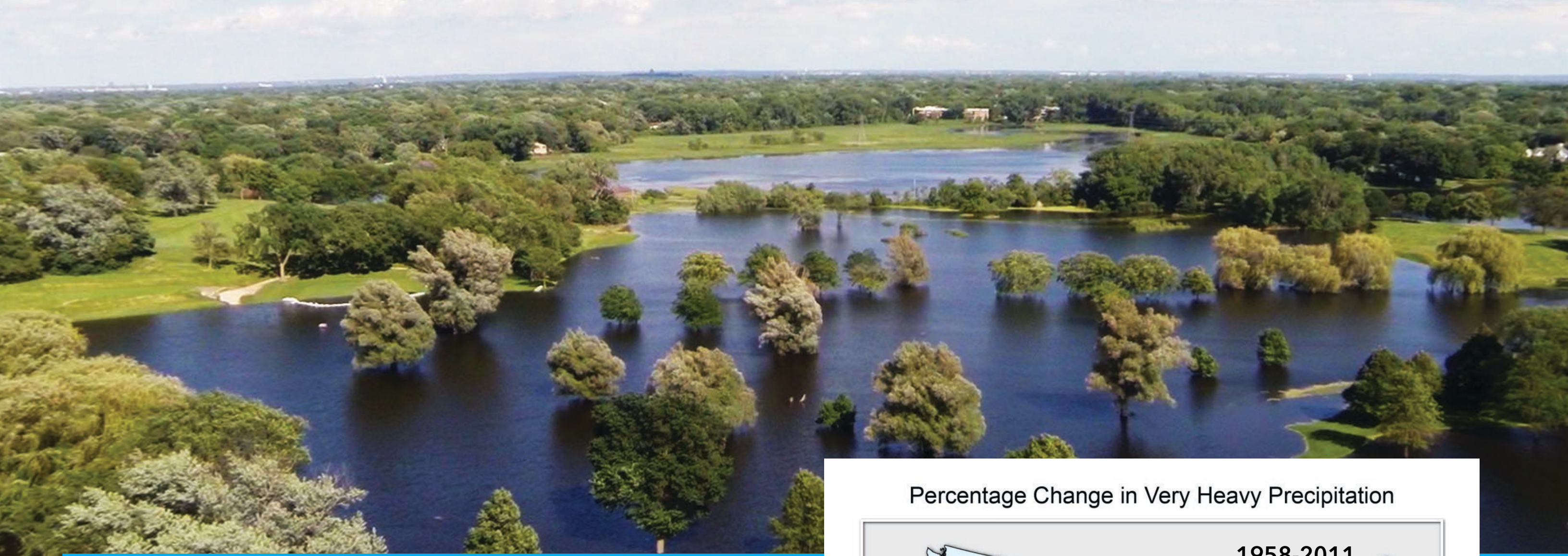
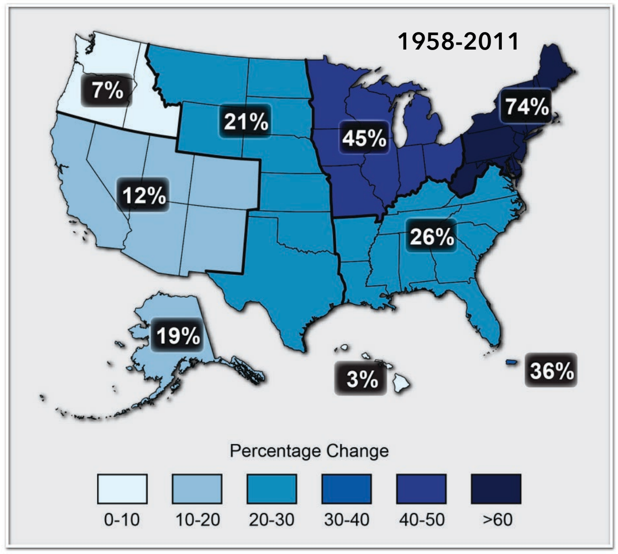


COMMUNITY ADAPTATION PLANNING FOR CHANGING LANDSCAPES & CLIMATE

Percentage Change in Very Heavy Precipitation



(Source: Global Climate Change Impacts in the United States, updated from Karl et. al 2011)

ASSESSING STORMWATER CAPACITY AND ABILITY TO ADAPT IN TWO MINNESOTA COMMUNITIES – MINNEAPOLIS AND VICTORIA

Minnesota has been hit by a number of "Mega Rain" events during the last 30 years. In fact, extreme weather events are increasing in frequency across the country, with some of the largest increases in the Upper Midwest as seen in the figure (upper right), which shows changes in very heavy precipitation from 1958-2011.

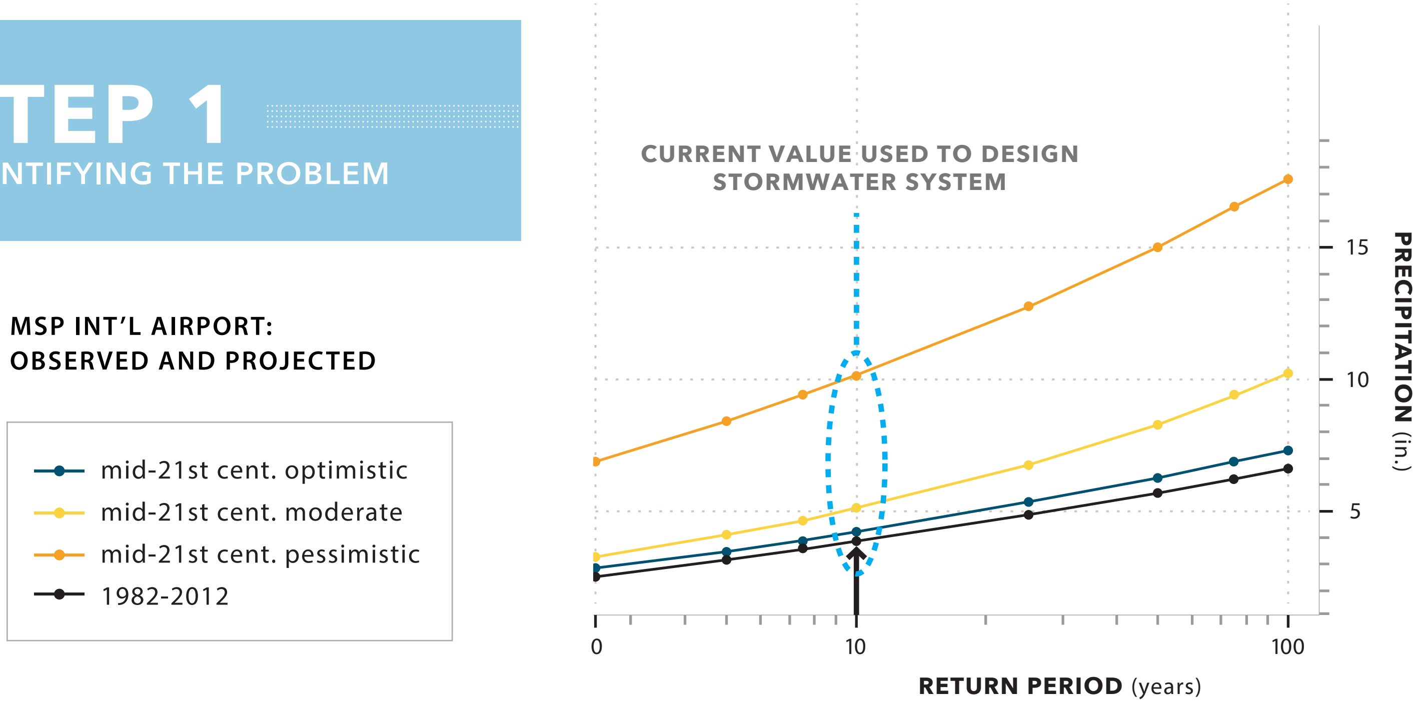
Preparing to manage the risks of these extreme rain events requires that our communities understand their vulnerabilities and capacity to adapt, both from a technical and social standpoint. To demonstrate this process, the Minnehaha Creek Watershed District partnered on a study with Syntectic International, Antioch University New England, the University of Minnesota and two communities in the Twin Cities area – Minneapolis and Victoria.

Funded by a grant from the National Oceanic and Atmospheric Administration's Climate Program Office, the study had two overarching goals: assess vulnerability to both land use and rainfall changes, and build capacity to support community adaptation.* This was done through both climate and hydrologic modeling and a community-driven planning process in which technical assessments of impacts were incorporated into collaborative planning to understand opportunities and barriers for adaptation.

Top Banner: Minneapolis, 2014 (Credit: Justin Hickman) **Top Right:** Duluth, 2012 (Credit: MPR) **Bottom Right**: Owatonna, 2010 (Credit: Jeffrey Thompson-MPR)

STEP 1
IDENTIFYING THE PROBLEM

MSP INT'L AIRPORT:
OBSERVED AND PROJECTED

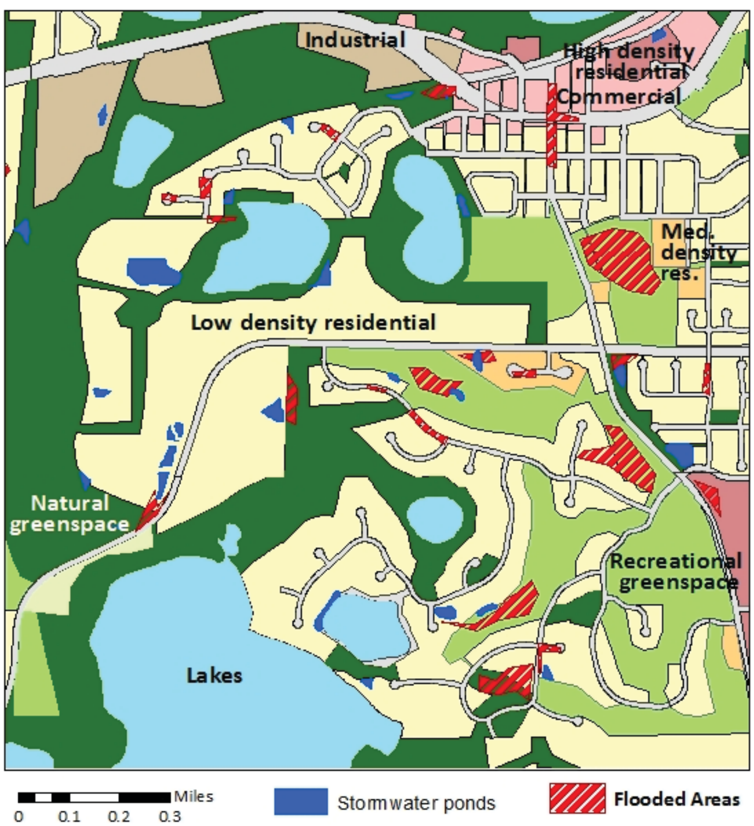


In this study, we focused on changes in what is often called the 10-year storm, that is, the amount of rainfall in a 24-hour period that has a 10% probability of occurring in a location in any given year. This storm, which is equivalent to about 4 inches in the Twin Cities area, is often used to design much of the infrastructure intended to control flooding. As indicated in the figure above, the study predicted the magnitude of this storm to change by as little as 10% to as much as 150% by the middle of this century. The calculations were derived using an innovative technique to regionalize different Global Climate Models.

STEP 2
DETERMINE VULNERABILITIES

We used hydrologic models to assess how the two test communities' flood risk would be impacted by these anticipated changes in rainfall, as well as future land use changes (built-out conditions). What we found is that vulnerability to flooding in a densely populated neighborhood in South Minneapolis was quite different from a still-growing community such as Victoria, where projected flooding is limited to recreational and natural green space (see figure to right). Results from this vulnerability assessment were used to inform community-led discussions of issues surrounding more frequent extreme rainfall, growing communities, and the need for adaptation planning.

MID-21ST CENTURY PESSIMISTIC FLOOD PROJECTION – VICTORIA



STEP 3
INVESTIGATE OPTIONS

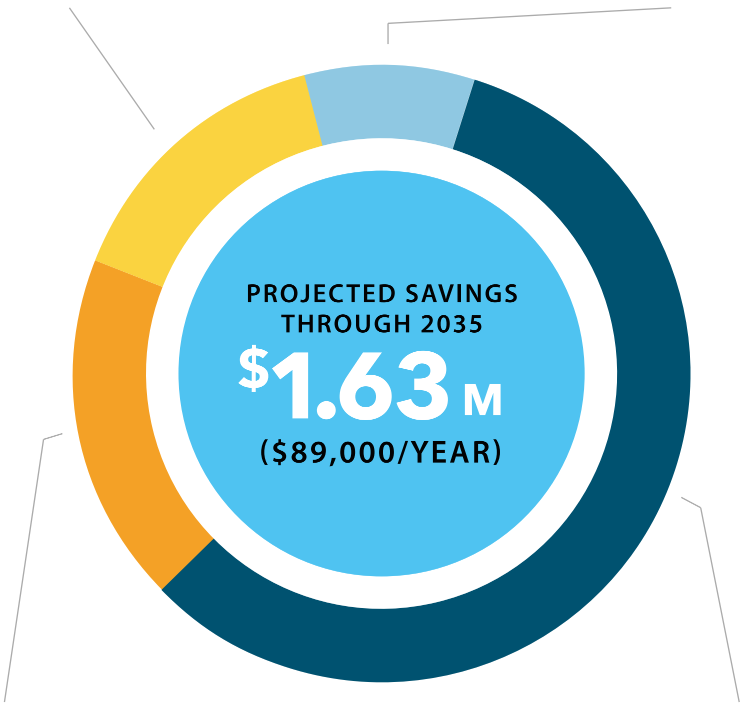
The process was two-fold: **identify the preferred adaptive strategies** a community can take to reduce impacts from extreme rainfall and land use changes, and **assess a community's capacity** to increase resilience to flooding. Adaptive strategies that were identified included a) do nothing, b) upsize existing stormwater infrastructure, c) develop additional flood storage, and d) utilize low impact development* options to mitigate flood volumes.

This study also relied on a community-led process in which stakeholders were convened to build social capacity and identify local and regional actions related to adaptation planning, and the barriers and constraints to their implementation. Out of these sessions, four priority action areas emerged:

1. **education and outreach** to raise awareness and consensus among policy makers for managing risk;
2. **land use planning** to create guidelines for policies that promote preservation of natural hydrologic corridors, wetlands, and other natural elements that serve to buffer flooding;
3. **stormwater infrastructure and low impact development** to identify options for water quality and flood control within the contexts of new and redevelopment; and
4. **sustainable funding** to assess funding sources and needs for updating infrastructure and identify opportunities for proactive adaptive management.

HOW MUCH MONEY CAN BE SAVED BY USING GREEN INFRASTRUCTURE?

Chester Creek watershed, Duluth, MN



Graph Source: Economic Assessment of Green Infrastructure Strategies for Climate Change Adaptation: Pilot Studies in the Great Lakes Region, May 2014

STEP 4

EVALUATE RISKS AND COSTS

We applied cost estimates, using local cost data when possible, to determine the economic costs of implementing adaptive strategies in each community. As expected, total costs were higher in the Minneapolis study site due to the larger volume of flooding predicted there, and the higher costs of construction due to density and existing infrastructure, but per unit costs of flood mitigation measures were similar between the two sites. Flooding in the Victoria site could also be managed by allowing excess water to pond in streets and existing low-lying areas. Although this may be a low-cost adaptation option, it would require ongoing commitment to current policies and evaluation of public perceptions of street flooding.

According to a study of the Chester Creek Watershed in Duluth, MN, which was heavily damaged by flooding in 2012, the benefits of incorporating green infrastructure* measures including retention areas, permeable pavement, underground storage and stormwater tree trenches could help the city realize $1.63 million in savings through 2035 (see figure to left). Other potential benefits, including improved water quality, additional wildlife habitat and green space, and increased property values were not included in the study.

DEFINITIONS

Community Adaptation is a planning process designed to improve the capacity of local communities to adapt to changing conditions. It requires an integrated approach that combines technical knowledge with innovative strategies that not only address current vulnerabilities, but also build the resilience of people to face new and dynamic challenges. It also aims to protect and sustain the ecosystems that people depend on.

Low Impact Development is a comprehensive stormwater management and site-design technique that mimics predevelopment conditions. This is achieved by using design techniques that infiltrate, filter, evaporate, and store runoff close to its source through a variety of small, cost-effective landscape features located on-site.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water.

KEY FINDINGS
& IMPLICATIONS FOR TAKING ACTION

Good news: Even under the most pessimistic rainfall scenario, a substantial portion of the existing stormwater systems at both study sites were still sized adequately.

More good news: Green infrastructure helps increase community resilience to future climate uncertainty. In built-out communities like Minneapolis, low impact development practices were predicted to reduce the overall costs of adaptation efforts. In Victoria, the existing green infrastructure network stored a substantial volume of flooding and significantly lowered the total anticipated adaptation costs. This highlights the importance of zoning and community planning in preserving connectivity between streams, wetlands, and other low-lying areas, to enhance overall community resilience to extreme events.

The other news: Flood risk increased in all extreme rain event scenarios, requiring adaptive action. There is no one-size-fits-all when it comes to adapting communities to manage increasingly frequent extreme rainfall events. The types of adaptive measures and how they are implemented will vary from community to community.

For more information visit **www.minnehahacreek.org/WET**

From left to right: Underground filtration and storage, El Colegio High School, Minneapolis (Credit: MCWD), Green street planters (Credit: U.S. Environmental Protection Agency), Wet detention pond, Minneapolis (Credit: City of Minneapolis), Permeable pavers, St. Mary's Greek Orthodox Church, Minneapolis (Credit: Solution Blue)

MINNEHAHA CREEK WATERSHED DISTRICT

SYNTECTIC INTERNATIONAL

STRATUS CONSULTING

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Minneapolis City of Lakes

UNIVERSITY OF MINNESOTA

ANTIOCH UNIVERSITY NEW ENGLAND

VICTORIA City of Lakes & Parks