

WHAT IS FLOOD RISK?

REBUILD BY DESIGN

HUDSON RIVER

Hoboken Weehawken Jersey City New Jersey

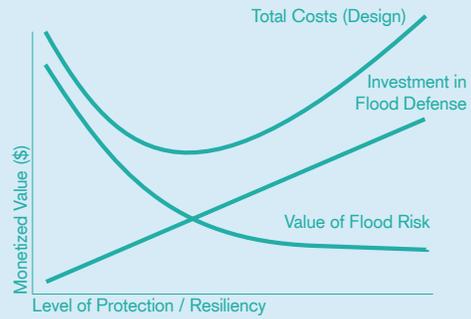
▪ RESIST ▪ DELAY ▪ STORE ▪ DISCHARGE ▪



What is Flood Risk?

Flood risk is the product of the vulnerability to flooding multiplied by the total value of the assets at risk to flooding. Flood risk is determined by the summed probability of flood hazards, as well as the assets at risk of these hazards.

With investment in flood protection, the flood risk will go down. By monetizing both investment and risk, an economic optimal protection level can be selected.



Flood Risk

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Decreased by Mitigation

Increased by Sea Level Rise

Probability

X

Decreased by Adaptation

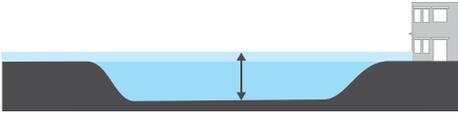
Increased by Population and Development

Consequence

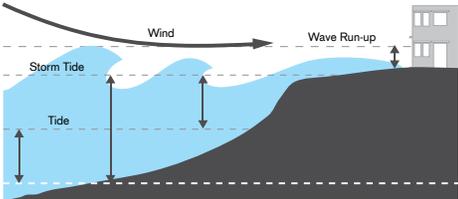
What is a Flood?



Pave, Pipe, Outfall



Riverine Flooding



Storm Surge

High water levels in the Sandy-affected region can ultimately be attributed to storm events and precipitation.

Urban Drainage

Precipitation may lead to flash flooding or inland flooding. Rain water cannot be stored or drained leading to overwhelming of the drainage system and flooding. As of September, 2015, Hoboken city council approved a \$11.9m state loan for a second flood pump to aid drainage.

Rivers

Riverine flooding is determined by high water levels in the river as a result of the discharge of the river and/or high coastal water levels. High river discharge is caused by (upstream) precipitation.

Coasts

High water levels from the Atlantic Ocean are the result of a combination of causes. The largest contributing factor is storm surge; which is a large scale increase of the water level caused by wind. In addition, storms can increase wave action. The influence of tides also determines the height of the water level.

Safety Levels vs. Flood Risk

- Flood risk takes into account the overall consequences of a flood. A 1% safety level means that the probability that a flood will occur within a given year is 1%. However, it does not indicate how severe this flood will be if it occurs.
- When monetized, flood risk can be used to determine the economically optimal safety level.
- It is important to realize that consideration of risks is complex and that political, psychological and social processes play an important role in addition to technical aspects.
- With an economic approach towards flood risk, the vulnerability of assets at risk and the protection costs are weighted. This asset consideration allows for the chance to prioritize flood protection measures and evaluate investments.

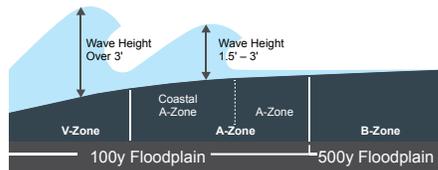
Flood Risk

Quantify and Monetize Flood

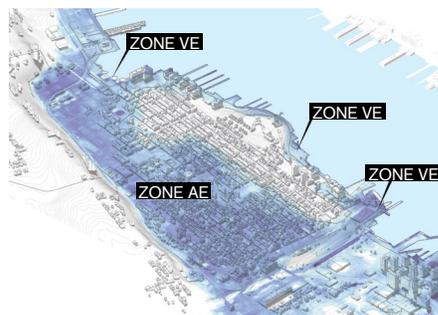
What are flood zones?

The Federal Emergency Management Agency (FEMA) uses Flood Insurance Rate Maps (FIRMs) to designate areas that lie within risk premium zones. These zones are called Special Flood Hazard Areas (SFHAs). SFHAs are delineated according to their levels of risk: However, floods can still occur outside of these high risk zones.

- Zone VE - Areas along coasts subject to flooding by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves.
- Coastal Zone AE - An area of special flood hazard extending inland to the limit of the 1.5-foot breaking wave.
- Zone AE - Areas subject to flooding by the 1-percent-annual-chance flood event.
- Zone X - Areas subject to flooding by the 0.2-percent-annual-chance flood event.



Identifying areas of risk



Hoboken Flood Zones

FEMA Flood Map

What are Flood Hazards?

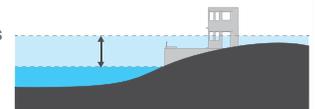
High water levels along the coasts and in rivers, as well as extreme precipitation can lead to various flood hazards. These flood hazards comprise the performance of the natural and built flood protection system and the urban drainage system. The main flood hazards in the Sandy-affected regions are:

Extreme water levels as a result of

- Storm surge and/or offshore storm events
- High river discharges
- (Under) performance of flood defense measures

Overwhelming of the urban drainage system as a result of

- Extreme precipitation
- Land use and impermeable surfaces
- (Under) performance of drainage system



Storm Surge



Wave Force



Erosion

What is 100-year flood?

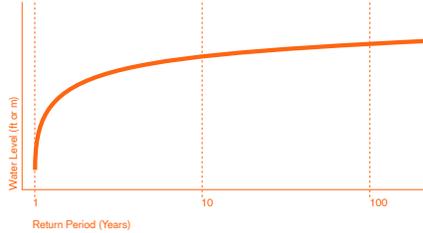
A 100 year flood is not a flood which occurs every one hundred years, but a flood that has a 1% chance of occurring every year. A 100-year flood tells you something about the

A 100 year flood is about five times more likely as getting flush in poker

In a floodzone, there is 1 in 4 chance that your home will be flooded before paying off your mortgage

You have 55% chance of experiencing a 100 year flood in your lifetime

Relation between Water Level and Return



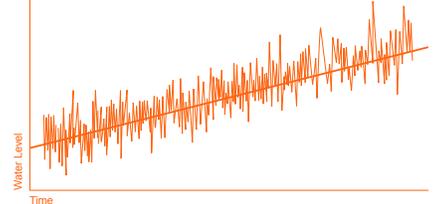
probability. The amount of devastation as a result of flooding is site specific, as are the possibilities and costs for mitigation. Because of sea level rise (and potentially other climate change related effects) the probabilities of a 100-year flood increase over time, therefore the future 100-year flood is a more significant hazard.

There is a difference between a 100-year storm and a 100 year flood. Because storms are measured by different characteristics, a 100-year storm does not necessarily produce a 100-year storm surge or flood.

Changing Probabilities

The probability of flood hazards can change over time. The main contributor to an increased probability of coastal flooding is sea level rise. In addition, climate change may have an effect on increased precipitation patterns and might increase the occurrence of storm events. These changes in probability increase flood risk over time, but the high-density urban environment flood risk is also influenced by the performance and design of flood defense measures as well as the value and amount of assets at risk to damage, loss or disruption.

Sea Level Rise



Decreased by Mitigation

Increased by Sea Level Rise

Probability

Assets at Risk

Consequence

Decreased by Adaptation

Increased by Population and Development

Flood Event

Assets at Risk

The consequences of a flood include loss of life and property as well as disruption of public services and loss of jobs. The assets at risk from a particular flood event inform the need for adequate flood protection measures.



Hoboken's real estate value has skyrocketed over the past decade. Residential value per square foot has risen over 500%. As a result, a significant amount of residents' wealth resides in their home value



Superstorm Sandy caused over \$100 million in property damages, and incurred significant costs in lost business revenue. While one-time property damages are the most visible toll of the storm, ongoing disruptions to business operations can be devastating to business owners, the communities they serve, and the workers they employ. For businesses operating at the margins of profitability, storm damage and



disruption may be sufficient to cause the business to fail.



Safety & Quality of Life are also compromised during and after flood events.



Three-quarters of Hoboken lies within the designated FEMA flood zone.



Critical Infrastructure is likely to be disabled or damaged after a flood, posing serious risk to our hospitals, energy, and transportation systems, as well as business operations and supply chains.



More than 50,000 people rely on public transit in Hoboken every single day. Approximately 2/3 of Hoboken residents use transit to get to work.

Future Real Estate Development, which has been a major driver of Hoboken's economic growth in the past decade, is inhibited and made more costly, in high-risk areas. New development also increases the amount of assets at risk.

Glossary of Useful Terms

100-Year Flood: A flood with a 1% chance of occurring in any given year.

500-Year Flood: A flood with a 0.2% chance of occurring in any given year.

Combined Sewer: A type of sewer system that collects sanitary sewage and stormwater runoff in a single pipe system. During flood events, these systems may overflow, resulting in what is called Combined Sewer Overflow (CSO), which is a mixture of stormwater and sewage.

Flash Flood: A sudden local flood, typically due to heavy rain.

Floodplain: Any land area susceptible to being inundated by floodwaters from any source.

Flood Risk: The measure of vulnerability to flood with consideration to the likelihood of flooding and the total value of the assets at risk.

Flood Zones: Areas identified by the Federal Emergency Management Agency (FEMA) as special flood hazard areas or risk premium zones for flood insurance. These zones are indicated in Federal Emergency Management Agency Flood Insurance Rate Maps (FEMA FIRMs).

Green Infrastructure (also known as Blue-green infrastructure): is a system of urban and environmental strategies. These strategies include stormwater management, climate adaptation, better air quality, sustainable energy production, clean water, healthy soils, and an improvement in the quality of life and experience of cities.

Impervious Surface: Also known as impermeable surfaces, impervious surfaces refer to materials that do not absorb rainwater and cause water runoff.

National Flood Insurance Program (NFIP): A program created by Congress through the National Flood Insurance Act of 1968. The program enables property owners to purchase insurance protection from the government against losses from flooding.

Resilience: The ability to anticipate, prepare for, and adapt to changing conditions and to withstand, respond to, and recover rapidly from impacts or disruptions.

Return Period: With regard to flood, it is an estimate of the likelihood of a storm event. It is also known as a recurrence interval.

Storm Surge: A rise in coastal water level associated with a hurricane or other strong coastal storm.

Stormwater: Water that is caused by rain events or snow melt. Stormwater that does not get absorbed into the ground is referred to as stormwater runoff.

NEW YORK CITY

For More Information Visit any of the following sites:

Rebuild by Design - Hudson River
www.rbd-hudsonriver.nj.gov
rbd-hudsonriver@dep.nj.gov

National Flood Insurance Program
<http://www.floodsmart.gov/>

Federal Emergency Management Agency (FEMA)
<http://www.fema.gov/>

New Jersey Department of Environmental Protection
<http://www.nj.gov/dep/>

City of Hoboken, NJ
<http://www.hobokennj.org/>

U.S. Department of Housing & Urban Development
<http://portal.hud.gov/>

HUD: Rebuild by Design
<http://www.rebuildbydesign.org/>

Sandy Relief Fund
<http://sandynjrelieffund.org/>

Together North Jersey
<http://togethernorthjersey.com/>

This pamphlet provides insight into flood risk in the United States, the hazards and the assets as well as context on how to interpret and view this information. The purpose of this pamphlet is to provide stakeholders in the Hudson River region with information to streamline the discussion for challenges at hand as the result of flood risk.

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Disclaimer

The information presented in this pamphlet was produced in the context of the Rebuild by Design competition, and is intended for discussion with decision makers and stakeholders involved. This information is not complete and/or exhaustive and is provided for the U.S. context. No rights can be deducted from this document and the authors are not responsible for errors and misinterpretation of the provided information.

OMA team

The OMA team intends to improve the resiliency of critical nodes in high-density urban environments; points that are vulnerable and very productive (stacked functions) on a local level, but have a much broader (regional) impact.

Sources

City of Hoboken. <http://www.hobokennj.org/departments/environmental-services/storm-flood-zones/>

Hillen, M.M.; Jonkman, S.N.; Kanning, W.; Kok, M.; Geldenhuys, M.; Vrijling, J.K., and Stive, M.J.F., 2010. Coastal Defence Cost Estimates—Case Study of the Netherlands, New Orleans and Vietnam. Delft, the Netherlands: Delft University of Technology, 59p.

Jonkman S.N., Kok M., van Ledden M., Vrijling J.K. (2009) Risk-based design of flood defence systems: a preliminary analysis of the optimal protection level for the New Orleans metropolitan area. Journal of Flood Risk Management Vol. 2 Issue 3, p.170-181.

Jonkman S.N., Hillen M.M., Nicholls R.J., Kanning, W., van Ledden M. (2012) Costs of adapting coastal defences to sea-level rise – new estimates and their implications. Journal of Coastal Research, 29 (5) 1212-1226.

WNYC Flooding & Flood Zones Map. <http://project.wnyc.org/flooding-sandy-new/#14.00/40.7424/-74.0071>