by managing ground-water through wetlands, trees, and other vegetation.

- **Support varied types of programming.** The city slough should be designed primarily as a natural space, including varied habitats. However, to best use the green space and encourage community use, the park management should provide programming opportunities for the local community. These could include some dedicated recreational spaces, events, and education. Using a park

management model, such as a conservancy or “friends of the park” group, may be useful in providing funding, branding, and management expertise over the long term. Signage—and even incorporation into local school curriculums—could ensure that community members understand the ecological function and benefits of the slough.

- *Seek change in state enabling legislation, adding climate resilience as a CRA category and subsequently purchasing property.* Buyouts along Arch Creek are critical to the implementation of this vision. The CRA is one vehicle that could potentially be used for buyouts, although this function may initially require state enabling legislation to add climate resilience as a category. Once enabled to perform climate resilience–related work, the CRA should buy property along the Arch Creek slough. Site purchases should include land to be designated as open space and additional “edge sites” that could be developed with slightly higher-density affordable and workforce housing overlooking the slough. Policies could also propose the development of higher-density housing along the slough site.
- *Use tax-foreclosed property to “swap” for vulnerable properties.* A property swap with tax-foreclosed properties offers another potential means to acquire vulnerable properties that could fit within the city slough development area and provide relocation options for residents.
- *Designate HOME for relocation of renters in Arch Creek Estates over a five-year period.* HUD’s HOME Investment Partnerships Program, known as HOME, provides states and municipalities with funding for buying, building, and improving affordable housing. HOME is the largest federal block grant designated exclusively for affordable and low-income housing. These funds should be sought to buy out landowners who have suffered repetitive losses in flood-prone areas, as well as for the relocation of renters in Arch Creek Estates.



A canal at Sans Souci Estates.

Integrated Water Management

The implementation of a city slough would contribute to a broader plan for enhancing resilience in Arch Creek Basin, given its tremendous capacity to manage water and reduce flood vulnerability overall. However, beyond considering the possibilities for a large-scale investment such as this one, the county should look to implement more integrated water management approaches day to day. The current use of septic systems in Miami-Dade also lends an increased urgency to water management discussions, given the health, safety, and welfare issues associated with the groundwater.

The panel’s recommendations include the following:

- *Use modern tools to support resilience-informed decision making.* Many tools, such as modeling software, scenario planning, and decision support frameworks, offer resources to address the unique and sensitive dynamics of water planning. Future water management plans should be coordinated across the city, county, and higher levels, considering known trends and scenarios for multiple threats. Recognizing long-term water resource management obstacles that cannot be overcome through better technologies and improved integration will also be useful to guide future investments.
- *Consider closable gates or low-cost deployable plugs for the local canal system.* Many of the South Florida Water Management District canals occupy former natural creeks and sloughs, including Arch Creek and Biscayne Creek. These canals handle some aspects of rainfall-

induced local flooding but compromise regional fresh-water conditions because these canals allow saltwater to flow quickly inland during storms and high tides. Similarly, ongoing urban stormwater management efforts rely on sending water eastward, which defeats groundwater recharge goals.

Establishing low-cost deployable plugs or more elaborate closable gates at the mouths of South Florida Water Management District canals could assist with flood prevention and decrease saltwater intrusion. Such canal closures would have limited effectiveness to prevent serious flooding, in part because of bedrock porosity and the height of surrounding land and structures. However, they could reduce saltwater intrusion effects, and they could better manage nuisance flooding if current or future pumps, or temporary portable equipment, are used to maintain low water behind the plugs.

- *Implement systems for treated wastewater reuse.* Reuse of treated effluent reduces the amount of groundwater extracted and can help replenish fresh groundwater reserves, improving resource stewardship at two levels. Although the current Consent Order appears structured to handle the reuse mandate through end-of-pipe strategies at current treatment plants, alternatives should be considered.

For example, modern technology for decentralized wastewater treatment using anaerobic digestion and membrane bioreactors allows water to be kept local. Nutrient removal is higher at smaller-scale treatment facilities scattered throughout a community than it can be at centralized water treatment plants. The residual nutrients in treated wastewater can then benefit landscape plantings, sports fields, and even certain agricultural areas, where its use is known as “fertigation.” Furthermore, applying effluent to vegetated soils provides tertiary treatment that can achieve the highest-feasible nutrient removal levels, thereby reducing effects to sensitive natural resource areas, including Biscayne Bay and the Everglades.

- *Explore decentralized wastewater systems and alternatives to septic.* Decentralized wastewater systems are not new to south Florida, although the technology today has changed substantially, and its benefits are greater in the face of climate change. Historically, older technology “package plants” handling subdivision sewage treatment led to poor performance and regional problems with nutrient loading and pathogens. Rightfully, that technology was replaced with the current centralized sewer system and treatment plants. Despite a lingering distaste for decentralized systems, new technologies warrant further consideration. North Miami could be a site for a demonstration project featuring decentralized wastewater treatment and reuse, potentially including energy production from biogas recovery. This technology can be funded by third parties through public/private partnerships, providing investment for resilient infrastructure repaid through service fees at lowered costs or avoided damages over time.

Distributed wastewater treatment systems should also be explored as an alternative to the current use of septic, notably at the mobile home park in the vicinity of the Solé Mia development. Building, block, and neighborhood-scale distributed wastewater treatment systems can transform waste into energy, as well as provide irrigation for green spaces such as the city slough. Technologies such as membrane bioreactors and anaerobic digesters are some options that should be considered. Whatever technologies are used, removing

Ballet Valet, a parking garage in Miami Beach, uses green walls to capture rainwater before it hits the ground.



Flickr, PHILIP PESSAR

hazardous septic should be prioritized as development shifts from low to high ground.

Household-Scale Improvements

Alongside large-scale investments such as the city slough and integrated water management practices, opportunities exist to improve the natural functions of Arch Creek Basin on a house-by-house level. These short-term interventions could improve flood preparedness while making progress toward the large-scale vision for Arch Creek Basin.

The panel recommends the following:

- **Retain rainwater at higher elevations.** Capturing rainwater above ground can reduce flooding and help solve the tradeoff between urban inundation and recharge. These solutions include large-scale adoption of rain barrels, building-scale cisterns, and similar measures that capture roof runoff and release it slowly after intense rainfall passes. Examples such as the Ballet Valet garage in



FLICKR, ROGER MOMMAERTS

Rain barrels are a relatively cost- and space-effective way to capture water and combat stormwater runoff.

“Retain Your Rain,” Norfolk, Virginia

Norfolk’s “Retain Your Rain” workshop is an excellent case study of community engagement in implementing household-scale water resilience projects. Held shortly after the Miami panel, the “Retain Your Rain” workshop invited Norfolk neighborhood leaders, business owners, and residents to learn about how to reduce citywide flooding by retaining stormwater on their own properties.

Workshop activities focused on the “how-to” of stormwater management, with a block party and demonstration expo afterward. Participants installed four rain barrels and one rain garden and landscaped a former sidewalk to increase water retention. In total, about 50 neighborhood leaders participated from the Neon District, Ghent, and Chesterfield neighborhoods.

The project was a first effort to apply tactical urbanism efforts to a resilience planning program. *Tactical urbanism* refers to short-term, low-cost projects that can inspire long-term changes in the built environment. Rather than describing resilience as a goal accomplished solely through large-scale infrastructure projects, the workshop introduced



participants to ways to personally enhance the resilience of their houses and neighborhoods, which would also strengthen the position of the city as a whole.

The city hosted the workshop, which was led by Street Plans Collaborative, sponsored by 100 Resilient Cities, and supported by AMEC Foster Wheeler and ioby.

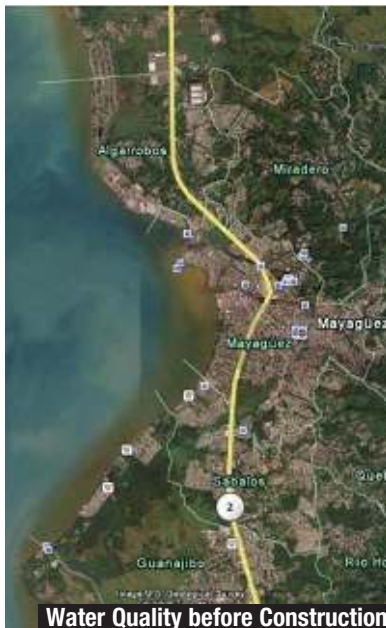
Swales in Arch Creek Estates look tired and no longer offer stormwater management.



Miami Beach incorporate infiltration floors and green walls to capture water that then flows down to irrigate “chia pet” vegetation.

- **Improve existing bioswales in Arch Creek Estates.** The rights-of-way in Arch Creek Estates currently include tired green spaces described as bioswales. However, these stretches of wilted grass and dirt have few water management abilities and are primarily used for garbage collection and parking. The county should prioritize improving these green spaces to restore their function

Mitigation atolls vastly improved the water quality on the coast of Mayaguez, Puerto Rico. Seen below are images before construction (left) and after construction (right) of the atolls.



Water Quality before Construction



Water Quality after Construction

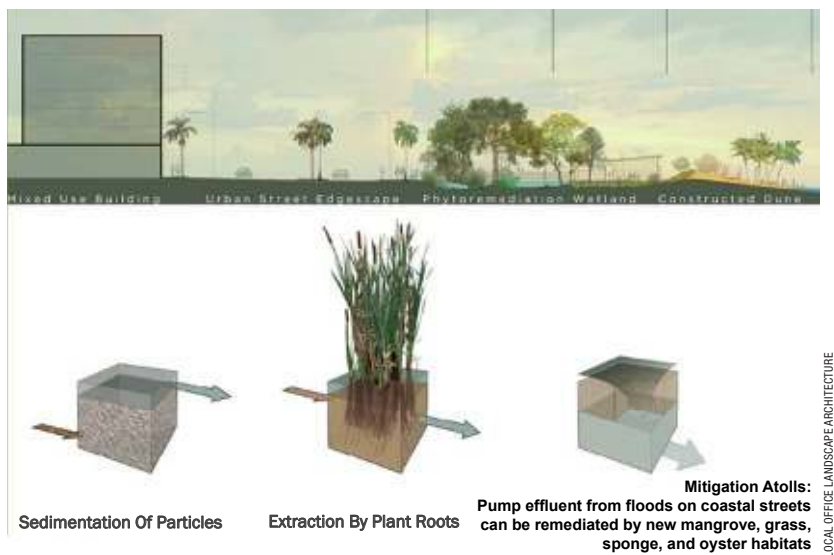
as bioswales. This action would require additional plantings, preferably including thick and heavy native grasses able to filter out contaminants and maintain surface soil permeability.

- **Implement household-scale micro-collection methods.** Individual households can manage ample stormwater on their own property, capturing and harvesting rainwater for reuse. The county should work in partnership with Miami’s many active community groups to identify neighborhoods that would benefit from household-scale water collection and spread the word among neighbors. The county could potentially provide seed funding for these sorts of efforts or could apply in partnership with community groups for grant funds to carry out the projects. How-to information addressing both design and local funding alternatives should be available at the Arch Creek Basin Resilience Resource Center. Projects could include the following:

- Backyard bioswales;
- Tree planting;
- Rainwater storage cisterns; and
- Green roofs.

Pumps, pictured here on a waterfront site in the Sans Souci neighborhood, are currently a primary means of dealing with nuisance flooding.





Mitigation atolls deliver water through a series of natural filtration methods to improve water quality while acting as a city's first defense against storm surges.

Bayside Mitigation Atolls

Although the panel focused primarily on improving the resilience of the low-lying inland areas of Arch Creek Basin, the waterfront sites are also uniquely vulnerable. Many of these neighborhoods, such as Sans Souci Estates, were developed with cut-and-fill methods before FEMA flood mapping provided development parameters. These areas generally have higher average household incomes than much of Arch Creek Basin, meaning they may have some resources to direct toward resilience and preparedness efforts.

Pumps are currently Miami-Dade County's key strategy for dealing with flooding in these neighborhoods. Although this infrastructure is likely to remain a critical part of the county's resilience work, it should be complemented with natural infrastructure to both manage water and provide ecological and social value. This is particularly critical given that the pumps send water, much of which is low quality, into the bay.

To complement Miami-Dade County's pumping strategy, the panel recommends:

- *Explore the concept of bayside mitigation atolls at pump outflow sites.* Mitigation atolls would offer one option for

ameliorating existing pump effluent and mitigating storm surge while creating an ecological amenity. Atolls would be sited at the current pump outflow sites, some of which are on open lots at the end of streets. Defined as a reef or island surrounding a small water body, these atolls could comprise mangroves, soft corals, sponges, and oysters. Each would be an "armored habitat" including a core surrounded by living shorelines featuring the full spectrum of habitats from mangroves and grasses to an intertidal zone home to oysters. After additional technical review and analysis, these atolls could be designed and sited at pump outflow stations with particular water quality issues.

These constructed atolls could become the focal points for new waterfront public spaces, including boardwalks and interpretive signage offering educational information on local ecologies and climate impacts. These atolls could even eventually become outdoor research labs, including installed sensors for monitoring pollutant update and remote monitoring apps offering data on rainfall and surge.

Recommendation: Implement a Pilot Adaptation Action Area

THE COMPREHENSIVE VISION for a more resilient Arch Creek Basin—including new high-ground TOD redevelopment, affordable housing, and the ecological reclamation of the city slough—will require cooperation among a range of agencies, jurisdictions, and stakeholder groups.

Regional Cooperation

The panel was asked to consider whether the Arch Creek Basin is a good candidate to be designated as an Adaptation Action Area, as authorized by the state of Florida. The answer was a resounding yes. The adaptation area framework offers a very good opportunity for regional

cooperation to combine disparate actions to address the climate vulnerabilities facing south Florida.

The panel also recognizes the opportunity this framework offers in the larger resiliency paradigm: the holistic vision for Arch Creek (including both new development and ecological reclamation) has potential to become a model for other vulnerable areas in the county and beyond. The alignment of policies, codes, financing, and services can comprehensively address economic, environmental, and social issues. In the case of Arch Creek Basin, both problematic sites and opportunities for mitigation and re-development exist within the adaptation area, contributing

Local Precedents for Addressing Climate Change and Resilience

Although achieving the vision for Arch Creek Basin may be a challenge, Miami-Dade has already shown leadership in climate change and resilience policies. The county and the city have collaborated regionally to address climate risks and have proactively sought to address climate change through internal work and external partnerships. Miami-Dade County's and the city of Miami's many efforts and distinctions include the following:

- Member of the Southeast Florida Compact, a partnership established in 2010 to coordinate mitigation activities across county lines, with participation from Miami-Dade, Monroe, Palm Beach, and Broward counties;
- Founding member of ICLEI, a leading global network of local governments committed to sustainability;
- First county to appoint a chief resilience officer;
- Signatories to the Compact of Mayors;
- Creator of a Sea Level Rise Task Force (City of Miami) charged with exploring the impact of sea-level rise on public services, real estate, property, and ecological

resources, with a goal of incorporating sea-level rise into the county's Comprehensive Development Master Plan;

- Participant in the Rockefeller Foundation's 100 Resilient Cities as of 2016; and
- Home to numerous, active, engaged community-level groups, committed to addressing climate change and achieving more prepared and resilient communities.



to a long-term development vision that improves resilience for all.

Accordingly, the panel recommends that Miami-Dade County, the city of North Miami, the village of Biscayne Park, the village of Miami Shores, and city of North Miami Beach designate by ordinance an Adaptation Action Area for the Arch Creek Basin. Designating an adaptation area on a watershed basis recognizes the inherent issue that flooding does not obey political boundaries.

Guidance from the state of Florida recommends four strategies for Adaptation Action Areas (see figure at right).

As described in the various site-based recommendations of the panel, each of these types of strategies can be deployed in Arch Creek Basin. Alignment of resources, land use plans, building codes, and infrastructure investment should apply in the most vulnerable areas first, protecting those in need and creating opportunities for more resilient local economies and natural systems. In particular, healthier natural systems can offer integrated solutions to help communities deal with acute shocks and chronic stresses.

Creation of the adaptation area should incentivize coordinated smart investment through sustainable practices that are inclusive of a community's needs. An alignment of resources for capital investment, development incentives, and leveraging of state or federal resources will be critical to the success of the adaptation area initiatives and to the implementation of the Arch Creek Basin vision. Vulnerability assessments should guide investment in critical infrastructure and assist with targeting focus areas for economic opportunity.

Area Comprehensive Plans must also include Coastal Management Elements to address key risks. The Florida statutes define the overall purpose of Coastal Management Elements as follows:

- Maintain, restore, and enhance the overall quality of the coastal zone environment;



STATE OF FLORIDA, DEPARTMENT OF ECONOMIC DEVELOPMENT, ADAPTATION AREA GUIDEBOOK

- Protect the orderly and balanced utilization and preservation ... of all living and nonliving coastal zone resources;
- Protect human life against the effects of natural disasters; and
- Limit public expenditures that subsidize development in coastal high-hazard areas.

In keeping with guidance from the state of Florida, the panel recommends the adoption of an Adaptation Area Steering Committee at the South Florida Regional Council to further define policies, align comprehensive plan amendments, develop building code recommendations, and identify economic incentives that would need to be enacted by the participating local governments in the adaptation area. The South Florida Regional Council is an appropriate group to convene the committee because of its cross-jurisdictional nature. The steering committee will play a key role in advancing the overall planning and development strategy for the Adaptation Action Area, with the input and participation of community members and experts offering perspective on the planning context, likely impact, and exposure.

Adaptation Action Area implementation strategies from official state of Florida literature.



Recommended steps to develop and implement planning concepts with community input and committee leadership.

11



The Adaptation Action Area planning process is multidisciplinary, requiring many different perspectives and analyses.

Financing and Land Management Tools

The panel recognizes the opportunities for enhancing resiliency in the Arch Creek Basin beyond the obvious coastal climate vulnerabilities. Aside from initial mitigation measures, an opportunity exists to foster economic, environmental, and social resiliency through an integrated multidisciplinary approach.

The panel's recommendations to achieve this vision include the following:

- **Leverage a broad range of funding sources.** South Florida has a variety of resilience funding sources, including funding from local, state, and federal agency programs. An adaptation funding list compiled by the Florida Department of Economic Opportunity offers dozens of options and details their timelines, funding cycles, matching requirements, and eligibility require-

ments. Many of these funders naturally align with the framework of adaptation areas.

- **Enhance county and municipal capital improvement programs.** Alignment of resources in each locality's and utility's capital improvement program is critical, particularly given the collective vulnerability assessments of the major infrastructure systems. The collective ability to leverage state or federal investment will be enhanced by pooling of resources. An enhanced capital plan is needed to address the breadth of challenges in this adaptation area and that consideration for generating revenue to support these projects will need significant community input. In addition, the county should consider establishment of Special Improvement Districts in unincorporated areas to support mitigation solutions.
- **Use conservation areas and easements.** The adaptation area should consider the use of conservation easements to serve as natural flood buffers, as open space, or in areas vulnerable to the impacts of stormwater inundation, tidal inundation, or sea-level rise. These properties are likely to have significant conservation values (coastal wetlands, beaches with natural berms or dunes, or other nature-based mitigation solutions). These donations enable smart investment in the mitigation solution by alleviating costly land acquisition. Landowners receive tax deductions, tax relief, and added protection for their

A variety of funding sources and planning strategies can be used for plan implementation in the Adaptation Action Area.



A Selection of Adaptation Funding Resources

Funding opportunity	Funding source	Funding goal	Eligibility	Website
Federal				
EPA BEACH Act grants	EPA	Implementing beach water quality monitoring and/or informing the public in the event of water quality issues	Coastal and Great Lakes recreational waters adjacent to beaches or other access points used by general public	www.epa.gov/beach-tech/beach-grants
EPA Smart Growth Implementation Assistance Program	EPA	Implementing smart growth projects; funding includes expert technical support	Regional, state, local, and tribal governments; nonprofits that partner with governmental body	www.epa.gov/smartgrowth/smart-growth-implementation-assistance
FEMA Flood Mitigation Assistance Program	FEMA	Decreasing or eliminating claims issued under National Flood Insurance Program; decrease amount of repetitive structure loss	Certain nonprofits, tribes, and local governments	www.fema.gov/flood-mitigation-assistance-grant-program
U.S. Army Corps of Engineers Clearing and Snagging of Waterways for Flood Control	Congress delegates authority to U.S. Army Corps of Engineers to allot funding	Decreasing flood damage by debris in rivers, evacuation of channels; improving construction adjacent to channels	Public agencies that abide by Section 21 of Flood Control Act of 1970	www.mvr.usace.army.mil/Business-With-Us/Outreach-Customer-Service/Flood-Risk-Management/Section-208/
State				
Florida Division of Emergency Management (DEM) Pre-Disaster Mitigation Assistance Program	DEM Pre-Disaster Mitigation Program	Decreasing risk of disaster damages to communities and property; decreasing "disaster recovery" related costs	State agencies, Indian tribal governments recognized by federal government, private and nonprofit organizations submit application to local government agency	www.floridadisaster.org/Mitigation/PDM/
Florida Department of Environmental Protection Beach Management Funding Assistance Program	Ecosystem Management and Restoration Trust Fund	Encouraging alliances with government sponsors for beach protection; projects can address beach nourishment and restoration, environmental monitoring, dune protection, etc.	Municipal governments and county governments or special taxing districts required to provide erosion protection	www.dep.state.fl.us/beaches/programs/becp/
Florida Inland Navigation District Waterways Assistance Program	Property taxes	Creating and implementing improvement projects for local waterway protection	Municipalities and local governments within certain district boundaries	www.aicw.org/index.jsp

properties in return for the reduction in value associated with the donated easement.

- *Consider the establishment of a Community Development District (CDD).* Considering the coastal management element of an adaptation area might limit public expenditures in coastal high-hazard areas. A CDD may be an appropriate financing mechanism to ensure that neighborhood-scale hazard mitigation solutions can be implemented. The CDD, controlled by its resident board

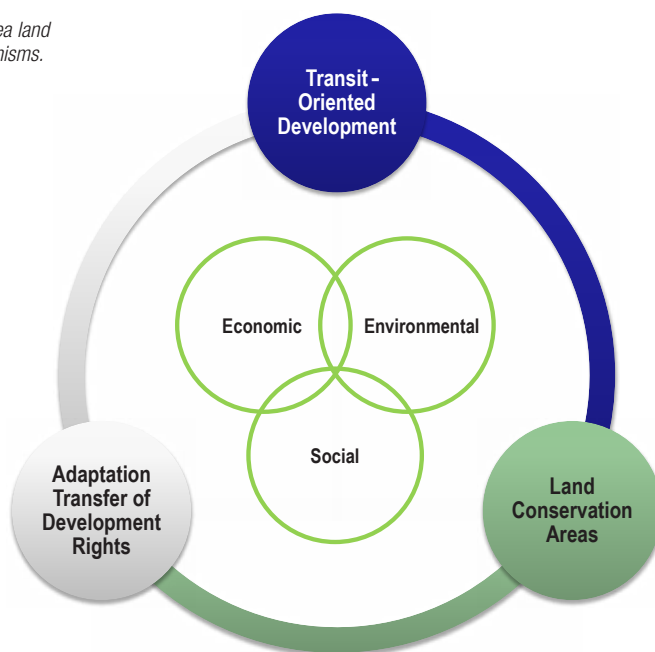
of supervisors, would serve as the legal entity with the power and right to enter into contracts for infrastructure improvements. The CDD would generate revenues from a neighborhood or area assessment and retain responsibility for construction, operations, and maintenance costs of the mitigation solutions. For example, a CDD could be the entity responsible for constructing mitigation atolls.

- **Create an adaptation area transfer of development rights (TDR) program.** Creation of an adaptation area TDR program can offer a structure for managed retreat or relocation as identified in the state of Florida’s guidance for adaptation areas. The TDR program can predesignate focus areas as sending and receiving zones; for example, the city slough site could be a sending area, and the TOD a receiving area. The sending area’s development could be reduced to allow restoration of natural systems or “flood parks.” These areas could be dubbed conservation zone overlay districts, with the intention of decreased permitting of certain uses such as residential and commercial development.
- **Reconstitute the North Miami CRA.** The North Miami CRA can be a valuable tool in the development of the proposed TOD area at NE 125th Street and North Miami’s downtown. A dedicated additional percentage of the CRA revenue could be apportioned to promote a focused, affordable workforce housing strategy in this area. In addition, the CRA could support this area being established as a receiver area in an adaptation area TDR program.
- **Use public/private partnerships for land acquisition.** As part of an adaptation area TDR strategy, a mechanism could be established to support the acquisition of properties (repetitive flood loss, vacant, blighted, etc.). The goal of these acquisitions is to alleviate repetitive flood damage to residences, then allow the creation of the city slough and flood parks using Arch Creek’s ecology as stormwater infrastructure. Any land acquisition program is likely to build from the county’s existing Environmentally Endangered Lands program.

Resilience dividends can be generated by supporting both mitigation solutions and the need to create new affordable housing. Eventually, this approach will alleviate the economic and social burden that residents experience by living in low-lying flood-prone areas. Stormwater capital funds should be considered to deliver aspects of this vision, because of the system benefit that can be gained through the creation of the proposed flood parks. The value of properties that have a tax lien from Miami-Dade County could be a potential secondary source. These properties could be offered as incentives for development partners to incorporate affordable workforce housing in targeted focus areas. Last, publicly owned land such as parking lots can be a valuable asset to leverage private investment that meets the visions and goals of the adaptation area.

- **Consider amendments to the Florida State Building Code.** While advancing plans for a more resilient Arch Creek Basin, the Adaptation Action Area leadership should consider the zoning and building code requirements that will influence the physical form of what is built. Future building and zoning code amendments—such as a “Climate Change Overlay” on a form-based code like the city of Miami’s Miami 21—would have a long-term impact on resilient development patterns. Furthermore, the Florida State Building Code could better address coastal hazard vulnerabilities, with amendments similar to those previously adopted for wind speeds.

Adaptation Action Area land management mechanisms.



Enhancing Energy Infrastructure

Energy infrastructure provides both an economic backbone and a safety lifeline, enabling or impeding a community's resilience. Power outages come at high costs, whether through loss of economic activity and household income, or the direct damages that result when pumps cannot operate to keep floodwaters at bay or air conditioning cannot prevent mold from forming.

The risks of power loss are greatest to populations that are already most vulnerable. An hourly worker's lost paycheck can put an individual or family at risk of homelessness, or having to choose between rent and food. Residents with limited economic means have the least flexibility to shoulder the costs associated with damages to their homes or vehicles, or to relocate if dwellings become uninhabitable.

The Current Approach

Miami-Dade County's electrical service is provided by Florida Power & Light (FPL), the third-largest utility in the United States (www.fpl.com/about/company-profile.html). As an investor-owned utility, FPL is regulated by the Public Service Commission and has been granted monopoly rights to sell electricity. FPL is a subsidiary of NextEraEnergy, and other subsidiaries such as FPL Services provide energy services such as LED lighting retrofits.

Despite high levels of reliability and a culture of continual improvement at the utility provider, the strategies in place to address climate risk and the risks of outage are not sufficient. Fossil-fuel generators and backup stations do not appear to adequately consider climate change and sea-level rise. FPL has no current energy-efficiency initiatives because an analysis by Duke and FPL deemed these to be too expensive. FPL also lacks a demand-side management program. Most critically, the FPL fuel mix is still largely fossil based, at roughly 60 percent natural gas, 20 percent nuclear, 18 percent renewables, and 2 percent other purchases.

The Need for Change

At a macro scale, reducing fossil fuel–driven energy is essential to slowing global warming and sea-level rise. At a micro scale, these same energy reductions can help enhance community economic and environmental resilience in several ways:

- Lowering energy use—and associated utility bills—helps alleviate part of the housing cost burden on low-income families and allows businesses and government to invest in productive functions.
- Although backup power sources and equipment are a necessary piece of a resilience energy system, reducing overall use diminishes the demands on the grid, especially during critical moments (such as high-heat days and storms), reducing the risk of outages and enabling backup systems to function better.
- Coupling energy efficiencies with renewable, distributed, and redundant generation (solar photovoltaic on homes, salt-tolerant batteries, waste-to-energy systems) contributes to resilience by enabling self-sufficiency and reduced interdependencies.

Florida has great potential to pursue a more sustainable approach to energy that will help address the large-scale threat of climate change and sea-level rise. It is, after all, “the Sunshine State.” However, according to the Solar Energy Industries Association (www.seia.org/state-solar-policy/florida), the state is ranked third nationwide for solar potential but only 14th for current solar capacity installed.

This unachieved potential is not on account of lack of interest. Several large-scale structural challenges exist in relation to these goals:

- The current low cost of utilities in Florida does not incentivize customer behavioral change. Although this is a positive situation for consumers now, particularly cost-burdened households, the cheap rates may not last forever. If households are not able to alter their consumption patterns, they will be hostage to rates that could rise.
- Under the current legal status, FPL is the only legal entity in Florida that can provide power. As a result, third-party power purchase agreements and private microgrids are not allowed, which limits investment into renewable energy generation.
- Florida does not have Renewable Portfolio Standard requirement (a legal requirement to generate energy from renewable sources, such as solar and wind power).

To improve the resilience of Miami-Dade and other counties and regions in Florida, energy policies should seek to encourage the use of renewables. Policy changes that would respond to the current challenges include the following:

- *Decouple the utility.* Decoupling encourages regulated utilities to promote energy efficiency for their customers, by realigning the profit model to no longer focus on total energy sold.
- *Provide incentives for savings.* Energy efficiency measures and distributed generation should be incentivized, to encourage a more resilient and sustainable energy model. Consumer involvement in demand-response also serves to raise awareness about energy use and encourages the use of less energy at peak times because of financial incentive.
- *Introduce legislation for a Renewables Portfolio Standard.* Requiring the increased production of energy from renewable sources such as solar, biomass, wind, and geothermal would slowly evolve the norm in south Florida.
- *Deploy smart microgrids as a climate adaptation strategy.* Smart microgrids offer an excellent means of integrating renewable energy sources and achieving more reliability and local carbon reductions.
- *Encourage the use of other sources of renewable energy, such as the following:*
 - Solar photovoltaics, especially on roofs, south-facing facades, and parking shade structures.
 - Geothermal heating and cooling, which would capitalize on south Florida's climate and geography, offers real estate opportunities from space-saving consolidation; offers lower operation, maintenance, and repair costs; and could be easily integrated and tied into solar photovoltaic and solar thermal systems.

- Alternative energy sources should be piloted, including waste-to-energy technology or fuel cells using natural gas, especially in higher-density development such as a TOD or institutional development.

Building-Scale Resilience and Energy Efficiency

Incorporating green building practices will both enhance the sustainability of building stock and provide opportunities for energy efficiencies.

Buildings that are energy efficient and that can produce and store energy will ensure the resilience and sustainability of electrical service. Reducing building energy demands reduces the need for expanding the electrical grid and can help enforce grid stability, especially in the face of increasing heat and storms brought on by climate change. The priority for reducing energy loads from buildings in this bioregional climate must focus on reducing cooling loads, with sensitivity to humidity and water intrusion.

Emergency Backup Power

Backup power has always been an important resilience concern for coastal Florida. Additional household-level options include the following:

- Saltwater batteries, attractive because of their long life and low toxicity, which offer electrical backup for 24–36 hours. Saltwater batteries can also operate on a grid or neighborhood scale.
- Solar installations, including solar arrays.
- Hybrid on-grid/off-grid with inverter and transfer switch.

Conclusion

A HISTORIC AND CROSS-JURISDICTIONAL flood basin, Arch Creek Basin is a 2,800-acre area within Miami-Dade County including neighborhoods that have experienced repetitive losses caused by flooding. The area's vulnerability stems from not only its environmental context and associated climate risks but also its social inequities and economic disparities within the broader Miami-Dade region. To move toward a more resilient future, local policy makers must address social equity concerns within the context of climate action planning. As a pilot Adaptation Action Area, Arch Creek Basin could offer an example of how to achieve this goal.

The panel's recommendations offer a comprehensive approach that provides both a safer new development pattern and an ecological reclamation. Key areas of focus for Miami-Dade moving forward include

- Building social resilience;
- Building on high ground;
- Restoring natural systems; and
- Implementing an Adaptation Action Area.

Building social resilience and working with existing community groups must be a pillar of any resilience strategy. Arch Creek Basin includes many at-risk communities, and climate change has the potential to make them even more vulnerable. Miami-Dade's impressive existing community infrastructure should be leveraged to provide local communities with clear information, education workshops on climate change, and opportunities for representation on key citywide committees. A Resilience Resource Center, designed to serve as a recovery assistance center and an

information and community center year-round, could also be a longer-term resource for communities in need.

Arch Creek Basin's development patterns must also shift to move toward a more resilient future. A future TOD on the high ground, coupled with a city slough park designed to manage water in the basin's most vulnerable area, offers opportunities for new homes, green space, and increased flood storage. This TOD should be designed as a vibrant, mixed-use neighborhood that takes advantage of its connectivity and relatively high location and that provides dedicated affordable housing for vulnerable households relocating from flood-prone properties. This strategy creates opportunities for all members of the community to stay within the area while encouraging a more resilient and better-connected development pattern less prone to flooding. A city slough park would also provide more flood storage while offering valuable recreational and ecological spaces to Arch Creek Basin's residents.

Advancing this vision requires the cooperation of a wide range of groups, including the county, local agencies, jurisdictions, neighborhoods, and other stakeholders. Using the Adaptation Action Area framework offers an opportunity to move beyond these boundaries and implement resilience concepts at the scale of the flood basin. The municipalities, agencies, and neighborhoods will need to take full advantage of the opportunities afforded by the Adaptation Action Area framework to advance the Arch Creek Basin vision. By doing so, they could set a precedent for holistic and equitable resilience planning. The panel hopes this set of recommendations provides the tools, context, and resources to begin moving forward with this vision.

Appendix: Arch Creek Basic Resilience Panel Recommendations and Time Frames

Topic	Recommendation	Key actors	Estimated time frame to begin implementation	Page
Build Social Resilience				
Outreach	Make critical information easily understandable and readily accessible for all communities	County, community groups	Immediate (0–3 years)	28
	Better understand the needs of residents to help inform policy and the development of climate solutions	County	Immediate (0–3 years)	29
	Offer seed funding for community projects	County, agencies, philanthropic groups	Immediate (0–3 years)	29
	Fund a county position for community resilience outreach	County, city of North Miami	Immediate (0–3 years)	29
	Invite community members to sit on key committees	County, municipalities, others	Immediate (0–3 years)	29
	Consider a design competition or other means of community engagement in the design process	County, community groups, universities, philanthropic groups	Immediate (0–3 years)	29
Housing policy	Include climate risk, resilience, and climate justice in the upcoming HUD Assessment of Fair Housing	County, municipalities	Immediate (0–3 years)	30
	Ensure that housing is added to community benefit agreements	County, municipalities	Immediate (0–3 years)	30
Community actions	Hold neighborhood Climate 101 workshops	Community groups	Immediate (0–3 years)	31
	Continue to develop grassroots leadership	Community groups	Immediate (0–3 years)	31
	Support yard-by-yard approaches for stormwater retention	Community groups	Immediate (0–3 years)	31
Build on High Ground				
Develop a TOD	Develop a TOD on the high ground around the future NE 125th Street station	County, city of North Miami, private development community	Long term (5–10+ years)	32
	■ Adopt a mixed-use, mixed-income housing strategy within a half mile of the proposed transit station	County, city of North Miami, private development community	Immediate (0–3 years)	33
	■ Design a pedestrian-scaled neighborhood	County, city of North Miami, private development community	Long term (5–10+ years)	34
	■ Emphasize placemaking	County, city of North Miami, private development community	Long term (5–10+ years)	34
	■ Include a Resilience Resource Center	County, city of North Miami, community groups, nonprofit or philanthropic groups	Medium term (3–5 years)	34

Topic	Recommendation	Key actors	Estimated time frame to begin implementation	Page
Deliver affordable housing	Ensure dedicated affordable housing for at-risk households in the area	County, city of North Miami, private development community	Long term (5–10+ years)	35
	■ Provide density bonuses for affordable housing within the TOD zone	County, city of North Miami	Medium term (3–5 years)	35
	■ Work with the CRA	County, city of North Miami	Immediate (0–3 years)	35
	■ Use tax increment funding, CDBG, and other funds as appropriate	County, city of North Miami	Medium term (3–5 years)	35
	■ Amend Miami-Dade's Affordable Housing Surtax program	County	Medium term (3–5 years)	35
	■ Make additional improvements and investments within the TOD zone to make for more competitive applications for Low Income Housing Tax Credits	County, city of North Miami	Medium term (3–5 years)	35
Maximize transportation resilience	Enhance the emergency evacuation networks	County, Department of Transportation (DOT), South Florida Regional Transportation Authority, other transportation stakeholders	Long term (5–10+ years)	35
	Improve overall multimodal connectivity, considering the TOD as a hub	County, DOT, transportation stakeholders, TOD stakeholders	Long term (5–10+ years)	35
	Protect the rail corridor	County, DOT, South Florida Regional Transportation Authority, other transportation stakeholders	Long term (5–10+ years)	36
	Develop additional waterborne transportation options	County, DOT, South Florida Regional Transportation Authority, private transportation providers	Medium term (3–5 years)	36

Restore Natural Systems

A signature green space: the “city slough”	Design a “city slough” park in current low-flood-prone areas to improve flood storage, mobility, and recreation opportunities	County, municipalities within Adaptation Action Area (AAA), future park management entity	Medium term (3–5 years)	37
	■ Manage stormwater			39
	■ Reuse rainwater and wastewater			39
	■ Include mobility links			39
	■ Include active, programmed spaces			40
Implementation of the “city slough”	Prioritize the development of the slough as part of a long-term resilience strategy, carried out in tandem with the TOD	County, municipalities within AAA, future park management entity	Immediate (0–3 years)	40
	Begin the park on a pilot basis with a three-block transect	County, municipalities within AAA, future park management entity	Medium term (3–5 years)	40
	Support varied types of programming	County/future park management entity	Long term (5–10+ years)	40
	Seek change in state enabling legislation, adding climate resilience as a CRA category and subsequently purchasing property	County, municipalities within AAA	Immediate (0–3 years)	41
	Use tax-foreclosed property to “swap” for vulnerable properties	County, municipalities within AAA, public/private land bank partnership	Immediate (0–3 years)	41
	Designate HOME for relocation of renters in Arch Creek Estates choosing to relocate over a five-year period	County, municipalities within AAA	Medium term (3–5 years)	41

Topic	Recommendation	Key actors	Estimated time frame to begin implementation	Page
Integrated water management	Use modern tools to support resilience-informed decision making	County, South Florida Water Management District (SFWMD), municipalities within AAA	Medium term (3–5 years)	41
	Consider closeable gates or low-cost deployable plugs for the local canal system	County, SFWMD, municipalities within AAA	Medium term (3–5 years)	41
	Implement systems for treated wastewater reuse	County, SFWMD, municipalities within AAA	Medium term (3–5 years)	42
	Explore decentralized wastewater systems and alternatives to septic	County, SFWMD, municipalities within AAA	Long term (5–10+ years)	42
Household-scale improvements	Retain rainwater at higher elevations	County, municipalities within AAA, private property owners	Immediate (0–3 years)	43
	Improve bioswales in Arch Creek Estates	County, community groups	Immediate (0–3 years)	44
	Implement household-scale micro-collection methods	County, community groups, households	Immediate (0–3 years)	44
Bayside mitigation atolls	Explore the concept of bayside mitigation atolls at pump outflow sites	County, SFWMD, municipalities within AAA	Medium term (3–5 years)	45
Implement a Pilot Adaptation Action Area				
Financing and land management tools	Leverage a broad range of funding sources	County, municipalities within AAA	Immediate (0–3 years)	48
	Enhance county and municipal capital improvement programs	County, municipalities within AAA	Immediate (0–3 years)	48
	Use conservation areas and easements	County, municipalities within AAA	Immediate (0–3 years)	48
	Consider the establishment of a Community Development District	County, municipalities within AAA	Immediate (0–3 years)	49
	Create an adaptation area transfer of development rights program	County, municipalities within AAA	Immediate (0–3 years)	50
	Reconstitute the North Miami CRA	County, municipalities within AAA	Immediate (0–3 years)	50
	Use public/private partnerships for land acquisition	County, municipalities within AAA	Medium term (3–5 years)	50
	Consider amendments to the Florida State Building Code	County, municipalities within AAA	Medium term (3–5 years)	50

About the Panel

David A. Stebbins

Panel Chair

Buffalo, New York

With 37 years of diversified experience in urban planning and development, Stebbins is executive vice president of Buffalo Urban Development Corporation (BUDC), a nonprofit development entity that specializes in urban redevelopment. BUDC is currently redeveloping a 35-acre, 700,000-square-foot former industrial complex on Northland Avenue in the city of Buffalo. This complex will be the future home of the WNY Workforce Training Center, as well as an entrepreneurial and small business center. Previously, Stebbins helped create the Buffalo Lakeside Commerce Park, a 275-acre reclamation of the former Hanna Furnace Steel Mill and Union Ship Canal, and RiverBend, a 260-acre site of the former Republic Steel in South Buffalo along the Buffalo River and the future home to the High-Tech Manufacturing Innovation Center (Solar City). His responsibilities also include coordination and assistance of redevelopment and infrastructure projects in downtown Buffalo in conjunction with the city of Buffalo and other downtown stakeholders.

Before his tenure with BUDC, Stebbins worked for several public and not-for-profit organizations in the Buffalo area with responsibilities for waterfront planning, economic development, small business assistance, and real estate development, including multitenant industrial buildings, downtown mixed-use, urban infrastructure, brownfield redevelopment, and business park projects.

Stebbins is also an associate professor in the University at Buffalo's School of Architecture and Planning, teaching a graduate course in real estate development in the school's inaugural Master's of Real Estate Development Program.

He is an active and full member of the Urban Land Institute, serving as vice chair for membership of ULI's Urban Revitalization Council and cochair of the ULI-WNY Regional Satellite of the New York District Council. He has served on eight ULI Advisory Services panels.

He has a BA in environmental design from the University at Buffalo and an MA in city and regional planning from the University of North Carolina—Chapel Hill. He qualified as a member of the American Institute of Certified Planners in May 1986.

James Lima

Panel Vice Chair

New York, New York

Lima has extensive private and public sector experience in the planning and implementation of urban revitalization projects throughout North America and structuring public/private partnerships in real estate development. His current and recent work includes providing urban design, public policy, and programming recommendations for a \$500 million flood protection initiative (the "BIG U") in Lower Manhattan; working with the Presidio Trust of San Francisco on a land use study and implementation strategies; and on behalf of the Alliance for a New Penn Station, writing the report *Unlocking Penn's Potential*, calling for a new Penn Station (New York City) Redevelopment and Value Capture District.

Before founding JLP+D in 2011, Lima was a partner at the national real estate and economic advisory firm, HR&A Advisors, with a focus on downtown and waterfront revitalization. In 2003, Lima was then New York City mayor Michael Bloomberg's appointee as founding president of the Governors Island Preservation and Education Corporation, a public corporation created to oversee the planning,

redevelopment, and operations of the historic 172-acre former military facility in New York Harbor.

A frequent speaker at Urban Land Institute and other conferences, Lima has served on Advisory Services panels throughout North America and has lectured on urban redevelopment at Harvard, Princeton, Yale, Columbia, Penn, and Syracuse, as well as in Rotterdam, Amsterdam, and São Paulo. He is a member of the Design Trust for Public Space's Design Trust Council. He also serves as secretary of the New York Harbor Foundation and on the Economic Development Committee of the Fourth Regional Plan for the Regional Plan Association in New York.

Wendi Goldsmith

Manchester, Massachusetts

Goldsmith heads the specialty advisory practice Sustainability Visions and serves as director of the nongovernmental organization Center for Urban Watershed Resilience. She is a Yale-trained geologist with two decades of experience guiding communities and engineering teams to adopt measures to better address sustainability and climate change. She founded and led Bioengineering Group, a consulting firm with more than 70 professionals, for 23 years until its sale in 2014. For the past five years she has engaged with European researchers, funded in part through insurance industry support, to develop pragmatic strategies to guide climate adaptation and resilience. She is the winner of the 2016 Joan Hodges Queneau Palladium Medal "for championing science-based practices for resilient facility and infrastructure design and construction using interdisciplinary solutions to integrate ecosystem services, with a broad history of facilitating creative and successful collaboration between engineers, environmental scientists and sustainability policy advocates."

A pioneer in green infrastructure, Goldsmith has supported local, state, and federal agencies to carry out water resources engineering projects accommodating or harnessing natural processes. She has developed and applied metrics related to the innate capacity of many natural systems to dissipate and convert energy inputs,

thereby improving ability to resist, absorb, recover, and adapt in the face of disaster impacts. She played a lead role on the planning, design, and program management of the \$14 billion post-Katrina Hurricane Storm Damage Risk Reduction System, the first regional-scale climate adapted infrastructure system in the United States, informed by climate forecasts and related dynamics. She coordinated the science, policy, and engineering disciplines involved in implementing engineering design criteria for the new resilient infrastructure system in Greater New Orleans under U.S. Army Corps of Engineering contracts totaling \$200 million in services.

Known for building consensus among diverse and often antagonistic stakeholder groups to help advance large public projects, Goldsmith facilitates value-based planning processes to link community interests (such as public health, safety, quality of life, and economic development) with financial parameters necessary to support financing decisions. Her work exemplifies solutions operating on a systems level, addressing risk and resilience across uncertain scenarios.

She has led research and development programs for the U.S. Department of Defense, developing methods for evaluating and optimizing renewable energy and efficient/resilient buildings, infrastructure, and site design. She is well regarded for her expertise in practical application of climate science in the built environment, notably within river corridors and coastal landforms. She has written and presented extensively on climate change resilient design in urban settings and frameworks for decision making informed by community engagement. She has supported various ULI events, including serving as a panelist for the 2013 Spring Meeting on Resilience in Washington, D.C.

Walter Meyer

Brooklyn, New York

Meyer founded the firm Local Office Landscape and Urban Design in 2006 with Harvard Graduate School of Design classmate Jennifer Bolstad. Operating between infrastructure, urbanism, and territory, the firm has garnered

accolades from across the disciplines of architecture, landscape architecture, public policy, science, and art. The partners teach at Columbia University, Parsons/The New School, and Pratt Institute.

The firm's recent built work includes the Parque del Litoral, in Mayaguez, Puerto Rico. The two-mile-long urban beach park is the largest in the country. The park restructured the postindustrial shore into a dune forest that protects the city from sea surges, while phytoremediation wetlands protect the sea from the city's pollution. The design was endorsed by the Caribbean Tsunami Institute for coastal resiliency, and the project won an honor award from AIA Puerto Rico, as well as a Cemex award for sustainable infrastructure.

After Hurricane Sandy the firm's partners started Power Rockaways Resilience, a nonprofit dedicated to fundraising and delivery of solar generators to volunteer centers throughout the coastal Rockaway peninsula in Queens, New York City. Currently, Local Office is advising the National Park Service, the New York City Department of Parks and Recreation, and the U.S. Army Corps of Engineers on coastal resiliency in the New York Bight. The firm's built work in the Miami metropolitan region includes Miami Grand Central Park, a temporary public/private partnership on the former Miami Heat Arena site; the Coral Gables Miracle Mile streetscape, a resilient redesign of an urban retail corridor; and Micco/Doral Park Pavilion, in which the firm collaborated with local artist Michele Oka Doner to realize a sculpture at the scale of public space.

Meyer has been recognized for leadership in coastal resiliency by the Congressional Hispanic Caucus and was named a 2013 Champion of Change for post-Sandy global resiliency by the White House. He studied landscape architecture at the University of Florida and urban design at Harvard's Graduate School of Design.

Manuel Ochoa

Washington, D.C.

With almost 20 years' experience in urban planning, housing, and community development, Ochoa is senior analyst and program director for Enterprise Community Partners, where he currently leads Enterprise's fair housing policy work. He leads a working group that seeks common ground on policies that increase opportunity for communities. Last year, Ochoa was the project manager in Miami where the team made recommendations on how to use city-owned property for affordable housing through the National Resources Network for Cities.

Previously, he was regional director of homeownership for the Latino Economic Development Center, a community-based organization in the Washington, D.C., region. Ochoa managed a team of counselors who served approximately 1,000 clients a year through prepurchase counseling, foreclosure prevention, and financial education. He expanded the team to efficiently serve more clients and launched a financial education and coaching program. He was also active on the foreclosure crisis in regional media outlets such as the *Washington Post*, NPR, WAMU, and Telemundo. He also produced a weekly Spanish-language radio program focused on financial and housing counseling advice.

Earlier, Ochoa served as deputy assistant secretary for grant programs in HUD's Office of Community Planning and Development. He was responsible for the day-to-day management of the CDBG program, HOME program, and Environmental Review office. He also had oversight for over \$30 billion in disaster relief assistance to the Gulf Coast and the Midwest. He led the department's effort to rapidly and successfully launch the first Neighborhood Stabilization Program.

A member of the American Institute of Certified Planners, Ochoa has worked as a local planner in several cities. He also helped revitalize commercial districts as a member

of the National Trust for Historic Preservation's National Main Street Center. A native of Miami, Florida, Ochoa is a graduate of the University of Miami and holds a master's degree in regional planning from the University of North Carolina—Chapel Hill.

Judi Schweitzer

Lake Forest, California

Schweitzer is a pioneer in designing and applying innovative green and sustainable community development solutions for real estate policy, acquisitions, entitlements, development, and construction relating to master-planned communities, resorts, lifestyle, and mixed-use commercial projects. She founded Schweitzer + Associates Inc. to apply her 25-plus years of experience and knowledge in complex multifaceted real estate developments to the challenges facing the real estate industry today. She is seen as an industry expert and is entrusted by industry organizations, public, private, and nonprofit entities to review and design policies, programs, and solutions that are transformative in the marketplace.

She leads and assembles multidisciplinary consulting teams with cutting-edge expertise to help clients navigate the dynamic and often confusing world of sustainable development. With her clients, Schweitzer creates projects that are innovative, high performance, environmentally responsible, sustainable, beautiful, and valuable. Schweitzer's ongoing research contributes practical solutions and insights to the industry's understanding and quantification of the value proposition of green and sustainable developments. She is developing proprietary tools that will enable true cost pricing, and total cost accounting/valuation that addresses total costs and benefits, both market (economic) and external (global impacts) for various stakeholders in development and design decisions.

Schweitzer has designed and taught the inaugural Sustainable Real Estate Development Course through the Master of Real Estate Development Program at USC and is in the process of helping design a new Sustainability Certificate program for Truman State University, which is a preferred

provider for Boeing Corporation. She is a sought-after lecturer and speaker on sustainable real estate development and sustainable economics; she has published a variety of articles on the subject and is the coauthor and major contributor to ULI's bestselling book *Developing Sustainable Planning Communities*.

Julie Ulrich

Philadelphia, Pennsylvania

Ulrich is the director of urban conservation for the Nature Conservancy. She has extensive experience in sustainable planning and design and has worked at the intersection of cities and ecology for over ten years.

Working as a sustainability specialist for the city of Portland, Oregon, Ulrich contributed to the development and implementation of numerous green infrastructure projects. Focusing on ecological and social resiliency in cities such as New Orleans, Toronto, and Stockholm, she is passionate about reenvisioning the relationship between cities, communities, and nature.

Ulrich received her master's of urban planning and design from the University of Virginia's School of Architecture and is a senior fellow with the Environmental Leadership Program. She also serves on the faculty of Philadelphia University's sustainability program.

Bob van der Zande

Amsterdam, The Netherlands

Van der Zande has been director residential markets for the city of Amsterdam since 2009, responsible for the residential programs of the city and the metropolitan region. He founded the Investors Office (Residential) in 2012 to seek new markets and new investors to speed up housing production. After the crisis of 2008, a paradigm shift needed to be initiated and developed, changing the way the city and the region worked in the field of city development. Interaction with the private sector and understanding of the change in demand were crucial.

In 2009 the city of Amsterdam became part of the Urban Investment Network, as part of ULI. In 2011 van der Zande organized the Amsterdam Summit with participation of 150 international ULI members. He is a known speaker on several conferences and workshops in cities such as Berlin, Tokyo, Dublin, and Brussels, and in the Netherlands.

He is member of the European Urban Regeneration Council. In the last two years he served on two Advisory Services panels. At Expo Real Munich and MIPIM Cannes, van der Zande leads the Dutch presentation and program in a public/private cooperation of over 20 partners.

As a member of the executive board of the Watertorenberaad, a national Dutch council for innovation in spatial planning, he was responsible for the publication of a study for a new development strategy on the Sluisbuurt. Recently he organized the annual conference of the Watertorenberaad in collaboration with ULI Netherlands.

His private sector experience includes the position of senior project manager with Architectural Graphics Inc., a national leader in signage manufacturing. Other executive management experience includes the positions of vice president of the Hampton Roads Chamber of Commerce and administrator of the Virginia Maritime Association. He served in the U.S. Marine Corps Reserves from 1992 to 1998.

Williams holds a BA in history from the Virginia Military Institute and an MBA from the Regent University School of Business. In 2016 Williams was the recipient of the Julian F. Hirst Distinguished Service Award by the Hampton Roads Chapter of the American Society of Public Administration.

Ron Williams

Norfolk, Virginia

Williams has served as deputy city manager for the city of Norfolk since January 2012. He joined the city in 2002 and previously served in the positions of director of budget and grants management, special assistant to the city manager, and director of intergovernmental relations. His area of oversight includes planning and infrastructure of the city. He is an advocate for urban resiliency, complete streets, and placemaking. Williams served as project lead for the city's Better Block demonstration projects, development of Norfolk's Coastal Resiliency Strategy, the award-winning Slover Library, the Norfolk Consolidated Courthouse, the construction of five new public schools, and major public/private economic development projects.

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