

FUNDING RESILIENCE IN THE GREATER HOUSTON REGION: SYNOPSIS FROM A PUBLIC-PRIVATE SECTOR WORKSHOP

A Green Paper Report



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Funding Resilience in the Greater Houston Region: Synopsis from a Public-Private Sector Workshop / A Green Paper Report

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COVER PHOTO: SEAN PAVONE

Motivation for Workshop

Recent severe weather events have caused considerable damage to the Houston region. After a major natural disaster there is always a push to quickly rebuild infrastructure and communities, so we can get back to “normal.” After three severe weather events in three successive years, there is now considerable debate about what “normal,” means in this region. It is apparent that rebuilding communities, homes and infrastructure should not occur in the same way and, in some cases, in the same locations. Rather, improved design and construction standards and the equitable deployment of nature-based infrastructure, stormwater infrastructure, home buyouts and other strategies to make neighborhoods and communities across the Greater Houston Region more resilient to future disaster is a must if we are to ensure the region’s future economic and social vitality and environmental quality.

Recent community discussions of how and where rebuilding (and new development) should occur in this region are now often framed in the context of building back better. There is a growing understanding that these severe weather events are occurring with greater frequency and intensity and bringing with them routine property damage, increasing insurance costs, as well as local economic and government impacts. With this framing, rebuilding quickly after a storm with an emphasis of building back better sounds like a good approach to take. The key limiting factor, however, is that there is a significant lack of public funding to do so. There are estimates that it could take up to \$25 billion to build in a way that would mitigate future flooding impacts. Further, because we cannot completely prevent flooding, tough choices must be made by individuals, communities and public officials about where and how we will build back better.

Residents of Harris County recently took a significant step to help with the recovery effort. In August 2018, voters passed the largest bond in Harris County history – \$2.5 billion to aid in post Harvey rebuilding and recovery. With the passage of this bond, FEMA is likely to provide an additional \$1 billion. There is also the possibility that the Texas Legislature may grant approximately \$1 billion from the rainy-day fund.

Even with this substantial step by Harris County voters, with the known sources of public funding available and possibly being allocated to the region, Houston will not have enough funding to build back, much less build back better. With this understanding, regional discussions among key stakeholders from the private and public sectors, regarding the mobilization of private investment to supplement the public dollars has begun. Bringing additional private investments to the region presents an opportunity to quickly scale up the development of more resilient infrastructure. To prompt private sector funding to the region, the Houston Advanced Research Center (HARC) convened a half-day workshop on September 12, 2018, on innovative funding opportunities for resilient infrastructure. A significant motivator for this event was to get key public and private sector decision makers and

community leaders more comfortable with the concepts of innovative funding approaches. Without the comfort and security of understanding innovative resilience financing instruments, adoption of these funding mechanisms will be slow, and implementation of resilience projects will be sluggish.

Key stakeholders from the City of Houston and Harris County attended the workshop, along with representatives from finance, insurance, engineering, real estate, academic, environmental conservation and community-based organizations (CBOs). The goal of the workshop was to improve understanding of and determine opportunities for implementing innovative financing approaches for more resilient infrastructure.

The following sections offer a high-level overview of some of the resilient infrastructure funding options that are being considered and implemented locally and nationally, a detailed outline of the workshop proceedings, and next steps and potential paths forward for the Houston region.

Innovative Funding Options for Resilient Infrastructure

Long-term resilience will require new and innovative ways of thinking about public and private investment. With a growing number and intensity of severe weather events occurring nationally, and less public funding available for recovery, cities such as Washington DC, New Orleans, Miami and Houston are looking to pioneer innovative policies and mechanisms to unlock private investment in resilient infrastructure.

Some of the funding options to supplement traditional public infrastructure spending gaining the attention of public and private sector entities include environmental impact bonds (EIB), green bonds and resilience bonds. These funding mechanisms have the potential to provide immediate capital investment into the market which is critical to achieving the goal of building back quickly and in a more resilient fashion.

Environmental Impact Bonds

Environmental Impact Bonds (EIB) are tax-exempt municipal bonds using a pay-for-success approach. This model provides upfront capital, reduces government risk and places project performance risk on private sector investors. The public sector repays investors based on whether the agreed-upon environmental outcomes are achieved. If agreed-upon performance is not achieved, the investor covers the loss. The expectation is that with less risk, governments may be more willing to invest in more innovative financing for resilient infrastructure.

The most recent example of an EIB is a coastal restoration project in Port Fourchon, Louisiana just south of New Orleans. This EIB is a \$40 million "pay for success" environmental bond, with

funding provided the Deepwater Horizon oil spill settlement. The funding allows the State of Louisiana to accelerate project development for much-needed coastal restoration efforts. The first EIB issued in the United States was created in Washington, D.C. in 2016 to rebuild its stormwater management system and reduce runoff and combined sewage overflows. The City issued a \$25 million performance bond, backed by Goldman-Sachs and The Calvert Foundation.

Green Bonds

Green bonds are similar to traditional bond issuances with one key difference; they must demonstrate some level of environmental benefit or possess green attributes as defined by the Climate Bonds Standard Board¹. Much of the news on green bonds focuses largely on funding renewable energy or energy efficiency projects. However, as this market matures, the scope continues to widen. Green bonds have now been issued to facilitate resilience activity such as funding early warning systems and water infrastructure projects. The San Francisco Public Utility Commission recently issued a \$499 million green bond to develop stormwater management infrastructure.²

Resilience Bonds

Resilience bonds³ are financial instruments that capture reductions in insurance premiums attributable to overall reduction in community risk due to investment in more resilient infrastructure. Reduced risk is quantified by insurers and provided as a premium reduction to the insured. The difference between the original premium and the new premium, reflecting a reduced flood risk, can be invested into the project. After the project is paid off, the premium benefit remains and goes directly to the insured.⁴ Resilience bonds provide needed funding for upgrades that reduce natural disaster related risk.

The three funding approaches described above were the primary focus of HARC's September 12, 2018 workshop event. However, other funding approaches were also discussed including funding from tax increment reinvestment zones (TIRZ) and public improvement districts (PIDs). Both types of entities generate funding from property taxes or a separate assessment to be collected and spent within their boundaries.

¹ <https://www.climatebonds.net/standards>

² <https://sfwater.org/index.aspx?page=1182>

³ <http://www.refocuspartners.com/wp-content/uploads/pdf/RE.bound-Program-Report-September-2017.pdf>

⁴ Resilience bonds are not municipal bonds. They are insurance contracts similar to catastrophe bonds. Catastrophe bonds are issued by insurance companies to cover the risk of catastrophic natural disasters or events.

Resilience Workshop

On September 12th, HARC convened the Innovative Resilience Financing workshop in Houston, Texas. The workshop brought together key stakeholders and decision makers from Harris County and the City of Houston to work with finance, engineering, real estate, and insurance experts, as well environmental groups, conservation organizations and community-based organizations (CBOs), to discuss ways to increase private investment in regional resilience efforts. The event largely focused on introducing innovative funding mechanisms that could be deployed in the Houston region to rebuild after Hurricane Harvey and make the communities more resilient.

The two-hour workshop was designed to allow for information sharing and capacity building among key regional decision makers. The first half of the workshop was an overview and discussion of resilience financing by local and national experts. Following this overview, three storm-water management projects were brought forward by local government representatives to provide archetypes of projects that may benefit from various innovative funding approaches. They include a greenfield project, a residential project and an industrial project. For each of these projects, the focus was on mitigating flood impacts under different development scenarios. After the initial discussion, the workshop participants broke out into five work groups. Three work groups focused their discussion specifically on one of the project archetypes. The fourth table discussed specific applications of nature-based infrastructure to all three projects. The fifth table discussed the role of CBOs in the implementation of innovative resilience projects. Each of the groups had about 45 minutes to discuss the projects, potential financing applications and opportunities for public private partnerships. The work group discussions were followed by a report-out from each table.

Private Capital Funding Perspective

The introduction to the resilience finance discussion was framed around three key themes:

- *It takes time to get resilience projects planned, approved and implemented;*
- *Funding will be wasted if infrastructure is built back according to original design criteria, rather than being built according to newer, more resilient standards;*
- *Not enough money is available from the public sector to fund all of the resilience work that is required.*

Because there is not enough public-sector resilience funding, communities need to engage the private sector markets for resilient infrastructure investment. There are mechanisms in place, and under development, that can ensure value is captured for building more resilient infrastructure. The outcome is a more resilient community, facing less risk from severe weather events.

To effectively utilize different funding sources, one of the key needs is to capture value from public projects that is typically untapped. The private market must be incentivized and able to quantify the financial benefits of a public project to show an appropriate return on the project. Coupling physical protection, such as infrastructure projects to mitigate risk, with financial protections from the insurance and finance sector is one way to bridge this gap. In many places, insurance companies are finding it more cost effective and efficient to work toward reducing risk exposure rather than paying for recovery and rebuilding efforts. Avoiding losses (both actual and perceived) is a key driver in the development and implementation of many of these new resilience financing tools.

A key focus when looking at resilient infrastructure is to work toward a tangible resilient dividend. To encourage private investment, there must be near-term economic returns for any capital provider, as well as benefits for the local government and community. Inclusion of a methodology to calculate the resilience dividend in upfront infrastructure decisions helps with decision making between alternatives to reduce damage levels and speed recovery with limited resources.

When prioritizing project investments, the community must be able to target key resilience goals, identify the economic, social and built environment dependencies to provide the appropriate selection criteria to reduce risk and improve resilience. By focusing on the social and economic needs of the community and how the built environment is expected to meet those needs over time, the result is more optimal resilient infrastructure. This infrastructure can help organizations, communities and individuals to better withstand and recover from disasters. Further, appropriate resilience investments lead to overall improvements of the community which will lessen impact of environmental stressors, which would improve the community's ability to maintain essential functions.

Risk mitigation related benefits can be difficult to quantify, but it is critical to the success of obtaining and implementing these innovative financing strategies. Many benefits of certain resilience infrastructure projects are not fully realized and factored into the final decision-making process. Quantifiable, monetized performance measures must be developed to ensure proper project performance. For example, quantifying the risk of interruption to daily business for a commercial/industrial organization is important. The benefit of resilience investment can be directly tied to reducing this risk of business disruption.

Innovative financing and public-private partnerships for resilience are still relatively new, but there is increasing recognition that they are important tools to fill the gaps in public funding and would allow for risk-reducing infrastructure projects to be completed more quickly.

Public Sector Perspective

A key concept discussed at the workshop was how the Gulf Coast Region can work to protect life and property by accessing and utilizing private sector funding. Public money is not enough to mitigate the multiple flooding risks associated with sea level rise, storm surge, riverine flooding, channel flooding and overland sheet flow. The recent Harris County \$2.5 billion bond, post-Harvey FEMA and HUD dollars will not be enough to fully develop a more resilient infrastructure system at the scale that is needed for this region. In addition, it takes a significant amount of time to receive these funds and build out the proposed projects. New funding is needed to fill the gaps of public funding and expand the project opportunities equitably to beneficiaries.

During the workshop, participants discussed the issues they face with regards to stormwater management and flood mitigation. According to the feedback received, there is far more need than government funding available; and significant financial resource barriers limit the number of projects and speed of project implementation. There was consensus among the group that now is the opportunity to consider innovative funding sources for resilience project. It was also acknowledged that innovation is not always thought of favorably by public officials; many of whom are not rewarded for taking risks.

Further, it was discussed that project planning will need to include a diversity of partners to ensure the appropriate stakeholders and resources are being tapped. In Houston, as elsewhere where city leadership is recognizing risks from more extreme weather events, there is a burgeoning “new wave of collaboration” between government officials, financiers, developers, and communities.

Workshop Discussion on Resilience Bonds

After discussions focused on the needs of the community, the workshop turned its attention to resilience bonds as a specific mechanism to fund more resilient infrastructure. Funding from a resilience bond is derived from a reduced insurance premium that occurs when a project is built to deliver a greater level of resilience. Private capital is willing to participate in resilient infrastructure efforts, but it must see a fair return on its investment. Flood mitigation projects generally do not generate revenue; however, one can estimate and capture the value to the economy of a more resilient community. A resilience bond captures value from decreased risk for the insured and the investor.

Resilience bonds are an innovation derived from catastrophe bonds (i.e., cat bonds) which are issued to insure large-asset holders (including insurance companies) against major disasters. Risk is based on the development of a risk profile created via a natural disaster risk catastrophe model, the output of which is the basis for the issuance of a cat bond. The catastrophe bond provides insurance for policy holders – the investor will lose the value of this bond if a disaster

strikes during the term of the bond, and the funds will be used to pay out claims. If no disaster occurs, then the investor receives the full benefit of investing in that bond.

It is feasible to take the information and data used to issue a cat bond to assess the impact of a project on the risk profile, and then figure out how to build that infrastructure in a resilient way that minimizes risk. The reduction in risk allows for the insurance premium to decrease. This insurance savings can be used for investing in more resilient projects. Although the premium is now lower, the insured would still pay the same premium but the difference between the original insurance premium and the new reduced risk premium would go toward funding the more resilient infrastructure (see figure 1).

Of the innovative resilience funding mechanisms described above, participants at the September 12th workshop were cautioned that resilience bonds will work best for larger projects with a defined and manageable number of direct beneficiaries, such as a large industrial complex or campus. Resilience bonds will be less effective in a project area that has many uninsured properties and are more difficult to structure if there are many diffuse smaller beneficiaries, such as a residential neighborhood. However, even though communities may not be directly involved in the resilience bond process, they will benefit from more resilient infrastructure. Secondly, the more diffuse the protection, the more difficult it is to determine the value and the more difficult to quantify the insurance risk and savings.

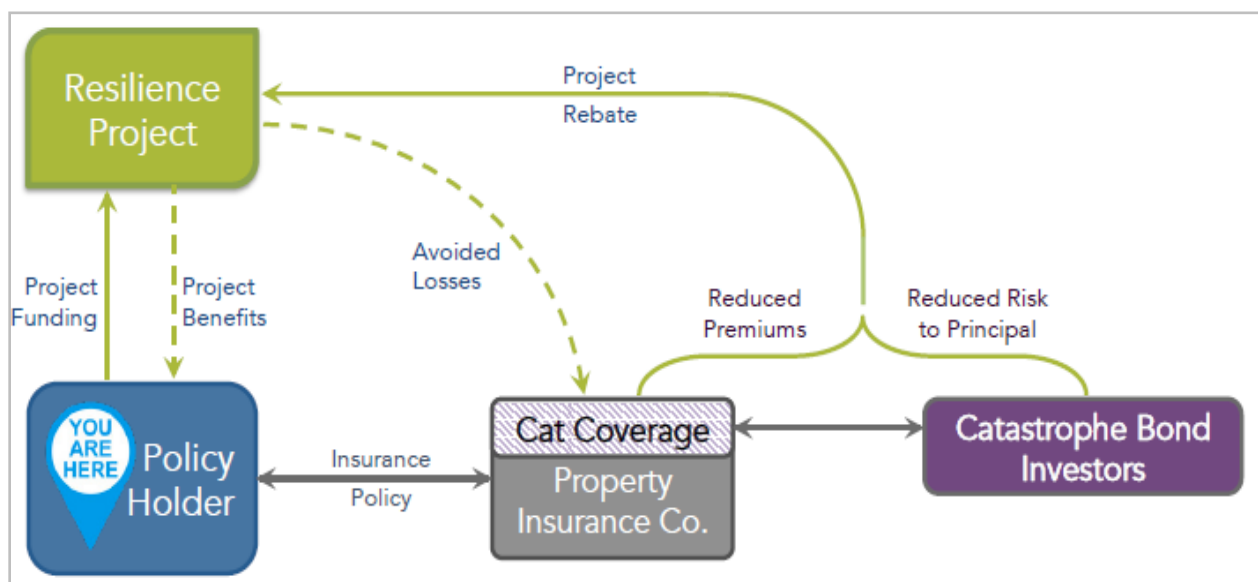


FIGURE 1. RESILIENCE BOND MODEL.

Three Project Archetypes: Four Perspectives

Three different public-sector project types were introduced at the workshop. The projects serve as examples of plans that could be developed in the Gulf Coast region. For each project type, different innovative financing options were discussed, with a primary discussion on how to utilize resilience bonds and environmental impact bonds to help fund a portion of these projects.

The three project types include a greenfield reservoir development project (greenfield), a project to modify a detention basin and channel in a highly industrialized area (industrial), and a final project on detention and channel improvements in a highly residential area (residential). A fourth perspective represented views of community based organizations and nature-based infrastructure work groups which discussed the three projects types more generally.

Industrial

PROJECT DESCRIPTION

The project setting represents an area that consists of industrial complexes surrounded by residential development. A detention system exists and is connected to a channel that conveys water out of the area. In its current state, a substantial portion of the surroundings, particularly roadways, floods with a five-year rain event (a 20-percent chance of occurring in any given year). For larger storms with greater than 10-year (a 10-percent chance of occurring in any given year) to 100-year (a 1-percent chance of occurring in any given year) probabilities, flooding of property becomes more prevalent and there is greater risk to the residential community and industrial complexes.

To alleviate the risk associated with 10-year to 100-year floods, it is proposed that the existing detention basin be made deeper and channel improvements made to improve conveyance of water from the area. These improvements could potentially reduce the water service elevation by up to 4.5 feet, thereby reducing risk to the surrounding community and significantly reducing risk of road flooding. The funding will be required to excavate and repair existing detention ponds and for right-of way-improvements.

The beneficiaries of the project would consist of major companies with properties in the basin; commercial and residential developers; individual land/home owners; and the traveling public. The project's benefits would accrue mainly to those entities that exist in the basin, with relatively little downstream benefit, since the water flows directly into Galveston Bay.



FIGURE 2. HOUSTON'S CONTINUED ECONOMIC GROWTH DEPENDS ON ACCESSIBILITY TO ITS PORTS — SUCH AS BARBOURS CUT TERMINAL. SOURCE: U.S. ARMY CORPS OF ENGINEERS.

SOLUTIONS DISCUSSED

Different types of funding options were discussed. The conclusion was that resilience bonds may be the optimal approach to consider due to the fact that there is one large industrial customer. It would be relatively simple to quantify risk benefit for one, large entity. The industrial complex's risk of flooding could be reduced, thereby potentially reducing their insurance premium. This reduction could be quantified and captured in a manner that helps to cover the cost of the project. It was not expected that the surrounding community would have the necessary insurance coverage to be a key player in supporting the development of the resilience bond.

With this dynamic in place, it was anticipated that industry investment to mitigate flooding risk to property be based on internal risk modeling. If industry sees a risk and it is determined that there is significant risk to the surrounding community, can industry contribute funds and supplement public dollars to repair and enhance infrastructure for the entire community. Do models exist where this approach has been considered?

To engage this industrial customer, it is important to understand the degree to which flooding is integrated in their risk assessment. If not already doing so, the company would need to incorporate flood risk in their models. The risk should consider the likelihood of a severe weather event and the intensity and vulnerability of the site to a specific event. Once a business quantifies this risk, the company would then determine options to reduce risk and monetize those risk reducing options.

A key next step that was identified was for the City of Houston to talk with major companies in specific basins to discuss ways to effectively capture, distribute, and reduce the risk, and gauge industry interest through the type of project proposed by the City and its associated financing.

QUESTIONS FROM STAKEHOLDERS

- 1) *Who is the primary beneficiary of this project? The conclusion was that it is a large industrial complex at risk of flooding. The surrounding community and other commercial and industrial operations would also benefit, but likely to a lesser degree.*
- 2) *For areas with large concentrations of industry, resilience bonds may be a good fit. However, questions were asked during the discussion to better understand the value of such a project to the private sector. For example, what are annual expenditures on flood insurance? How is business continuity or reducing business disruption quantified? Can value be realized that would justify private capital investment or private sector investment in flood mitigating efforts? In assessing overall community risk there needs to be critical mass of stakeholders. It is not typical for heavy industry to publicly discuss risk, as in likelihood of spill, potential liability, vulnerability, etc.*
- 3) *How does a resilience bond work when the primary beneficiary is self-insured? More clarity is needed.*
- 4) *Is there an incentive for the large industrial complex to participate if they can protect their individual plant with flood mitigation measures on-site? If so, then we would not anticipate a high likelihood of participation in a more public infrastructure development process.*
- 5) *What would happen if the commercial company sells the property? It was unclear as to what would happen to the insurance premium reduction and whether it would carry over to the next customer.*
- 6) *There is some undeveloped land in the project area that may be of greater interest to developers if there was a reduction in flood risk. The reduction in flood risk would open more land up for development. With a reduction in flood risk, due to this project, would existing landowners and/or land developers be willing to participate in a resilience bond approach?*
- 7) *Does this project reduce overall risk to the Houston economy because it limits flood exposure to a large employer in the region? Like the greenfield site, downstream benefits are diffuse. If there are indirect benefits to Houston and exposure can be limited, does this reduced risk to region reduce insurance rates?*

Residential

PROJECT DESCRIPTION

A second project considered conveyance improvements of existing bayous and streams along with the development of a 2,400-acre retention pond and public park. The project area consists primarily of residential properties along a bayou, intermixed with suburban style commercial properties.

In this scenario, the retention pond would be excavated at an existing landfill site. The landfill site would be mined to extract valuable material that can be sold. The project would decrease risk to the existing neighborhood that may experience 100-year rainfall events. In addition to reducing 100-year rainfall risk, the retention pond would also be developed as a neighborhood park. It is anticipated that with this work, approximately 8,000 homes upstream and downstream of the project would benefit due to decreased flood risk.

SOLUTIONS DISCUSSED

A resilience bond was initially considered for this project. However, there is significant complexity in applying this funding mechanism. First, with a high number of individual property owners, realizing the risk benefit and the subsequent premium reduction would require additional upfront work to align the residential beneficiaries. An aggregated risk reduction would need to be agreed upon by property owners. Property owners would then have to agree to continue to pay the pre-project insurance premium until project is paid off.



FIGURE 3. RESIDENTS FLOCK TO NEARBY WATERWAYS TO ENJOY THE MANY NATURAL BENEFITS OF THESE AMENITIES. SOURCE: WILLOW WATERHOLE CONSERVANCY.

Second, due to current flood insurance coverage among residential properties in Houston, it is likely there would be a low number of insured within the project area. With such few insured, a premium reduction for those insured may not be enough of an overall reduction to provide a

significant revenue stream for a large-scale project. Increasing the number of flood insurance holders may require a government mandate, which is not likely to be politically feasible.

Another option discussed was whether the City would be willing to develop a tax increment reinvestment zone (TIRZ) for this project area. With a TIRZ, the property taxes generated within the zone would stay in the TIRZ. This funding may be made available to provide a revenue stream to this project.

The TIRZ was thought to be an option but questions arose as to the size of the property tax base in the project area. If the project area is a low-income neighborhood, it could make it difficult to generate funds necessary to provide adequate revenue. Due to the limits of the property tax base, there was some additional discussion regarding other revenue streams, particularly related to generating revenue from the new park. For example, having parking meters placed at the park to generate revenue from park users.

Due to the limited amount of funding provided by the TIRZ option, a variety of bundling options were discussed including a small resilience bond that would capture the risk reduction from those insured. Also, options around leveraging FEMA dollars, particularly their hazard mitigation grant and HUD dollars, may provide additional funding for this project.

QUESTIONS FROM STAKEHOLDERS

- 1) *Specific to converting the landfill, participants were concerned about using a landfill for such a purpose, as well as the possible environmental risk to the surrounding neighborhood due to air-borne particulates from disturbing the site.*
- 2) *At the end of this session, a primary question remained regarding accessing private capital. One suggestion was to consider a public-private partnership (P3).*



FIGURE 4. SPRING LAKE IS A WONDERFUL GREENFIELD EXAMPLE. SOURCE: MICHAEL REILAND.

Greenfield

PROJECT DESCRIPTION

For this project, the focus was on the development of a reservoir in a sparsely populated area that would capture upstream stormwater flow for slow release into the connected waterways. A significant driver for this project is to reduce risk of sheet flooding and overflows of downstream reservoirs and bayous. The primary costs for this project – estimated at up to 90% of total project cost – will consist of securing the property/easement necessary for the reservoir.

SOLUTIONS DISCUSSED

When discussing the reservoir, questions were raised regarding the reservoir size. The concern was how to provide optimal risk reduction with minimal footprint and impact to existing environmentally sensitive areas with increasing likelihood of higher intensity events.

Existing plans are based on current floodplain data. Project planning and investment for this project and others must consider the new Atlas 14 data.⁵ With the release of this new data, it is expected that many areas that were not in the floodplain may now be identified as being in the floodplain. After Hurricane Harvey, models that were used to determine location and size of the reservoir, as well as bayous that would be impacted by project, are seen by stakeholders as not adequate.

The control of water releases was also a central topic. Based on how current reservoirs performed during Hurricane Harvey, there was discussion about how to best manage the release of water from the reservoir during and after an event. The decision of how to control the water with specific release mechanisms will largely be a cost factor. It is anticipated that gates may provide greater control of water release but also may significantly increase cost of project and adversely impact the environment.

Resilience bonds and impact fees were discussed with a focus on the creation of a tax TIRZ or public improvement district (PID). A TIRZ would be able to hold funds in the zone for stormwater management projects. The success of the TIRZ would largely be due to the ability to develop the area in way that provides a viable tax base for the TIRZ. The use of a PID was also discussed but runs into a similar problem. Further, a PID adds a supplemental assessment, beyond existing property taxes, to fund infrastructure investment. The question was considered as to whether there is an appetite for an additional assessment within this project area.

Ultimately, regardless of funding mechanism, the primary question was whether a greenfield site, with a largely undeveloped geography, would have sufficient tax base to generate

⁵ <https://www.noaa.gov/media-release/noaa-updates-texas-rainfall-frequency-values>

necessary revenue. It was pointed out that with existing flood risk, future development may not occur. Without future development, there is not sufficient tax base to fund the project via a TIRZ or PID, nor the concentration of insurance holders to justify a resilience bond.

QUESTIONS FROM STAKEHOLDERS

Based on this discussion, a variety of questions were raised that require additional research.

- 1) How can development occur that allows for the growth of the necessary tax base, but at the same time limit ad hoc development that may complicate stormwater management? Participants also were unclear as to role of the federal government. If some of this infrastructure is US Army Corp of Engineers infrastructure, then they should have a role in paying for some of this infrastructure.*
- 2) With the release of new floodplain data, how will the size of the reservoir be reconsidered to deal with the reality of more intense and frequent rain events? Will large reservoir project planning do a better job at accounting for bayous and watersheds that connect with or are contiguous?*
- 3) How can decision makers and planners take a more regional approach in planning this new development? Some of the beneficiaries will be those that are downstream, and those adjacent to existing bayous downstream from this project. How can their risk reduction be quantified and applied to overall risk reduction of project?*
- 4) There are requirements for detention within a new greenfield development. This helps, but it does not deal with regional flooding issues. The detention and retention projects must be done with an understanding of how the region would benefit. A regional perspective that allows for coordinated on-site retention with a larger reservoir project may possibly be a viable strategy to consider. How is such a coordinated strategy deployed?*

Community Based Organizations and Nature-Based Infrastructure

The community based organization (CBO) and nature-based infrastructure (NBI) work groups discussed the three projects more generally. A primary concern is that with these projects, community engagement may not properly allow for constructive input and that environmental justice concerns may be overlooked. In addition, groups were concerned with the degree to which they can be involved with the planning, designing and timing of investment.

The NBI organizations would like to see nature-based infrastructure considered widely in future projects across the region. The CBOs would like to participate in planning efforts regarding how these projects would impact their neighborhoods and local economy. CBOs contend that public officials should recognize that resilience is not just provided by traditional/hard infrastructure, but also through social systems, e.g. healthcare, public services, etc. They stated the need for

considerations that would allow for job creation, procurement and vendor/firm selection that would provide equitable opportunities for all to participate.

Another topic discussed was opportunities for the development of community benefit agreements, which allow for agreements between neighborhood groups and project developers to ensure the provision of specific amenities and risk mitigation.

The CBOs discussed the allocation of existing public dollars. A prime concern brought up by participants at the CBO table was that public dollars would be used in a way that would benefit private sector developers or industry groups, with minimal benefit to residents and the overall community. CBOs felt that private industry should directly support these projects through investment. This concern was echoed by the table discussing the industrial project archetype. The NBI workgroup had direct interest in environmental impact bonds and saw, at least for the projects discussed during the workshop, that environmental impact bonds may be more likely to find success.

QUESTIONS FROM STAKEHOLDERS

There were significant questions regarding project funding criteria and metrics; for example:

- 1) *Can a set of expected output criteria for specific types of natural infrastructure be developed (i.e. land conservation initiatives, low impact development strategies, etc.)?*
- 2) *Can novel criteria (e.g. reduced sedimentation from shoreline stabilization and restoration projects) be developed to support quantifiable, monetized performance measures?*
- 3) *There was also a great deal of discussion on the need to identify potential beneficiaries in the region that would be willing to participate in financing these types of bonds for NBI.*

Conclusions

The primary focus of this workshop was to help private, public and community leaders better understand how to build back better after Hurricane Harvey and future events. With recent severe weather events causing considerable damage to the Houston metropolitan area, there is growing awareness that the region is facing a new “normal” and will likely continue to experience more frequent and intense severe weather events. If this is the new normal, how does Houston rebuild from recent storms and build new infrastructure that will reduce future risk?

It is in the region’s best interest not to build back to what we had, but to build forward towards a vision in which communities are more resilient with regards to social, environmental and economic well-being. When building for resilience, it is key that the region focus on improved design and construction standards and the equitable deployment of nature-based infrastructure, stormwater infrastructure, home buyouts and other strategies to make neighborhoods and communities across the Greater Houston Region.

Harris County voters demonstrated a willingness to invest in infrastructure through a recent approval of a \$2.5 billion bond to aid in post Hurricane Harvey recovery and ensure a more resilient future. Unfortunately, this funding, coupled with federal and state dollars, is a fraction of what is required.



SEE APPENDIX FOR LARGER IMAGE.

With this mind, the workshop participants concentrated on identifying other funding strategies. Several funding options were discussed including environmental impact bonds, green bonds and resilience bonds, with a primary focus of the workshop on resilience bonds. As stated above, this funding mechanism allows for private capital to be used to fund resilient infrastructure in a timely manner.

When introducing these funding mechanisms, the primary intent was to increase familiarity and comfort levels associated with innovative resilience financing instruments. Without this dialogue, adoption of these funding mechanisms will be slow, and implementation of resilience projects will be sluggish. Based on the deliberation that occurred at the workshop, key steps were taken to increase the opportunity for the introduction of innovative funding mechanisms to be a part of the region's core resilience strategies.

As the region moves forward key considerations must be kept in mind and addressed:

- *Resilience should be included as a key component of economic development, community planning and disaster recovery initiatives. Future planning and development must include response and recovery, as well as prevention and protection. With the recent upward trend in extreme weather events, proper planning and investment will be required to reduce disaster impacts. Therefore, communities need to be better at defining risks, setting priorities, and determining pre and post event costs.*
- *Resilience planning and investment is difficult due to the uncertainty of the timing and frequency of major events and willingness of investors. Appropriate resilience metrics and key indicators must be developed that can quantify risk of events to a community. By not quantifying future economic impacts, the ability to make a case to invest in more resilient infrastructure will be less likely.*
- *Further, resilience investments should not focus on economic first costs, rather the focus should be on life-cycle benefits of having the asset in place, including social and environmental benefits that are not as easily quantifiable.*
- *Private sector capital is available, but there are two constraints. For private sector capital to enter into the market it must be incentivized and participants must be able to quantify the benefits of a public project to show an appropriate return. Further, communities must be comfortable with private sector capital entering a space that traditionally has been funded by the public sector. It is imperative that communities better understand the cost, benefit and trade-offs of different investment strategies.*



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Appendix 1. Graphic Summary of Fishbowl Dialogue and Public Discussion.

The image below was created by graphic facilitator, Jessica Jarvis of MCV Consulting. The image encapsulates the discussion that took place during a fishbowl dialogue and audience conversation on the evening of September 12, 2018.

Fishbowl dialogue participants included: Shannon Cuniff, Director of Coastal Resilience, Environmental Defense Fund; Jose Peralta, Director, Aon Risk Solutions; Jamie Rubin, CEO, Meridiam North America; Peter Schultz, PhD – Vice President, ICF and Stacy Swann – CEO and Founding Partner, Climate Finance Advisors. The conversation was moderated by: Shalini Vajjhala, PhD – Founder & CEO, re:focus partners; Gavin Dillingham, PhD – Clean Energy Director, HARC and Margaret Vaughan – MCV Consulting.

