

## CLIMATE CHANGE AND FINANCIAL RISK – GUIDANCE DOCUMENT

City and County of Honolulu Climate Change Commission

July 2020

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### PURPOSE

Pursuant to the Revised Charter of Honolulu (“RCH”) Section 6-107(h), the City & County of Honolulu Climate Change Commission is charged with gathering the latest science and information on climate change impacts to Hawai‘i. It provides advice and recommendations to the mayor, City Council, and executive departments as they look to draft policy and engage in planning for future climate scenarios as well as reduce Honolulu’s contribution to global greenhouse gas emissions.

The purpose of this guidance document is to provide considerations of the emerging financial risks affiliated with climate change, particularly climate shocks and stressors relevant to the City & County of Honolulu. Learning from climate-related hazard events in other jurisdictions, like the wildfires in California (2017-2018) and Australia (2019-2020), underscores the importance of understanding and taking action towards mitigating new sources of climate risk. This prompts the need to critically examine the nature of hazards, current insurance information and mechanisms used by the City, as well as general practices of public finance. This guidance document highlights potential alternative risk transfer options to address climate change shocks as well as discusses City public finance in the context of climate change stressors. Hurricanes and sea level rise are used as illustrative climate change shocks and stressors.

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### RECOMMENDATIONS

There is need for the City and County of Honolulu (“City”) to take action on climate change adaptation and potential financial impacts. Climate change will affect the City’s revenues and expenditures, as well as increase acute financial risk in the aftermath of climate-related disaster events. Municipal credit rating agencies have warned that cities must address climate change or otherwise face potential credit downgrading. This would affect the City’s ability to borrow money when it is most needed. In response, the Climate Change Commission (“Commission”) suggests that the City should:

1. Direct City departments with authority regarding City infrastructure to assess how climate change shocks and stressors (see Table 1) will impact their systems and long-term budgetary requirements. This can be achieved through immediate adoption of the implementation strategies of the O‘ahu Resilience Strategy.<sup>1</sup> In particular, improved infrastructure project review processes, longer-term financial plans and better alignment of the City’s pre-disaster mitigation plan to capital/budgeting are important steps to integrating consideration of climate change within existing City processes. In addition, departmental functional plans should be leveraged with increased coordination across departments. New integrated planning frameworks, such as the Commission’s recommendation for the adoption of a ‘One Water’ framework, can help increase coordination across departmental silos.
2. Reexamine the adequacy of City property insurance relative to climate change shocks. Currently the City spends almost \$4 million annually to purchase approximately \$300 million in property insurance. The total value of City property is \$3.8 billion.<sup>2</sup>
3. Further explore the alternative risk transfer market, which are mechanisms to transfer financial risk other than traditional insurance products, and the appropriateness of market products for the City. For example, the California Earthquake Authority (CEA) issued a catastrophe bond in 2011. This allowed the CEA to obtain reinsurance from capital markets (rather than traditional reinsurance).<sup>3</sup>
4. Improve the transparency and availability of aggregate O‘ahu residential-level data regarding insurance coverage to climate-relevant shocks, working with the Hawai‘i Department of Commerce and Consumer Affairs (DCCA), Insurance Division.<sup>4</sup> The level of private insurance coverage is important to understanding

the relationship between private and public financial exposure post-disaster and there is little publicly available data to assist in City decision-making outside of the National Flood Insurance Program (NFIP).

5. Continue “mainstreaming” climate change adaptation measures to minimize risk exposure; for example, through building codes, stormwater management and other land use measures. This is an area for further research.

## **I. INTRODUCTION**

The climate crisis is increasingly causing financial and economic disruption<sup>5</sup> and it is projected to worsen in the future.<sup>6</sup> Rating agencies are investigating the impact of climate change on the fiscal health of cities. In 2017, Moody’s released a report warning jurisdictions that a lack of climate action, both in mitigation and adaptation, would likely result in credit rating downgrades. This negatively affects municipal ability to borrow money, further worsening financial vulnerabilities.

Within a year of releasing the report, Moody’s reached out to the City to get feedback via a “climate change survey.”

The survey asked whether the City has:

- 1) A natural hazard mitigation plan that addresses the City’s climate adaptation strategies,
- 2) A climate/sustainability action plan, and/or
- 3) Anticipates issuing debt to fund any climate change related initiatives.

The City answered that it is currently updating its Multi-Hazard Pre-Disaster Mitigation Plan<sup>7</sup> to incorporate climate change and is in the process of developing a Climate Action Plan.<sup>8</sup> The City responded that it anticipates expenditures in response to climate change, for example to address coastal infrastructure.<sup>9</sup> This is happening in response to the Mayor’s Directive 18-2, which incorporated the Commissions “Climate Change Brief”<sup>10</sup> and “Sea Level Rise Guidance.”<sup>11</sup> Overall, the City should take the necessary steps to invest in climate change mitigation and adaptation measures to protect the wellbeing of its people, which includes its creditworthiness. The City currently has a very high credit rating, which must be maintained.<sup>12</sup>

This white paper summarizes climate change impacts relevant to Hawai’i for the purposes of motivating consideration for emerging fiscal concerns due to climate change shocks and stressors. Climate-related shocks are rapidly developing, high impact events such as hurricanes, wildfires, heat waves, and extreme rainfall. Climate-related stressors are persistent, more slowly developing negative influences, such as sea level rise that exacerbates chronic coastal erosion and flooding. Using examples of climate change shocks and stressors (hurricanes and sea level rise), this paper assesses how they might affect the City’s fiscal health. It explores current risk reduction strategies relating to traditional insurance as well as alternative risk transfer mechanisms in response to emerging climate change induced risk.

## **II. HAWAI’I’S CLIMATE CHANGE SHOCKS AND STRESSORS**

The impacts of climate change can be broadly categorized into those that happen suddenly, a shock, or those that happen gradually, a stressor; impacts can also take the form of compound events and geographically distant events that have significance in Hawai’i. Both stressors and shocks can have related cumulative and cascading impacts. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Climate change impacts have the capacity to produce a chain of consequences that further amplify the initial shock; for example, heat stress can result in power system failure with both physical and economic consequences. Table 1 below details key physical shocks and stressors posed by climate change in Hawai’i.

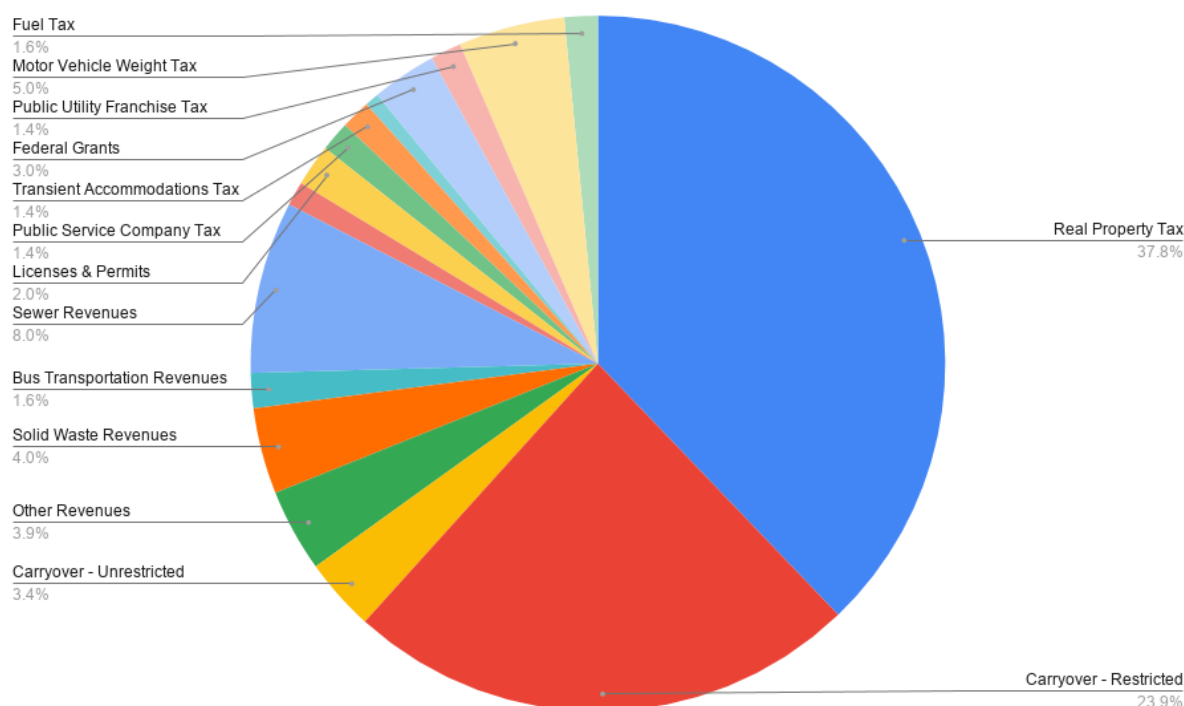
Table 1: Direct, Physical Climate Change Impacts: Shocks and Stressors

To the extent that shocks and stresses are related, they are listed within the same row.	
Shocks	Stressors
Tropical Cyclones (TC) – rising intensity, high winds, waves, storm surge, heavy rainfall and flooding, tracks moving North into Hawaiian waters <sup>13</sup>	
Extreme Rainfall and Flooding – rising incidence <sup>14</sup> , damaging floods and “brown water” alerts	Declining Observed Precipitation <sup>15</sup> - stress related to aquifer recharge and watershed & forest ecology, streams & aquatic ecosystems, increasing aridity, creation of new wildfire prone land, agricultural impacts, drought
Landslides and Rock Falls – related to extreme rainfall and regional geology and topography <sup>16</sup>	Soil Erosion – especially related to heavy rainfall events, cumulative impact to aquatic ecosystems and coastal water quality
High Winds <sup>17 18</sup> (Not TC) – All of O’ahu is susceptible to windstorms, local topography can create especially vulnerable “wind speed-up” areas	Declining Trade Winds <sup>19</sup> - declining air circulation and quality, physical discomfort and availability for renewable energy generation
Heat Waves <sup>20</sup> – Increasing incidence of consecutive days with high temperature with impacts to health, transportation, energy, agriculture, and construction sectors	Rising Heat Stress – exacerbates urban heat island effect, increasing power demand and physical discomfort; increasing potential for health problems especially among the elderly, the ill and the young.
Wildfire <sup>21</sup> – Total burned area statewide has increased more than fourfold in the last century and fire propagates rapidly in dry nonnative grasslands	Growing Aridity – increasing wildfire occurrence and associated costs (personnel, air quality), impacts to food production and native ecosystems.
Sea Level Rise Event – various types: king tides, extreme erosion, increased flooding w/ rain at high tide, high surf <sup>22</sup> ; damage from Tsunami and storm surge increased	Sea Level Rise & Chronic Coastal Erosion <sup>23</sup> – worsening coastal erosion, rising demand for seawalls and retreat strategies, at-risk buried infrastructure and drainage, polluted groundwater, flooding
Marine Heat Wave <sup>24</sup> - Increasing frequency, often regionally associated with the “El Niño” phase of ENSO	Coral Bleaching <sup>25</sup> – reef collapse, impacts to fish and ecosystems, sea surface temperature and ocean acidification contribute to bleaching

### III. CITY FINANCIAL CONSIDERATIONS OF CLIMATE CHANGE SHOCKS AND STRESSORS

In fiscal year (FY) 2020, the C&C brought in \$1.4 billion in property tax revenues.<sup>26</sup> This is an increase of about \$140 million from FY 2018. <sup>27</sup> Overall increases in property values are leading to increasing property tax revenues. In FY 2019, the City’s entire operating budget comprised \$3.32 billion, where real property tax revenues make up 38%.<sup>28</sup> Other notable sources of revenue for the City are Bus Transportation (1.6%), Solid Waste (4%), and Sewer (8%). The motor vehicle weight tax is 5% while the fuel tax is 1.6%. While real property tax revenues tend to fund city operations more broadly, many of the other taxes tend to be more resource and sector specific.

Figure 1: Sources of City Revenue, FY2019



Source: City and County of Honolulu - Executive Program and Budget Report for Fiscal Year 2019

Shocks and stressors are physical phenomenon that have impacts to socio-economic systems. In the focus of this work, they can have substantial financial impacts. Examples in terms of both shocks and stressors, as well as to increasing costs and potentially decreasing revenues, are provided below.

**Shocks:** The City's 2019 Multi-Hazard Pre-Disaster Mitigation Plan provides insight into the order of magnitude of fiscal impact from future hazard events specific to O'ahu. This plan includes a risk assessment that estimates losses "linked directly to a hazard event including all damages, deaths and injuries, loss of habitation, and employment losses due to the closure of damaged facilities."<sup>29</sup> The metric is normalized to a measurement of average annualized losses. What stands out from this analysis is that the magnitude of estimated wind-driven hurricane damages are far greater than all else, at \$410 million per year.<sup>30</sup> For context, the damage from coastal erosion is estimated at \$3 million annually; debris flows and rock falls at \$1-5 million annually; and wildfire at \$1 million annually.<sup>31</sup> Tropical cyclones are of particular concern because, as a result of climate change, they are following new pathways that will bring them near Hawai'i more often.<sup>32,33</sup> Climate change is projected to cause a northward shift of hurricanes, which will increase the chance of their making landfall and posing severe flood risks to O'ahu communities and infrastructure along the coast as well as further inland.<sup>34</sup> An increasing number of storms have tracked closer to Hawai'i in recent years: Hurricane Guillermo in 2015, Hurricanes Celia, Darby and Lester in 2016, and Hurricanes Lane and Olivia in 2018. Tropical cyclone intensities increase with warming, both on average and at the high end of the scale.<sup>35</sup> Moreover, the atmosphere generally holds more moisture as temperatures increase (unrelated to hurricanes). This means there will potentially be potentially far greater amounts of rainfall in short periods of time, triggering worse floods.<sup>36</sup> In April of 2018, for example, torrential downpours in East O'ahu and northern Kaua'i caused destructive flash flooding. In Waipā, Kaua'i, there were 49.69 inches of rainfall within 24-hours, setting a national record.<sup>37</sup> A total of 532 homes were affected by the flooding on both Kaua'i and O'ahu, as well as an estimated \$20 million in damages for just public properties.<sup>38</sup>

Stressors: The economic cost of stressors to Hawai'i's economy and, more particularly, those of the City and County of Honolulu, are not particularly well documented with the exception of assessed land costs and sea level rise. The Hawai'i Sea Level Rise Vulnerability and Adaptation Report finds that, with 3.2 feet of sea level rise (within a broader multi-hazard exposure area), \$12.9 billion in assessed land value will be made vulnerable.<sup>39</sup> The damage to property will likely result in lower property tax revenues, as follows:

- \$9.3 billion: the assessed value of residential land (\$2013) within the 3.2 feet sea level rise exposure area.<sup>40</sup>
- Taking the real property tax rate of \$3.50 per \$1,000 as an approximation, this amounts to \$32.5 million (\$2013) in lost property tax revenue from residential properties on O'ahu.
- With a higher property tax rate of \$12.4 per \$1,000 for commercial and industrial activities, as well as \$5.70 for agriculture, there is an estimated additional \$31.7 million (\$2013) in loss from all other sectors.<sup>41</sup>
- The City's property tax revenues for the same year of the study (2013) for the residential sector were \$444 million and from all other sectors \$388 million.<sup>42</sup> The estimated losses, at a maximum, account for about 8% of total annual residential property taxes.
- However, since value will likely shift to other properties in areas less vulnerable to climate change impacts, the assumption of sudden and direct losses are an overestimate of total net losses.

#### City Assessment of Climate Change Shocks and Stressors

Currently there are a number of City departments that have brought issues of climate change adaptation into their analysis of facilities and operations. The Department of Environmental Services has altered its future wastewater facilities plans to account for additional sea level rise, and has adapted current infrastructure by raising electrical equipment from ground level. The Board of Water Supply has completed a system vulnerability analysis as a result of both sea level rise and differing future scenarios of rainfall patterns. Continuing departmental vulnerability assessments is a critical start, and could be regularly documented within Department functional plans. This also requires additional departmental coordination.

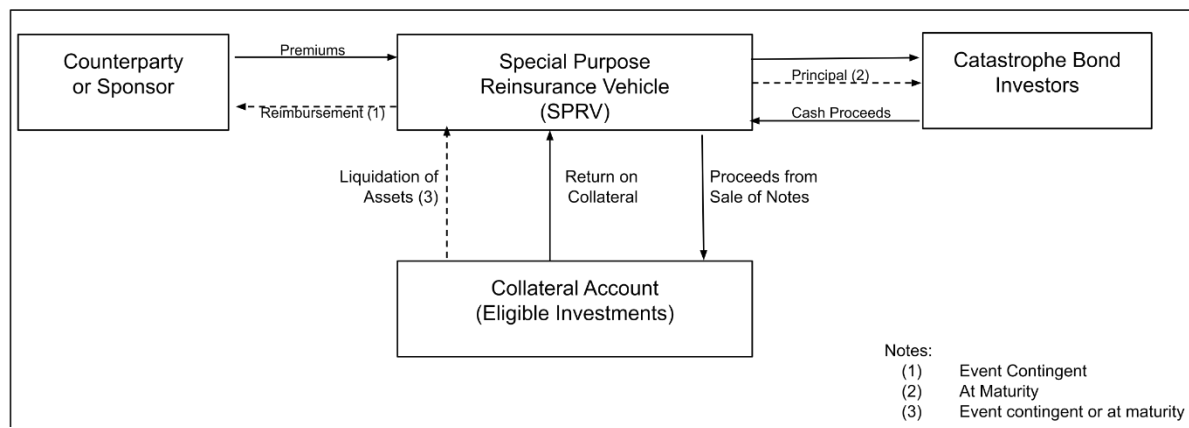
In addition, as part of the financial response to environmental shocks, the City spends \$3 million annually to purchase \$300 million in property insurance coverage. This is relative to about \$3.8 billion in City property value. There is need to reexamine the adequacy of this coverage relative to increasing climate change shocks. The following sections explore both traditional insurance and reinsurance tools, as well as alternative risk transfer mechanisms.

#### **IV. ALTERNATIVE RISK TRANSFER**

While reinsurance generally plays a role in minimizing the exposure gap of traditional insurance products and companies, there has been a rise of alternative risk financing tools that engage a broader investor base. In addition to traditional insurance and reinsurance, like property insurance discussed above, the City should also continue to explore alternative risk transfer mechanisms in response to emerging climate change risks.

Insurance-linked securities (ILS), for example, show the growing convergence between the insurance industry and capital markets.<sup>43</sup> Catastrophe bonds are a type of ILS which are linked to non-financial risks, such as natural disasters, and are sold on the capital market. At the end of Q1 of 2019, the outstanding catastrophe bond and ILS market reached a high of \$37.9 billion.<sup>44</sup> The catastrophe bond concept is that: an insurer, reinsurer or government issues the bond via a special-purpose vehicle (SPV), usually with a high yield and a 3-5 year maturity. If a specific pre-determined "trigger" takes place (for example, a hurricane or flood of certain magnitude) and meets the defining criteria of the catastrophe bond, then the investors lose the principal that they initially invested, as those funds go to pay off the claims made by the insured. However, if the pre-specified event does not take place within the timeframe of the catastrophe bond, then the investors get their principal back along with the yields they received in the interim. In short, the money is held in a SPV and if the event happens, then a payout is made.

Figure 2: Flow of Investments for Catastrophe Bonds



Adapted from Moody's Approach to Rating Catastrophe Bonds (2016)<sup>45</sup>

Figure 2 above shows the flow of money and where the money is held for a catastrophe bond. For example, if the City were to issue a catastrophe bond for hurricanes and investors were to purchase it, the money would be held in a SPV and would only be released if 1) the pre-specified conditions of the catastrophe bond were to occur to give a payout to the City, or, 2) if the bond matured and the money returned back to the catastrophe bond investors. The benefit of the City issuing such a bond is they can take advantage of the much higher limits that are allotted in the capital market (compared to a municipal bond, for example). Essentially, investors bank on the odds of a certain natural disaster not taking place, and simultaneously, issuers of the catastrophe bond are able to take advantage of large pools of money with higher limits in capital markets in the case a catastrophe does take place.<sup>46</sup>

Catastrophe bonds, like many insurance products, can be structured on a parametric basis or as indemnity-based. This is an additionally important consideration for the City in response to climate change shocks. Indemnity-based payouts are more traditional in structure: payouts are made according to actual covered losses. The primary benefit of an indemnity-based program is that there is lower 'basis risk,' which is the difference between the expected and actual recovery.<sup>47</sup> A disadvantage of indemnity-based insurance is that the payout for damages takes longer because damages must be estimated. For example, after the 2010-11 New Zealand earthquakes, it took up to seven years for claims to be settled. In addition, there could exist moral hazard (which is a lack of incentive to guard against risk) on the part of the insured. A way to mitigate this would be to establish as part of the insurance policy a program by which the insurer can audit the insured to safeguard that additional risks are not taken within the management of the insured asset.

Parametric insurance products are set up such that if a pre-determined trigger were to occur, then a set payout would take place to the insured. This usually occurs relatively quickly in comparison to indemnity-based products because no assessment of damages is needed.<sup>48</sup> Parametric insurance products guarantee a certain amount of payout if a pre-specified event occurs, regardless of the actual losses.<sup>49</sup> As a result, there is limited to no moral hazard relative to the insured because the amount of the payout is entirely divorced from damages incurred. The disadvantages of parametric insurance products are that basis risk is relatively high – as it is possible to experience damages from an event with zero payout if the trigger is not met.

Figure 3 shows the relationship of indemnity to parametric-based insurance project.

**Figure 3: Indemnity to Parametric-Based Insurance**

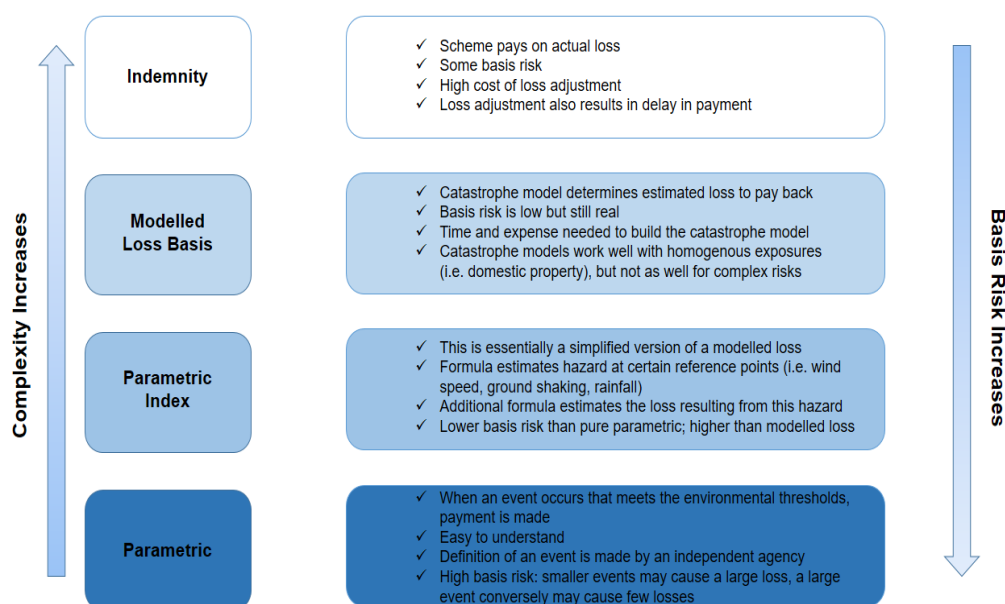


Figure adapted with permission from Willis Towers Watson: Resilience Finance: The Role of Insurance, July 2019

Two case studies showcasing indemnity-based and parametric structures are provided below. The first is of the California Earthquake Authority and the second is of New York City's Metropolitan Transportation Authority (MTA).<sup>50</sup>

### **Case Study: Catastrophe Bonds & the California Earthquake Authority**

Catastrophe bonds were first created and issued in the mid-1990s after Hurricane Andrew took place in Florida, causing \$17 billion in insured losses. The damage was much larger than people had expected, some insurance companies went bankrupt and the reinsurance market dried up temporarily. Since then, catastrophe bonds have become increasingly more popular due to the amount of capital issuers can access.

In 2011, the Special Purpose Vehicle called Embarcadero Re was set up to administer the catastrophe bond between investors and the California Earthquake Authority (CEA). The funds were placed in a collateral trust account, where the CEA can only access the funds for actual insured losses. While catastrophe bonds can be structured to be triggered parametrically, the CEA's catastrophe bond is an indemnity-based structure.

Today, the CEA has more than \$17 billion in claim-paying capacity, enough coverage to endure impacts from a reoccurrence of the 1906 San Francisco, 1989 Loma Prieta or 1994 Northridge earthquake.

(Source: <https://www.insurancejournal.com/news/national/2018/08/07/497273.htm> and <https://www.artemis.bm/news/2000-cea-policyholders-exposed-to-m-6-4-california-earthquake/>)

### **Case Study: Catastrophe Bonds & the New York City MTA**

When Superstorm Sandy hit the East Coast in 2012, New York City's network of subways, buses, and trains experienced severe flooding in tunnels and terminals. The estimated cost for repair was \$4.75 billion. When the time came for MTA to renew its policies, it was not able to get the same traditional reinsurance that it had in the past.

Turning to the catastrophe bond market, MTA developed MetroCat Re Ltd. The \$200 million bond was the first solely storm surge-based parametric transaction in the market. The parametric triggers in the bond are transparent and based on data received from existing tidal gauges surrounding the city, run by the United States Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA).

(Sources: [https://www.businessinsurance.com/article/00010101/NEWS06/308119970/New-Yorks-MTA-buys-\\$200-million-cat-bond-to-avoid-storm-surge-losses](https://www.businessinsurance.com/article/00010101/NEWS06/308119970/New-Yorks-MTA-buys-$200-million-cat-bond-to-avoid-storm-surge-losses) and <https://www.artemis.bm/news/new-york-mta-targets-125m-parametric-metrocat-re-2017-1-cat-bond/> )

In addition, tailored insurance policies (unrelated to ILS) can be created such that they reflect specific place-based risks to climate change. A case study of parametric insurance for coral reefs in Puerto Morelos, Mexico, is provided below.

### **Case Study: Parametric Insurance & Quintana Roo, Mexico**

According to preliminary studies, a loss of 1 meter of reef crest height would increase built capital damages up to 300% in Puerto Morelos (one of the municipalities in Quintana Roo, Mexico). Healthy reefs work to reduce wave energy and storm surge and provide protective services to the shore. Up to 97% of a wave's energy can be reduced by having a well-functioning reef – creating a natural seawall.

In 2018, the Quintana Roo government established the Coastal Zone Management Trust to raise and manage funds for reef and beach maintenance and repair in the tourism sectors of Cancun and Puerto Morelos, Mexico. The first ever coral reef parametric insurance policy was developed by The Nature Conservancy, Swiss Re and the Mexican state of Quintana Roo. This parametric product is an ex-ante guarantee to provide a quick payout upon the occurrence of pre-determined conditions, often in the case of natural disasters.

The trust receives funds from an existing fee paid by beachfront property owners, and other private and public sources. The policy is a one-year parametric policy, meaning that if wind speeds exceed 100 knots (in a pre-specific area) within the year of coverage, a payout will be made to the trust fund. These funds finance the repair and maintenance of the reef as well as pay for the reef's new insurance policy.

(Source: [https://www.nature.org/content/dam/tnc/nature/en/documents/TNC-CoastalManagementTrust\\_Infographic\\_04.pdf](https://www.nature.org/content/dam/tnc/nature/en/documents/TNC-CoastalManagementTrust_Infographic_04.pdf))



## V. RELEVANT PRIVATE AND FEDERAL INSURANCE

There are a number of important types of private and federal insurance relevant to climate change. In Hawai'i, the Department of Commerce and Consumer Affairs (DCCA), Insurance Division, regulates the 'admitted market,' which are companies that have been approved and operate within the State's Department of Insurance set of criteria. In general, this includes hurricane and homeowner insurance policies. Flood insurance is mostly provided by the National Flood Insurance Program (NFIP). However, there are also companies operating in Hawai'i that are not regulated by DCCA, known as 'surplus lines,' that offer policies for all of these types of insurance and others.

Supplemental Hurricane Insurance Policy to Homeowner Insurance Policy: Generally, standard homeowner insurance policies in Hawai'i will cover perils including fire, lightning, or tree branch fall damages. However, supplemental hurricane insurance is needed to cover windstorm damages associated with hurricanes.<sup>51</sup> A useful tool for homeowners in Hawai'i is the "My Insurance Doesn't Cover What?" issued by DCCA, which explains the perils covered and not covered by standard homeowner's insurance.<sup>52</sup> Another valuable resource is the "Hawai'i Homeowner's Handbook to Protect for Natural Disasters" by the University of Hawai'i's Sea Grant College Program, issued in September 2019 which provides more information on natural disaster risk reduction, including a section on hurricane insurance.<sup>53</sup> Unfortunately, there is limited publicly available data on hurricane insurance policies in Hawai'i. Though providing individualized data would be problematic, creating metrics for aggregate data could be an area of collaboration between the City and DCCA, Insurance Division.

National Flood Insurance Program: The National Flood Insurance Program (NFIP) is a type of indemnity-based insurance product that is managed by the Federal Emergency Management Agency (FEMA) and provides flood insurance for both public and private structures.<sup>54</sup> According to the State of Hawai'i 2018 State Hazard Mitigation Plan, about 27.8 square miles of O'ahu are located in a Special Flood Hazard Area (SFHA) where it is mandatory to have flood insurance if the structure is being used as collateral for a federally backed loan.<sup>55,56</sup> The SFHAs account for about 4.6% of the total land area of O'ahu and 74,931 people.<sup>57</sup> There are 38,524 NFIP policies in-force on O'ahu, as of September 2018, valued at a total of \$9 billion.<sup>58</sup> However, FEMA Flood Insurance Rate Maps (FIRMs) do not account for future conditions which means they do not forecast shifts in flood risk exposure areas.<sup>59</sup> Additionally, there are cases where FEMA flood maps and zones are incorrect or outdated,<sup>60</sup> which does not capture the real exposure residents are facing. According to FEMA, 20% of all NFIP claims are from outside mapped SFHAs (i.e. in "low" and "moderate" risk flood zones), which may signal that NFIP maps are not accurately representing flood risks or that claims are coming outside of mandated flood insurance areas.<sup>61</sup> O'ahu's adopted FIRMs present large swaths of "D" zones, or areas of undetermined risks where no studies have been conducted. This affects risk comprehension and appropriate building siting, design and regulations. It acts as a disincentive for those who would like to proactively maintain flood insurance coverage, but may be hesitant to do so due to high rates resulting from undetermined risk.

The NFIP was originally designed to be a self-funded program supported by using the premiums collected from policyholders. The NFIP does have statutory borrowing authority from the US Treasury if a flood event exceeds the program's financial capacity. As flood events have become more frequent and catastrophic, the need for the NFIP to borrow money has significantly increased since 2005. The NFIP has since 2017 purchased reinsurance to the value of \$1 billion from Swiss Re.<sup>62</sup> Private flood insurance, although increasingly available, is quite small relative to NFIP.<sup>63</sup> NFIP flood insurance is available to eligible structures located in any NFIP participating community,<sup>64</sup> whereas private insurers can be more selective about their allocation of insurance coverage.

## VI. Conclusion

Assessing the options to finance and transfer climate change-induced risk is an important component of a portfolio of risk management strategies toward creating a more resilient O'ahu. To do so requires vulnerability assessment by and across City departments. This should include incorporation of new sources of climate change induced risk, both shocks and stressors, into budgeting and long-term planning. In addition, the City should examine its level of insurance coverage relative to climate change shocks and stressors and continue to explore alternative risk transfer

mechanisms. Lastly, to protect health and safety, the City should also invest efforts into mainstreaming adaptation and climate resilient development. Some ways to integrate adaptation and decrease risk exposure are: hurricane retrofit programs, improving stormwater management and integrating green infrastructure, and updating building codes. These are areas of future inquiry.

### **Acknowledgements**

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## **Glossary of Terms**

**Admitted Insurance** – insurance from a carrier that is licensed (and therefore backed) in a state; in Hawai'i regulated by the Department of Commerce and Consumer Affairs.

**Alternative Risk Transfer Market** – markets that allow for the transfer of risk outside of traditional insurance markets.

**Annualized Loss** – considers all future losses for a specific hazard type resulting from possible hazard events with different magnitudes and return periods averaged on a “per year” basis.

**Basis Risk** – the difference between expected and actual payout, as a result of imperfect hedging.

**Catastrophe Bond** – (“cat bond”) a high-yield debt instrument designed to transfer risk to capital market investors.

**Flood Insurance Rate Map (FIRM)** – the official map of a community where the Federal Emergency Management Agency (FEMA) has identified flood hazard areas and their levels of risk.

**Indemnity-based Products** – insurance products where payouts are made according to actual covered losses.

**Insurance-Linked Securities (ILS)** – financial instruments that are sold to investors whose value is affected by an insured loss event.

**Moody's** – a provider of credit ratings, research, and risk analysis; one of the three large credit rating agencies.

**National Flood Insurance Program (NFIP)** – a program under FEMA that aims to reduce the impact of flood events.

**“One Water”** – an integrated approach to water management that takes a holistic perspective of the multiple forms of water in communities.

**Parametric insurance** – insurance products that provide a pre-specified amount of payout if an event occurs, regardless of the actual damages from the event.

**Real Property Tax** – taxes paid by real estate owners based on the City's assessed value of land and structure.

**Reinsurance** – the transfer of risk from insurers to a portfolio of risk.

**Special Flood Hazard Area (SFHA)** – area where the National Flood Insurance Program's (NFIP's) floodplain management regulations prohibits lending institutions from securing a loan without adequate flood insurance.

**Surplus Line** – segment of the insurance industry that may not be licensed (“admitted”) in a specific state, often providing coverage for higher risk activities.

- <sup>1</sup> City and County of Honolulu, Office of Climate Change, Sustainability and Resiliency. *Ola O'ahu Resilience Strategy*. 100 Resilient Cities, 2019. <https://www.resilientoahu.org/resilience-strategy>.
- <sup>2</sup> Correspondence with John Hashimoto, City and County of Honolulu, Risk Management Division, March 13, 2020.
- <sup>3</sup> California Earthquake Authority. *Annual Report to the Legislature and Insurance Commissioner on CEA Program Operations*, California Earthquake Authority, 2012. <https://www.earthquakeauthority.com/About-CEA/%E2%80%8BAnnual-Legislative-Reports/Annual/Annual-Legislature-Report-2011>.
- <sup>4</sup> The admitted market is composed of insurance companies that have been approved by the State's Department of Insurance. It should be noted that there are other operating insurance companies in Hawai'i that are non-admitted, also known as surplus lines, which are not regulated by the DCCA.
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- <sup>6</sup> The IPCC, Special Report on Climate Change and Land, 2019 states that "Delaying climate mitigation and adaptation responses across sectors would lead to increasingly negative impacts on land and reduce the prospect of sustainable development (medium confidence)."
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