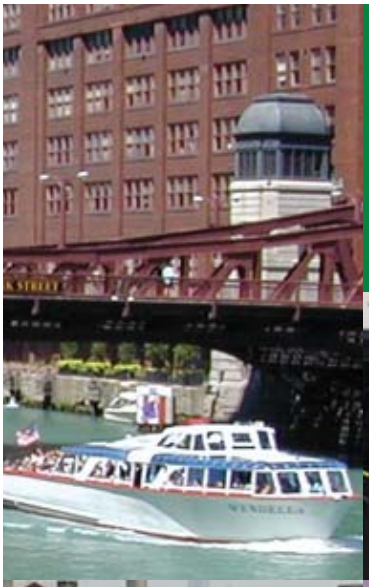
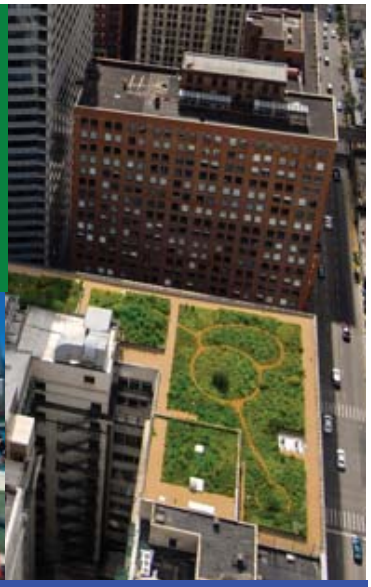
Chicago Area Climate Change Quick Guide:





Adapting to the Physical Impacts of Climate Change

CHICAGO CLIMATE ACTION PLAN

For Municipalities and Other Organizations

Edited by Julia Parzen • March 2008

Table of Contents

1 Introduction 4

2 Global Lessons on Climate Change Adaptation 6
2.1.1 Build Adaptive Capacity 6
2.1.2 Embed Climate Change Considerations Into Planning Processes 6
2.1.3 Look for Win-Win Actions 6
2.1.4 Take Incremental Steps That Maximize Future Options 7
2.1.5 Be Dynamic, Aware, Nimble, and Flexible 7
2.2 Overview of Project Approach 7

3 Risk assessment 8
3.1 Introduction 8
3.2 Methodology 8
3.2.1 Scoring System 9
3.2.2 Climate Predictions and Impacts Identification 10
3.3 Results 11

4 Risk Reduction 14
4.1 Introduction 14
4.1.1 Planning Tactic: Create an Adaptation Leadership Group 14
4.1.2 Planning Tactic: Review Business Processes and Decisions with Reference to Climate Change Impacts 15
4.1.3 Planning Tactic: Implement a Climate Sensitive Procurement Strategy 15

5 Adaptation Tactics 19
5.1 Introduction 19
5.1.1 Identification of Adaptation Tactics 21
5.2 Recommended Adaptation Strategy 1: Reduce Vulnerability to Extreme Heat Events 21
5.2.1 Adaptation Tactic: Prepare for Extreme Heat Events 21
5.2.2 Adaptation Tactic: Manage the Urban Heat Island Effect 22
5.2.3 Adaptation Tactic: Increase Ozone Response Activities 22
5.3 Recommended Adaptation Strategy 2: Reduce Vulnerability To Extreme Precipitation Events 23
5.3.1 Adaptation Tactic. Include Climate Change Considerations in MWRD Combined Sewer Watershed Studies 24
5.3.2 Adaptation Tactic: Conduct a Stormwater Management Study 24
5.3.3 Adaptation Tactic: Pilot Distributed Solutions 24
5.3.4 Adaptation Tactic: Piloting Stormwater Parks 25

5.4 Recommended Adaptation Strategy 3: Reduce Vulnerability of Buildings, Infrastructure, and Equipment to Extreme Weather Conditions 26
5.4.1 Adaptation Tactic: Manage Power Vulnerability 26
5.4.2 Adaptation Tactic: Manage Fleet Vulnerability 27
5.4.3 Adaptation Tactic. Include Climate Change Considerations in Plans for New Development and Renovation 27
5.5 Recommended Adaptation Strategy 4: Reduce Vulnerability to Future Ecosystem Degradation 27
5.5.1 Adaptation Tactic: Participate in Preserving Native Species 28
5.5.2 Adaptation Tactic: Participate in Creating a New Recommended Plant List 28
5.5.3 Adaptation Tactic: Enhance Chicagoland Urban Forest Management 28
5.5.4 Adaptation Tactic: Enhance Chicago Urban Wetland Management ... 29
5.5.5 Adaptation Tactic: Protect Agriculture 29

6 Conclusion 30

Appendix I 31

This document is a summary of a report prepared by MWH for the City of Chicago on preparing for climate change. It is one of a series of reports on climate change and Chicago commissioned by the Chicago Climate Task Force. The Task Force was created by the City of Chicago, with the mandate of assessing the potential impacts of climate change on Chicago and, based on these impacts, developing a plan for the future. The Task Force included representatives from local communities, universities, business and labor, and city and state government. Working together, the members of the Task Force developed the Chicago Climate Action Plan, based on the information provided by this report. In addition to informing the Plan, this summary report also shows the municipalities and businesses why taking action to prepare for climate change is important and how to do it. Other reports in this series project the impacts of climate change on the city and explore options to reduce emissions. The full set of Chicago climate reports is available online at **www.chicagoclimateaction.org.**

1. Introduction

Publicity and urgency around global climate change are causing public and private decision-makers to consider vulnerability to climate-related risks. Municipalities, businesses, and other organizations cannot afford to ignore the impacts of climate change. Weather related catastrophes and insurance claims are rising. Investors and insurers are expressing concern. Protecting residents, shareholders, employees, and other stakeholders requires reducing greenhouse gas emissions and building resiliency, i.e. the capacity to adapt as climate changes. Cities have always been exposed to climate-related risks, such as flooding and extreme temperature. However, today, the climate change is increasing those risks and demanding greater attention to them.

In late 2006 Mayor Daley asked the Chicago Department of Environment to launch a Climate Change Initiative. The Chicago Climate Change Task Force guided this effort. The Task Force included representatives from business, civil society, government, and labor, who were tasked with developing a climate action plan for Chicago. A variety of research teams and consultants provided input to the Task Force. Grants from the Lloyd A. Fry Foundation, Grand Victoria Foundation, and the Joyce Foundation paid for most of the research. The City of Chicago quantified its greenhouse gas emissions baseline. It assessed the risks and opportunities that face Chicago related to climate change. (See Sidebar) It worked with hundreds of individuals and organizations to set a goal for reducing Chicago's greenhouse gas emissions, choose cost-effective actions to reduce its emissions (mitigation), prepare for climate change (adaptation), and take advantage of the opportunity to improve quality of life and create new jobs for Chicagoans. These choices are captured in the Chicago Climate Action Plan available at at **www.chicagoclimateaction.org**.

Summary of Climate Risks and Opportunities

Regulatory: Mandatory emissions-reduction legislation
Supply chain: Suppliers passing their higher carbon-related costs
Product and technology: Rival's developing climate-friendly offerings first (or other towns getting a better reputation)
Litigation: Lawsuits charging negligence, public nuisance, or trespass
Reputation: Destructive consumer or shareholder (or voter) backlash
Physical: Damage to assets through heat, drought, floods, and storms

Source: Harvard Business Review print Jonathan Lash and Fred Wellington, Competitive Advantage on a Warming Planet (reprint R0703F).

The most important step that Chicago has taken in response to global climate change is to commit to reduce greenhouse gas emissions. There still is time to avert the worst impacts of climate change if all cities, states, and nations take action. However, while global efforts to reduce greenhouse gas emissions can vastly reduce climate impacts, they cannot eliminate them. Cities and businesses need to build capacity to adapt to climate change.

The City of Chicago commissioned leading climate scientists at the University of Illinois and Texas Tech University to analyze what climate change impacts on Chicago could be, and then hired MWH, an engineering consulting firm, to use this research to develop a methodology and recommended actions to help the City prepare for a changing climate. The City asked MWH to create a planning document to integrate adaptation actions into the City's routine business processes at both strategic and tactical levels. The research on climate impacts is summarized in Research Summary Report, Climate Change and Chicago: Projections and Potential Impacts, available online at **www.chicagoclimateaction.org**.

This document summarizes the MWH findings, which the City took under advisement for its adaptation work. The City of Chicago believes that adaptation and mitigation must be closely aligned. We need to find the "win-win" approaches, i.e. adaptation steps that also reduce greenhouse gas emissions and save energy. These approaches are prominent in the Chicago Climate Action Plan. Vegetated roofs, for instance, cool the city as temperatures rise and retain water during storms (adaptation), while they also help increase the energy efficiency of buildings (mitigation). Increasing the size of the Chicago urban forest canopy can provide shade to decrease the urban heat island effect (adaptation) and reduce energy demand to cool buildings (mitigation). Rain gardens and permeable pavement capture storm water on site (adaptation), reducing the amount of storm water that must be pumped and the energy required to pump it (mitigation).

Vegetated roofs help keep the city cool as temperatures rise, retain water during storms and increase the energy efficienciency of buildings.

Chicago's Green Steering Committee of departments and sister agencies led by the Mayor's office already has formed four multi-departmental working groups to consider the MWH report and other information to develop adaptation plans. The Office of Emergency Management leads an extreme heat group. The Department of Water Management is leading an extreme precipitation group, while the Department of Planning and Development is leading an ecosystem group. The Departments of Transportation, Buildings and Aviation are co-leading a buildings, infrastructure, and equipment group. Finally, a leadership, planning, and communications group is led by the Department of Environment. Each group is developing action plans that include primary actors, timelines, and budget implications. This process is the first step in making climate change adaptation part of business as usual in Chicago. As the City completes its adaptation implementation plans, it will provide progress reports on its climate Website.

The City of Chicago takes seriously its role in providing credible information and education about climate change to every community in the Chicago region. The MWH methodology and the recommended action steps may be of value for consideration by other municipalities and, in some cases, by companies and organizations in the region, even though they only address local impacts to the City of Chicago. We hope that this summary of Chicago's approach to adaptation will help mayors, city managers, risk managers, sustainable development officers, presidents, and executive directors to also accept the challenge of taking climate change into account as they plan for the future and shape the behavior of their organizations.

Planning for climate change adaptation implies changing the human system as well as changing the "bricks and mortar" infrastructure.

2. Global Lessons on Climate Change Adaptation

Worldwide response to climate change differs based on the prevailing regulatory framework, and the urgency with which leaders and organizations have recognized the need for action. In many cases, countries outside the US are more advanced in their development and implementation of strategies related to climate change. There are many national government sponsored agencies (for example the UK's Climate Impacts Programme – UKCIP, and New Zealand's Ministry of Environment) that are renowned resources for business and local communities across their respective countries. Several key lessons can be drawn from the efforts of these and other organizations.

2.1.1 Build Adaptive Capacity

Planning for climate change adaptation implies changing the human system as well as changing the "bricks and mortar" infrastructure. According to the UKCIP, building adaptive capacity is the putting in place of all of the support systems, data collection, evaluation processes, awareness-raising, and policy framework(s) which will encourage, allow or require individual businesses and regions to undertake adaptation. Only when such work has been undertaken in a particular organization or sector can the work of delivering adaptation actions begin.

2.1.2 Embed Climate Change Considerations Into Planning Processes

Planning processes identify future organizational operational, equipment, or infrastructure needs involving procuring new goods, services and/or products or building new infrastructure that must function under a new set of climate conditions. To manage risk, planning processes should be modified to account for potential impacts of climate changes. For example, New Zealand has issued guidelines for local authorities that include specific questions to be asked when drawing up individual plans, including:

- Does the risk management analysis take into account changes due to climate change?
- Do the effects of climate change reflect the current level of uncertainty in the region and should a cautious approach be adopted as a result? If not, is this explained?
- Does the plan include a specific commitment to keep up-to-date with changing understanding of climate change and its implications, including any relevant local monitoring or liaison?

2.1.3 Look for Win-Win Actions

Adaptation measures will almost always have multiple benefits, which may include reduced energy costs, improved aesthetics, reduced air and water pollution, and so on. These benefits can and should be considered and evaluated to convey the overall benefit of these measures.

The Scientific Expert Group Report on Climate Change and Sustainable Development, prepared for the 15th Session of the Commission on Sustainable Development in

February 2007, asserts that the clear way forward is to promote much wider adoption of “win-win” approaches that reduce climate-change risks while saving money, or that produce immediate co-benefits outweighing the costs of the measures. These “no regret” options deliver benefits greater than their costs, regardless of the extent of climate change.

2.1.4 Take Incremental Steps That Maximize Future Options

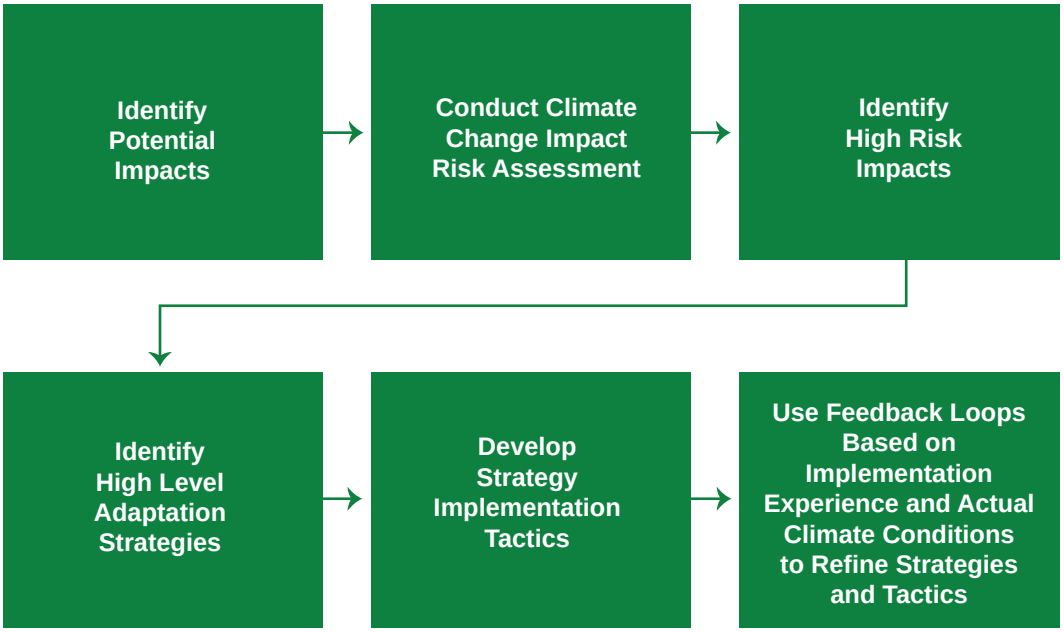
If possible, take incremental steps rather than large actions to keep options open to adapt in the future. Avoid making decisions that make it more difficult to manage future climate risks. Phased projects can help to avoid costly decisions. Also distributed infrastructure can be more flexible in responding to change than investment in large centralized systems.

2.1.5 Be Dynamic, Aware, Nimble, and Flexible

The paradox of process planning is the intermixed integration of past, present, and future. We plan for the future, do so in the present, and use data from the past. Specifically, the urban planning process uses historical data to measure the capability of current projects to achieve future goals. To adapt to climate change, municipalities and businesses need to continually incorporate new data and reassess decisions. The successful adaptation to climate change requires a learning organization, one that adapts to changing environmental factors.

2.2 Overview of Project Approach

To develop adaptation tools for the City of Chicago that also would be useful for other municipalities, businesses and organizations, MWH worked closely with City staff, sister agencies, and partner organizations to build on past and ongoing efforts. The City of Chicago took MWH’s work under advisement and is evaluating it as part of its adaptation implementation. The process by which predicted climate impacts per the Chicago research informed the selection and development of adaptation strategies relevant for Chicago entities is illustrated in the Figure below:



3. Risk Assessment

3.1 Introduction

To identify potential climate impacts for Chicago, the Chicago Climate Change Task Force commissioned leading researchers to produce:

- *"Climate Change and Chicago, Projections and Potential Impacts, Preliminary Draft"* principally authored by Katharine Hayhoe and Donald Wuebbles, referred to in this report as "UIUC/TTU"
- *"Economic Impact Analysis of Climate Change for the City of Chicago, Preliminary Draft"* authored by the Corporate Risk Consulting group of Oliver Wyman, referred to in this report as "OW".

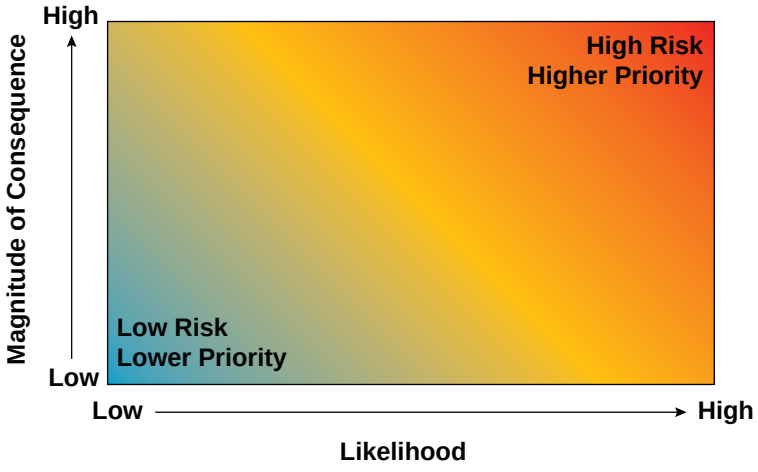
The UIUC/TTU report contains a comprehensive regional analysis of climate change projections for the near term (2010-2039), mid term (2040 – 2069) and long term (2070 – 2099). In addition, the report contains predictions of the impacts in climate-sensitive areas categorized under the chapters on Water, Health, Ecosystems and Infrastructure. The Infrastructure section is informed by a detailed assessment of potential economic impacts to various City of Chicago departments and sister agencies prepared by OW. The UIUC/TTU report, Research Summary Report, Climate Change and Chicago: Projections and Potential Impacts, describes projected climate impacts for Chicago and is available online at www.chicagoclimateaction.org.

To proactively manage climate change impacts, the City of Chicago asked MWH to use this research to create a City of Chicago risk assessment. MWH's process began by addressing these questions: (1) what is the likelihood of the occurrence, (2) what are the local consequences of climate change, and (3) what is the related risk of the various climate change impacts.

3.2 Methodology

The risk related to a Climate Change impact can be represented as a function of its likelihood and the magnitude of its consequence as reflected by the equation and the graphic below:

Risk = Likelihood x Consequences



The approach adopted for MWH's risk assessment for the City of Chicago was to combine a measure of the probability or likelihood of a predicted climate change impact occurring with a measure of the probable severity or magnitude of the consequence associated with specific impacts resulting from that prediction.

3.2.1 Scoring System

In order to apply a consistent evaluation of likelihood and consequence MWH used the simple scoring system shown in the tables below. For each of the climate-related predictions described in the City's climate research reports prepared by UIUC/TTU and Oliver Wyman, a scale of 1 to 5 for likelihood (5 being the most likely) was used. Similarly for each identified impact a scale of 0 to 5 was used for consequence (5 being of greater consequence, and 0 representing an impact with a beneficial outcome). Since Oliver Wyman generated specific data on potential costs of climate impacts on City of Chicago infrastructure, MWH created a parallel set of scores for these cost impacts.

MWH Climate Risk Scoring System		
Score	**Likelihood**	
5	Occurring now	E.g. UIUC/TTU report cites evidence of detectable trend.
4	Very Likely	E.g Prediction is primarily driven by increased average temperatures, which in general are more reliable output from general circulation models (GCM)
3	Likely	E.g. Prediction is driven by generally less reliable GCM output such as increased storminess
2	Somewhat likely	E.g. Prediction is hypothesized based on a combination of simultaneous climate outcomes.
1	Unlikely	E.g. Prediction is outside of range of likely scenarios presented by UIUC/TTU
0	Not used	N/A

MWH Climate Risk Scoring System for Infrastructure		
Score	**Consequence (General)**	**Consequence (Infrastructure Costs*)**
5	Catastrophic (e.g. major loss of life)	Loss of life doesn't apply to infrastructure costs
4	Very High (significant health effects, and/ or very high cost, approximately >$1B)	> $4M
3	High (high cost, approximately $10M - $1B)	$1M to $4M
2	Moderate (moderate cost approximately < $10M and/or disruption)	$0.25M to $1M
1	Low (primarily nuisance issue or relatively low cost)	< $0.25M
0	Benefit (any magnitude)	Not Used
** - Consequence determined for Infrastructure category using OW study data. Cost range based on Average Additional Annual Costs (2010 – 2099) using average of "High" and "Low" emissions scenario aggregated across all responding City of Chicago departments.*		

3.2.2 Climate Predictions and Impacts Identification

Over 70 different climate predictions were drawn from the UIUC/TTU report under the general themes of Water, Health, Ecosystems and Infrastructure and organized by the sub-themes shown in the following table:

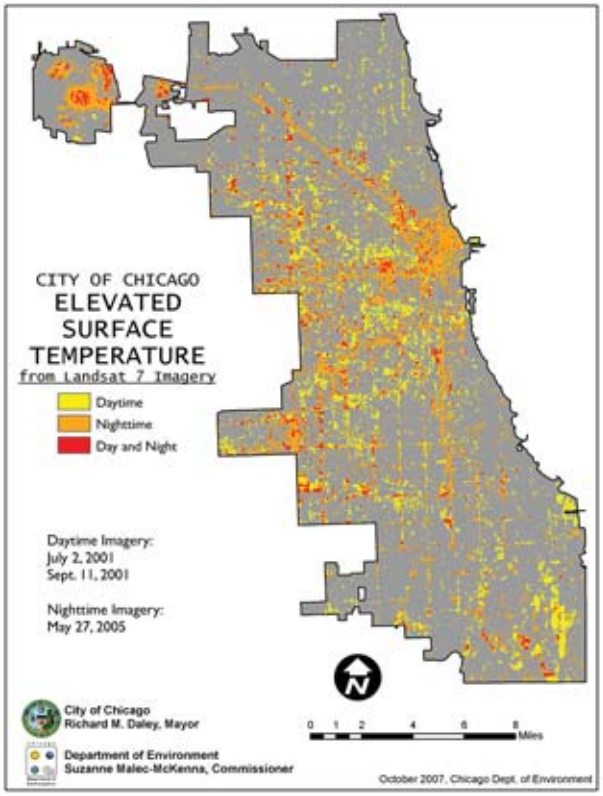
	Themes			
	Water	**Health**	**Ecosystems**	**Infrastructure**
Sub-Themes	Precipitation River Flow Lake Michigan	Heat Air Quality Vector-Borne Diseases	Natural Vegetation Animals Invasive Species Agriculture	Heating & Cooling Operation & Maintenance Labor Other

Multiple specific impacts may arise from these climate predictions. A total of over 80 different potential impacts were identified resulting from the climate predictions. Each prediction was individually scored, as was each separate impact.

3.3 Results

Overall risk scores for each identified impact were obtained as the product of the "consequence" score and the associated "likelihood" score for the driving climate prediction. Impacts with risk score of 15 and greater were classified as "High", impacts with risk scores in the range 9 to 14 were classified as "Moderate", and impacts with risk scores lower than 8 were classified as "Low".

Table 3.1 *(see pages 12 and 13)* contains a summary of all impacts ranked as Moderate or High, and illustrates the activities primarily affected by these risks and also provides a rough indication of the time frame during which Chicago municipalities, businesses and other organizations may realize the risk.



Heat-related health issues are rated as high-risk and requiring immediate attention. This map shows areas of the city subject to the "heat-island" effect.

It should be noted that the content of this table is specific to the organizational structure, impacts, and related adaptation strategies that are applicable to the City of Chicago. Other organizations are urged to carefully examine the table structure and methodology that resulted in development of this table as they plan their own unique approaches to climate change adaptation. For example, a commercial business enterprise employing large numbers of people under working conditions that do not include air conditioning cooling should develop and when needed, implement a plan for conducting business as usual under the extreme heat event conditions that are forecast.

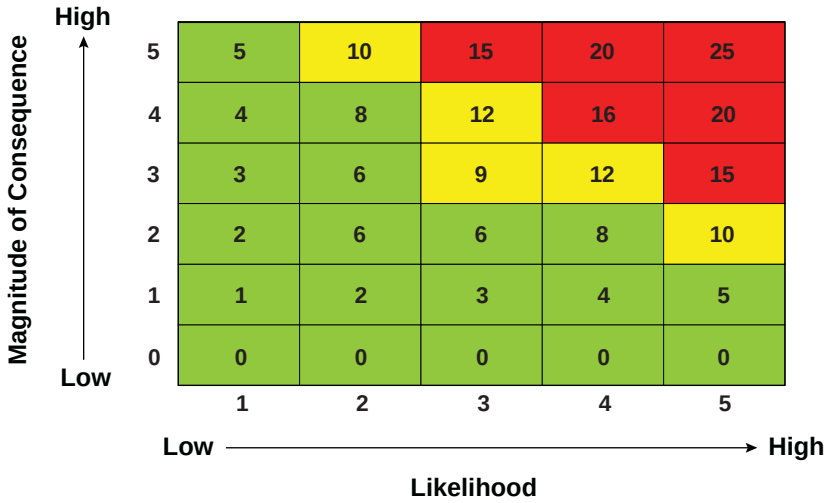


Figure 3.3. Classification Scheme for Overall Climate Risks

Table 3.1

Impact	Risk	Timing **	Construction, Buildings & Property	Tourism	Environment	Fire	Fleet Management	Housing	Human Services	Emergency Management	Police	Public Health	Streets and Sanitation	Transportation	Water Management	Parks and Open Space	Storm Water Management
Need to get greater penetration of A/C to residential units (particularly high risk areas)	Moderate	Near	x					x				x					
Damage to property and increasing cost of insurance due to stormwater	Moderate	Mid	x			x			x			x	x		x		x
Higher costs associated with managing invasive species	Moderate	Mid			x										x	x	
Increased potential for shoreline erosion/ storm damage	Moderate	Mid			x						x					x	
Possibility of higher frequency/severity of storms	Moderate	Mid				x				x	x		x			x	
Increase in Ozone-related health impacts (hospitalization, illness)	Moderate	Mid				x						x				x	
Reduction in “services” provided by urban forest	Moderate	Mid														x	x
Increase in replacement and maintenance costs for fleets	Moderate	Mid				x	x				x		x	x	x	x	
Lower revenue from summer events	Moderate	Mid		x									x				

NOTES

** Now = already happening, Near = 2010 - 2039, Mid = 2040 -2069

Table 3.1 (cont)

Impact	Risk	Timing **	Construction, Buildings & Property	Tourism	Environment	Fire	Fleet Management	Housing	Human Services	Emergency Management	Police	Public Health	Streets and Sanitation	Transportation	Water Management	Parks and Open Space	Storm Water Management
Increase in heat related deaths	High	Now	x	x		x		x	x	x	x	x		x		x	
Increase in heat related hospitalization	High	Now				x			x	x	x	x					
Increase in health impacts due to "water-in-basement" incidents	High	Near	x			x				x		x	x		x		
Increased annual energy costs	High	Near	x	x	x	x	x	x		x	x	x	x	x	x	x	x
Increase in tree replacement costs and landscape maintenance activities	High	Mid	x		x								x	x		x	
Damage to key infra-structure (pump sta-tions, electricity distri-bution equipment, etc.)	High	Mid	x	x			x	x					x	x	x		x
Impact to local wetland restoration / mitigation efforts	Moderate	Now			x											x	
Increase in insurance premiums, deductibles, exclusions, and/or no. of underinsured properties	Moderate	Now	x									x					
Increased costs for response action and clean-up after heavy rain events	Moderate	Near				x				x	x		x		x	x	x
Damage to property and increasing cost of insurance due to overbank flooding in area rivers	Moderate	Near				x				x	x	x	x	x	x	x	x

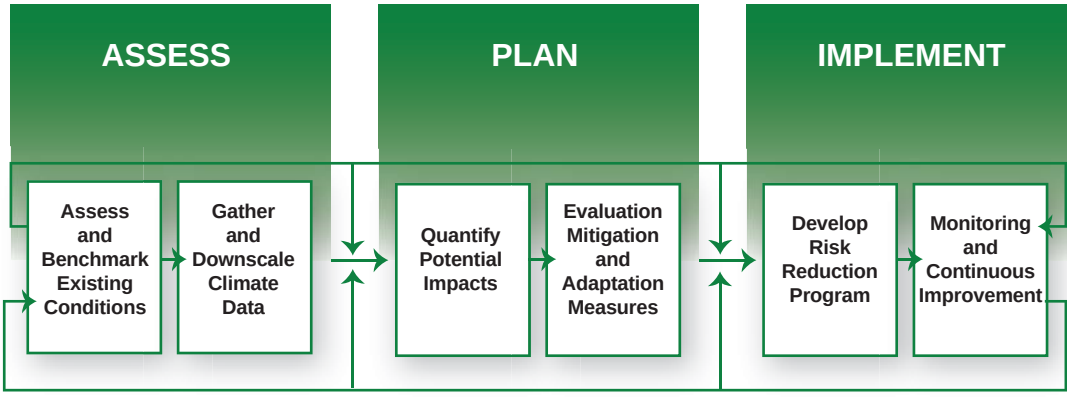
NOTES
** Now = already happening, Near = 2010 - 2039, Mid = 2040 -2069

4. Risk Reduction

4.1 Introduction

While we know that the climate already is changing, climate projections are uncertain. Decision-making based upon analysis of climate risk has to be repeatedly revisited to account for new data. Chicago area municipalities, businesses, and other organizations need an iterative process of continuous learning, monitoring, and improvement to effectively respond to the dynamics of climate change, as described in the figure below.

Climate Risk Reduction Program



While adaptation will occur as a set of discrete and incremental adaptation actions taken over a very long period of time, continuous learning is essential. Due to the long duration of the adaptation process and the incremental nature of the adaptation steps, on-going planning and communication, coupled with consistent leadership are key components of adaptation. Businesses and municipalities need to be able to continually evaluate current actions and identify and respond to new challenges.

4.1.1 Planning Tactic: Create an Adaptation Leadership Group

It can be a struggle to integrate climate issues into daily work. Experience with major change and enhancement initiatives throughout the world has shown that successful implementation requires more than good technical ideas. Governments and businesses need to focus a portion of their energies and resources on enhancing capacity as an organization to successfully initiate and deliver climate change adaptation measures.

An organizational planning framework for a climate change adaptation program might include the following steps:

- Embed climate change adaptation considerations into planning processes;
- Breakdown existing “silo” mentalities and foster cooperation;
- Be capable of responding to climate change knowledge that is incomplete and dynamic.

A collaborative process may be most important, as climate-related risks touch many departments and cover many aspects of life. The approach that the City of Chicago has

taken is to create a coordinating team of senior leadership, supported by interdepartmental or organizational working groups.

Coordinating Team (i.e. Steering Committee) responsibilities could include the following:

- Developing a common knowledge base
- Assessing risks and timing
- Reviewing and setting priorities
- Benchmarking against other cities and organizations
- Funding
- Monitoring and sharing implementation progress

The primary functions of the working groups could include:

- Conduct appropriate response planning and lead implementation activities
- Focus on implementation of identified priority projects
- Identify and remove obstacles and barriers to success
- Facilitate cross-departmental data and knowledge sharing
- Report progress back to the Steering Committee

Business decisions made every day can impact ability to adapt to climate change and the cost of adapting.

4.1.2 Planning Tactic: Review Business Processes and Decisions with Reference to Impact on Ability to Adapt to Climate Change

Public and private organizations make literally hundreds of business decisions each day. These decisions can impact vulnerability to climate change. The costs can be high even for small decisions.

Table 4.12 *(see next page)* includes a template for doing a quick analysis of climate change vulnerability of various types of routine business decisions. Decision makers can use this template as an initial guide to understanding on a rapid Yes/No basis, if decisions need to take into account climate change. Where decisions can have significant impacts on vulnerability to climate change, these potential impacts should be part of the decision process.

It should be noted that this simplified climate change business decision support template is structured to reflect the business practices of a municipality like the City of Chicago. Other organizations, including commercial business enterprises, can construct a similar template approach that is based on the routine set of decisions that are required to operate the business and serve its customers or other stakeholders.

4.1.3 Planning Tactic: Implement a Climate Sensitive Procurement Strategy

Part of preparing is ensuring that the market offers products that will be effective in a different climate regime (and minimize greenhouse gas emissions). The City of Chicago is already expanding its program to encourage departments to specify more environmentally-friendly products. The goal is to buy products/services that will function as intended over their expected lifetime – including the anticipated new climate conditions.

Municipalities, businesses and organizations across Chicago could take the following steps:

1. Develop a simple checklist to ensure procurement is in general alignment with climate change adaptation objectives and train procurement specialists in its use. To maximize win-win procurement choices, the checklist need not be limited only to adaptation measures, but could also incorporate objectives for reducing greenhouse

Table 4.12. Climate Change Vulnerability of Chicago Business Processes or Decision Areas Screening Level Evaluation—Sample Template (Put a Yes or No in Each Box)						
Business Process or Decision Area	**Impact on GHG Emissions**	**Vulnerability to Extreme Temperatures**	**Vulnerability to Extreme Precipitation**	**Building/ Infrastructure/ Equipment Vulnerability**	**Ecosystem Degradation Vulnerability**	**Opportunity for Leadership, Communication, Education on Climate Change**
Planning for product or service purchase						
Planning for new infrastructure						
Planning for landscaping projects						
Planning for open space projects						
Planning for major capital equipment						
Planning for new buildings						
Vendor sourcing						
Selection or design criteria						
Engineering (if required)						

Table 4.12. Climate Change Vulnerability of Chicago Business Processes or Decision Areas Screening Level Evaluation—Sample Template (Put a Yes or No in Each Box)						
Business Process or Decision Area	**Impact on GHG Emissions**	**Vulnerability to Extreme Temperatures**	**Vulnerability to Extreme Precipitation**	**Building/ Infrastructure/ Equipment Vulnerability**	**Ecosystem Degradation Vulnerability**	**Opportunity for Leadership, Communication, Education on Climate Change**
Procurement Requirements						
Construction						
Facility Maintenance						
Facility Operations						
Other						
Conventions, Shows, Events						
Public Relations and Com-munications						
Educational Program Changes						
Activity Scheduling (e.g., school hours)						
Labor Agreement Negotiations						

gas emissions (mitigation) as well. From an adaptation standpoint, procurement offices could require answers to a series of questions with every purchase request, including:

a. Does the product or service have any climate-related component? (Y/N)
b. Useful Life:
    i. Does the product or service have more than a 10-year life span? (Y/N) OR
    ii. If this is a replacement product or service, for how long has earlier version been in place? (if longer than 10 years then assume replacement will also have similar life)
c. Predicted Operating Scenario:
    i. Do the relevant climate change predictions indicate a deteriorating or improving operating climate? (Y/N)
    ii. Has specification been written to accommodate latest relevant predicted climate scenario?
d. Cost Justification:
    i. What is the estimated additional cost (saving) of purchasing "climate sensitive" product/service?
    ii. What is the estimated benefit (better performance, more reliability, longer service life, less maintenance)?
    iii. Does benefit outweigh cost?

2. Develop a list of definitely included or exempted products/services based on their use and related climate impacts.
3. Much of the initial work must be focused on awareness-building, training, development of contract clauses for standard bidding documents, and technical specifications or guidance on climate change concerns.

Procurement policies can be catalytic as they not only embed climate impacts in business thinking and encourages/requires suppliers to consider climate change, but also build demand for climate-sensitive products and services that have potential to improve adaptation economics over time.

5. Adaptation Tactics

5.1 Introduction

While each organization must find its own win-win responses to climate change, the City of Chicago believes that the broad adaptation strategies that MWH recommended based on projected Chicago climate impacts and interviews with City departments and sister agencies provide useful guidance for other municipalities and businesses preparing for climate change. The City of Chicago is evaluating these and other strategies for its own adaptation implementation plan through a multi-departmental work group process that also includes other expert stakeholders.

MWH followed a series of steps to recommend adaptation strategies and actions:

- Group the highest priority (risk) impacts and brainstorm adaptation strategies and actions to counter them.
- Evaluate the costs and benefits of each action.
- Choose a mix of actions that has the best benefit-cost ratio.
- Evaluate the effectiveness (or efficacy) of the plan and revise it.

This section describes potential adaptation tactics that MWH recommended for the City of Chicago. Each strategy builds off of existing City programs and initiatives. Because these strategies are responses to projected climate changes for the Chicago metropolitan region, they may be of value for consideration by other municipalities, companies and organizations in Chicago and the Chicago Metropolitan Region, although some may be less relevant to individual businesses.

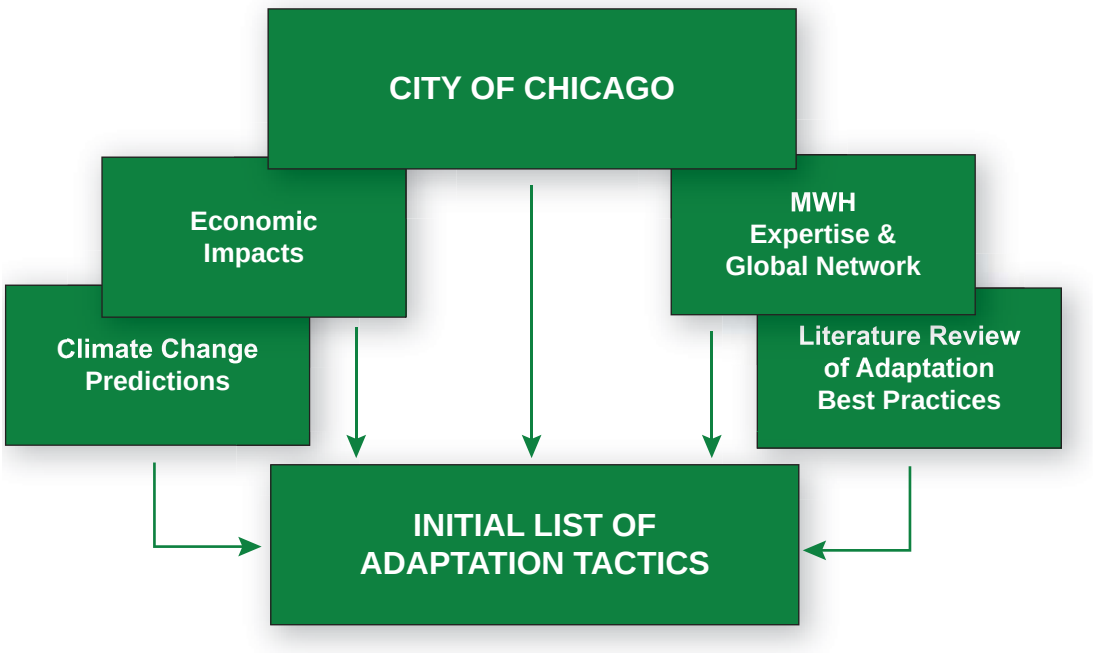
The climate change impacts are grouped according to the primary themes identified by UIUC/TTU in its Climate Change Impacts Report in Table 5.1.

One of the main adaptation strategies in the Climate Change Impacts Report is to "reduce vulnerability to extreme precipitation events."

Table 5.1 - Significant Climate Change Impacts by Adaptation Strategy				
STRATEGY	1. Reduce vulnerability to extreme heat events	2. Reduce vulnerability to extreme precipitation events	3. Reduce vulnerability of buildings, infrastructure, and equipment to extreme climate conditions	4. Reduce vulnerability to ecosystem degradation
IMPACTS	• Increase in heat related deaths • Increase in heat related hospitalization • Increase in ozone-related health impacts (hospitalization/ illness) • Lower revenue to City from events	• Increase in health impacts due to "water in basement" incidents • Damage to property and increasing cost of insurance due to stormwater • Increased costs for response action and clean-up after heavy rain events • Possibility of higher frequency/ severity of ice storms • Damage to property and increasing cost of insurance due to overbank flooding in area rivers • Increase in insurance premiums, deductibles, exclusions, and/or number, of underinsured properties	• Increased annual energy costs due to probable need for additional air conditioning/ cooling during summer • Damage to key infrastructure (pump stations, electrical distribution equipment, etc.) caused by extreme weather events (temperature and/or precipitation) • Increased potential for shoreline erosion/storm damage • Need to get greater penetration of A/C to residential units (particularly in areas of high risk resident populations) • Increase in replacement and maintenance costs for City vehicle fleets	• Increase in tree maintenance and replacement costs • Increase in landscape maintenance costs • Potential higher costs associated with managing invasive species • Reduction in "beneficial services" provided by urban forest resources • Potential impacts to local wetland restoration/ mitigation efforts • Increase the overall level of protection of natural resources to manage declining species diversity and related degradation of ecosystems

5.1.1 Identification of Adaptation Tactics

After identifying priority adaptation strategies through a risk assessment of the projected impacts, the next step MWH took was to isolate a series of specific actions or "tactics" that can be implemented to support those strategies. MWH identified climate change adaptation tactics from a variety of sources as illustrated below.



MWH further refined the tactics based on interviews conducted with certain City Departments, which were used to obtain feedback on existing capabilities and obstacles to implementation. Individual tactics were analyzed using a systematic prioritization and ranking procedure that identifies those tactics that appear to be most suitable for early implementation in response to the magnitude of the related risk *(See Appendix I)*. The following sections describe the adaptation strategies and associated adaptation tactics.

5.2 Recommended Adaptation Strategy 1: Reduce Vulnerability to Extreme Heat Events

According to the reports on climate change impacts prepared for the City of Chicago, temperature related drivers contribute the majority of the total net economic impact from anticipated climate changes. The objective of an adaptation strategy to reduce vulnerability to extreme heat events is to address the following climate change impacts:

- Increase in heat related deaths
- Increase in heat related hospitalization events
- Increase in ozone-related health impacts (hospitalization/illness)
- Lower revenue from decreased attendance at summer events/summer tourism

5.2.1 Adaptation Tactic: Prepare for Extreme Heat Events

As a highly developed, major metropolitan area, Chicago already has a sophisticated emergency response planning and coordination system in place and operational. The City of Chicago will drive continuous incremental improvement of emergency response plans, coordination, and response actions as climate change plays out in the future.

Based upon the MWH analysis, potential adaptation actions for businesses and other organizations in Chicago and the Chicago Metropolitan area include:

- Neighbors are currently asked to check up on neighbors during heat events, but this could be expanded to outreach to employees, churches, neighborhood groups, and others to increase the reach of such well-being checks.
- Open up more “cooling centers” during heat waves.
- Support efforts to get greater penetration of efficient A/C to residential units in areas of high-risk resident populations.
- Ensure that employees and tenants have adequate cooling and information during heat waves. Building owners and users have many easy steps they can take to promote cool tenants.

5.2.2 Adaptation Tactic: Manage the Urban Heat Island Effect

Chicago has been a national leader in addressing the Urban Heat Island phenomenon, through green roof construction, and also through the Green Alley Initiative. The City of Chicago has for nearly a decade worked to reduce the Urban Heat Island effect, and (along with Baton Rouge, Houston, Sacramento and Salt Lake City) was selected in 1998 to be involved in the EPA’s Urban Heat Island Pilot Project (UHIPP) as part of the Heat Island Reduction Initiative (HIRI). The City is in the process of taking additional steps to address the Urban Heat Island phenomenon.

Based upon the MWH analysis, potential adaptation actions for businesses and other organizations in Chicago and the Chicago Metropolitan area include:

- Identify “hotspots” within the city that impact you, including buildings and parking lots, and inform and help drive decisions towards temperature reduction, energy savings, and air quality improvement.
- Optimize routine tree planting to take into account and offset the urban heat island effect.
- Participate in tree planting campaigns in priority planting areas.
- Develop and share best practices with other organizations.

5.2.3 Adaptation Tactic: Increase Ozone Response Activities

Higher temperatures will exacerbate smog. Meeting the ozone standard is the first step in addressing this challenge. The State of Illinois designated the Chicago metro counties (Cook, DuPage, Kane, Lake, McHenry, Will, Grundy (partial), and Kendall (partial)) as non-attainment areas for the 8-hour ozone standard. The State is preparing a State Implementation Plan (SIP) for attainment planning for the non-attainment counties.

Based upon the MWH analysis, potential adaptation actions for municipalities, businesses and other organizations in Chicago and the Chicago Metropolitan area include the following steps to avoid worse air quality under a higher temperature regime:

- Support public transit discount days, especially during the Ozone season. Provide public transit, tax-free, flexible, spending account benefits to employees.
- Share information with employees and residents about ways they can reduce ozone precursor emissions through energy conservation, lawn maintenance, and public transit.
- Encourage less engine idling for trucks, buses, locomotives, and marine vehicles.
- Use natural landscaping to reduce emissions from mowers and maintenance equipment.

Reducing automobile traffic would help relieve smog.

- Use low VOC building materials, including adhesives, caulks, manufactured wood products, paints, thinners, and primers below USEPA VOM limits.
- Participate in green programs that reduce energy use.

5.3 Recommended Adaptation Strategy 2: Reduce Vulnerability To Extreme Precipitation Events

The objective of an adaptation strategy to reduce vulnerability to extreme precipitation is to address the following climate change impacts:

- Increase in potential health impacts due to “water in basement” incidents
- Damage to property and increasing cost of insurance due to stormwater
- Possibility of higher frequency/severity of ice storms
- Damage to property and increasing cost of insurance due to over bank flooding in area rivers
- Increase in insurance premiums, deductibles, exclusions, and/or number, of underinsured properties

The City of Chicago is served by a combined (sanitary and stormwater) sewer system, much of which was built over one hundred years ago. Historically, the system has suffered two major problems: (1) combined sewer overflows (CSOs), which is the term given to discharges of untreated sewer water to area waterways when the largest sewers (interceptors) are flowing full, and (2) local basement flooding during intense rain events when the local collector sewer network is full. These two separate problems have separate solutions, which are currently being implemented.

The Metropolitan Water Reclamation District (MWRD) with significant Federal funding is addressing the CSO issue with the Tunnel and Reservoir Plan (TARP). Started in the 1970s, a generation of engineering and construction effort is reaching fruition, with the large diameter tunnels completed, and the 2 main reservoirs under design/construction. CSO frequency has already decreased (and water quality in the Chicago River has

Properly designed and implemented downspout disconnections, rain barrels, permeable paving and green roofs can all help alleviate stormwater management problems.

improved), and completion of the reservoirs is expected to bring about an order of magnitude decrease in future CSO events.

Several measures have been implemented by the Chicago Department of Water Management to address basement flooding: Installation of "Rain Blocker" devices which detain stormwater in the street rather than overloading the sewer system, encouraging the disconnection of downspouts, where appropriate, which also slows the rate at which water enters the system, and recently adopting a new Stormwater Ordinance which requires large new developments to manage the first 1/2–inch of rain entirely on site.

5.3.1 Adaptation Tactic. Include Climate Change Considerations in MWRD Combined Sewer Watershed Studies

A viable first step in incorporating climate projections into stormwater planning would be to incorporate projected conditions into MWRD watershed studies, which are part of a well-resourced program and offers a real opportunity to be a catalyst for a change in thinking. These studies build on the need for interagency cooperation while taking advantage of MWRD's scientific capability and resources. Inclusion of potential climate change scenarios in hydrological planning by a nationally recognized agency would be groundbreaking in the US, and therefore catalytic in nature.

5.3.2 Adaptation Tactic: Conduct a Stormwater Management Study

The City of Chicago sewer infrastructure system can often handle only up to a two-year storm event. The Department of Water Management is making headway in analyzing and understanding the current system problems, which range from capacity issues and condition issues, to maintenance and staffing issues. Under climate change, it appears highly likely that the current problems and funding issues will be exacerbated. It is important for cities throughout the region to understand and factor in these impacts through stormwater management studies.

5.3.3 Adaptation Tactic: Pilot Distributed Solutions

Distributed solutions (e.g., downspout disconnections, rain barrels, permeable paving, and green roofs) can play a role in reducing the looming vulnerability, particularly in dealing with high frequency/low intensity storms, but they must be properly designed/implemented/maintained to be effective, which all takes resources. An important first step is to conduct adequate testing (pilot areas, performance monitoring, maintenance cost determination) of distributed solutions to prepare for future changes in climate, while conducting long-term modeling/planning studies such as that being contemplated by MWRD.

The Green Urban Design (GUD) plan, the result of an 18-month collaboration among City of Chicago departments, sister agencies, nonprofits and private businesses, is a good example of the City's existing effort to use technology, design and process improvements to help to adapt to climate change. In 2008, the City plans to implement the highest priority steps in the GUD plan. GUD actions include capturing as much rain as possible where it falls using permeable pavement, rooftop gardens and green alleys. Current activities under the City of Chicago's Green Urban Design (GUD) program, which could be incorporated into distributed solutions for stormwater management, include the following:

- Paving permeability compatibility with stormwater ordinance – allowing permeable paving solutions (current requirement of compacted base and asphaltic concrete

surfacing conflict with Stormwater Management Ordinance implementation)

- Residential Rear Yard Permeability – Requiring rear yard open space to remain permeable.
- Resolving conflict between mandatory sewer connection and City Stormwater management regulations and policies
- Allowing use of perforated plastic pipes for underground drainage as part of sub-surface stormwater management
- Enhancing downspout disconnection campaign
- Developing incentives for exceeding Stormwater Management Ordinance retention requirements
- Educating City staff on flexibility regarding stall dimensions (length can be reduced to 16' if overhang)
- Enforcing maintenance requirements (Stormwater Management Ordinance, Landscape Ordinance)
- Developing green roof specifications
- Improving/clarifying environmental requirements for paving materials
- Investigating use of impact fees/mitigation requirements based on 'parking excess' (thresholds beyond current ratios that triggers a 'premium')
- Researching feasibility of developing a stormwater plan for the City of Chicago public right-of-way in collaboration with MWRD
- Based on the Sustainable Street Design Standards, reducing impervious area whenever possible.
- Wherever possible, managing and cleaning the first flush of stormwater on the public right of way and diverting it to water bodies.
- Creating and restoring wetlands (stormwater parks) to help manage Stormwater entering the river.
- Using spaces adjacent to the right-of-way to manage stormwater.
- Developing a system of landscapes that are designed, managed and monitored to be part of the City's stormwater management infrastructure.

Based upon the MWH analysis, potential adaptation actions for businesses and other organizations in Chicago and the Chicago Metropolitan area include:

- Design and manage landscapes to be part of the City's stormwater management infrastructure.
- Use permeable paving solutions and reduce impervious area whenever possible.
- Keep yards of residences and property of businesses permeable.
- Participate in the downspout disconnection campaign.
- Exceed Stormwater Management Ordinance retention and Landscape Ordinance requirements.
- Install green roofs.
- Create and restore wetlands to help manage Stormwater entering the river.
- Create stormwater parks to reduce stormwater runoff and provide green spaces.

5.3.4 Adaptation Tactic: Piloting Stormwater Parks

As already outlined in the City of Chicago's Green Urban Design report, city government could bring together municipal agencies that have a role in planning and managing stormwater with city agencies that acquire, hold or manage vacant land to determine

the issues in using landscapes to manage stormwater in “stormwater parks.” This effort, which could be an ideal initial activity to launch development of a Stormwater management plan that addresses future climatic conditions, could be enhanced by also bringing other Cities and municipalities to the table to share best practicable approaches.

“Stormwater parks” can have the following benefits:

- To reduce stormwater runoff at a City-block scale (parcels and streets);
- To provide urban green spaces;
- To bring some surface water features to watershed;
- For additional upland habitat; and,
- To provide a public demonstration of Stormwater BMPs.

5.4 Recommended Adaptation Strategy 3: Reduce Vulnerability of Buildings, Infrastructure, and Equipment to Extreme Weather Conditions

Buildings, infrastructure and equipment will be subjected to more extreme climate conditions and events in the future. These conditions will place these facilities at increased risk of performance failure. If building owners are to continue to deliver the same level of service and responsiveness that people have become accustomed to, it will be necessary to implement adaptive responses to mitigate these risks and assure service levels do not decline due to extreme climate events. The objective of this adaptation strategy is to address the following climate change impacts:

- Stress on the power pool due to more summer heat waves
- Increased annual energy costs due to probable need for additional air conditioning/cooling during summer
- Need to get greater penetration of A/C to residential units (particularly in areas of high risk resident populations)
- Increased vehicle-fleet replacement and maintenance costs
- Damage to key infrastructure (pump stations, electrical distribution equipment, etc.) caused by extreme weather events (temperature and/or precipitation)
- Increased wear on buildings due to heat and weather extremes.
- Increased potential for shoreline erosion/storm damage

5.4.1 Adaptation Tactic: Manage Power Vulnerability

Hot summers and long heat waves could stress power delivery. Potential adaptation actions for municipalities, businesses and other organizations in Chicago and the Chicago Metropolitan area include:

- Undertake a power vulnerability study given climate change. Power vulnerability is particularly important for hospitals and other institutions on which Chicagoans rely.
- Use more fans and better ventilation to aid cooling.
- Reduce energy use.
- Switch to renewable energy sources to meet the need for cooling without increasing greenhouse gas emissions.
- Distribute current energy sources to improve resiliency of the existing system and assure critical facilities remain on line during extreme heat events.

5.4.2 Adaptation Tactic: Manage Fleet Vulnerability

Fleets also may be stressed by changes in extreme heat. Potential adaptation actions for municipalities, businesses and other organizations in Chicago and the Chicago metropolitan area include:

- Change purchasing of vehicles to achieve necessary heat tolerances.
- Change maintenance schedules to take into account greater stress on fleets.

5.4.3 Adaptation Tactic. Include Climate Change Considerations in Plans for New Development and Renovation

Based upon the MWH analysis, potential adaptation actions for municipalities, businesses and other organizations in Chicago and the Chicago Metropolitan area include:

- Taking projected climate changes into account in new development through analysis of building tolerances to changes in weather and building placement in relation to potential for flooding.
- Do the same for building and property renovations.

5.5 Recommended Adaptation Strategy 4: Reduce Vulnerability to Future Ecosystem Degradation

Long term temperature changes coupled with changes in precipitation patterns and storm severity are expected to have significant impacts on natural ecosystems in the Chicago area. The overall objective of this adaptation strategy is to improve the resiliency of the current ecosystems within the City of Chicago as a means of assuring continued ecosystem diversity and to protect these natural resources from degradation as a result of climate change.

It is recognized that climate change could disrupt ecosystems and precipitate regional shifts in vegetation and habitat. Predicting how specific species will adapt to climate change is difficult at best, but it is generally understood that in the Upper Midwest ecosystems will migrate northward.

The objective of this adaptation strategy is to address the following potential climate change impacts to the City of Chicago:

- Increase in tree maintenance and replacement costs.
- Increase in landscape maintenance costs.
- Potential higher costs associated with managing invasive species.
- Reduction in “beneficial services” provided by urban forest resources.
- Potential impacts to local wetland restoration/mitigation efforts.
- Increase in the overall level of protection of natural resources required due to declining species diversity and related degradation.

The City of Chicago and its sister agencies have many programs already in progress that contribute toward reducing the vulnerability of future ecosystem degradation. Other entities also have taken action. The Chicago Wilderness consortium, an alliance of over 200 public and private organizations, published “The State of Our Chicago Wilderness: A Report Card on the Ecological Health of the Region” in 2006 and continues to work at protecting, restoring, studying, and managing the natural ecosystems of the Chicago region.

Climate change could disrupt ecosystems and precipitate regional shifts in vegetation and habitat.

Trees must be regarded as part of the urban infrastructure that is just as vital as roads, bridges, and utilities.

5.5.1 Adaptation Tactic: Participate in Preserving Native Species

Climate change will further endanger vulnerable or threatened species in the region. As the climate warms, it will no longer be suitable for some species. Also, current insect and plant pests are likely to reproduce faster and cause more damage. Pests may move from the south into the Chicago region.

Potential adaptation actions for businesses and other organizations in Chicago and the Chicago Metropolitan area that have significant interaction with natural ecosystems include:

- To protect native species, regional businesses and property owners can support more intensive strategies of ecosystems management and greater efforts at conserving vulnerable species.
- As some mammals migrate north, their migration paths will pass directly through the Chicago region, and be blocked by urban and agricultural development. Property owners also can help by supporting investment in major green pathways through suburban areas to enable the migration.

5.5.2 Adaptation Tactic: Participate in Creating a New Recommended Plant List

Plant hardiness zones are being altered due to climate change. An approved plant list could be created in partnership with City departments and public stakeholders. The first action should be refinement of a recommended plant list for landscaping (e.g., plants that enhance pollutant removal, reduce urban heat island effects through high rates of evapotranspiration, or have increased stormwater uptake capabilities). This is likely to include adapted canopy tree species, adapted/native drought tolerant species, and tall grasses.

Potential adaptation actions for businesses and other organizations in Chicago and the Chicago Metropolitan area that routinely plant and maintain significant areas of landscaping, including trees, include:

- With representatives from the landscape nursery industry and other stakeholders, disseminate new plant lists. The landscape nursery industry is critical to the long-term success of a new recommended plant list since nurseries will be the supply sources for new plants that are not now in common use in the Chicago area. Widespread stakeholder involvement will result in greater buy-in and engagement in use of recommended plants.
- Create a program to actively monitor the health of the new plant materials installed in select areas to help demonstrate success and provide feedback for periodically updating the landscaping plant list.

5.5.3 Adaptation Tactic: Enhance Chicagoland Urban Forest Management

Urban trees are proven to provide a wide range of benefits to mitigation of climate change impacts, including carbon uptake, localized shading, and cooling, and improved stormwater management as well as improving the aesthetic appearance of the surrounding area. Climate change impacts will make trees an increasingly valuable resource, and potential extremes in weather patterns will demand increased management of this important resource to assure its diversity and long-term health. In fact, trees must be regarded as part of the urban infrastructure that is just as vital as roads, bridges, and utilities.

The City of Chicago has plans for its urban forest management, but many urban trees are located on private property. It is important for private property owners also to under-

stand this resource and manage it in the face of climate change. Important lessons can be drawn from the publication "Climate Change Adaptation Options for Toronto's Urban Forest." Toronto is located at approximately 43 degrees north latitude while Chicago is at approximately 41 degrees north latitude. The lessons include:

- Budgets often provide for planting new trees for urban forest canopy expansion, but comparable funding and resources are not usually available for watering and maintenance to ensure that new trees survive and grow to maturity.
- Storm damage to urban trees represents a significant potential cost that must be planned and budgeted if the long-term benefits of the urban forest resource are to be maximized. Damaged trees must be quickly and effectively cared for if they are to recover from the damage and continue to benefit the community as they mature.

5.5.4 Adaptation Tactic: Enhance Chicago Urban Wetland Management

Wetlands are proven to provide a wide range of benefits to mitigation of human impacts on natural ecosystems, including nutrient uptake, improved stormwater and urban runoff management, and provision of habitat for an exceptionally diverse group of plants and animals. Climate change impacts will make wetlands an increasingly valuable resource to Chicago, and potential extremes in weather patterns will demand increased management of this important resource.

Potential adaptation actions for businesses and other organizations in Chicago and the Chicago Metropolitan area include:

- Adapting current wetlands management practices to future impacts of climate change.
- Using the adaptive, natural treatment capacity of wetlands to mitigate impacts of climate change, such as increased stormwater runoff.

The technical literature on the subject of wetlands management plans developed by the US Army Corps of Engineers and others is quite large, and there are a number of examples of Comprehensive Wetlands Management Plans (CWMPs) available on-line for use as go-bys to jump-start Chicago efforts.

5.5.5 Adaptation Tactic: Protect Agriculture

Illinois farmers can adapt in a number of ways to the changing climate. Some options include:

- Adjusting planting and harvesting dates.
- Planting more heat tolerant or genetically-modified varieties better suited to future climate conditions.
- Switching to warmer season crops.
- Investing more capital in irrigation, crop storage, or livestock facilities.

Climate change can also provide opportunities for farmers. For example, farmers could increase their income by growing crops that benefit from increased CO_2 levels. The agricultural industry needs more research to identify strategies and adaptations for Illinois farmers. Research could include studies of heat-tolerant or CO2-sensitive soybean crops; ongoing and future pest problems; and economic opportunities that benefit both farmers and the environment.

6. Conclusion

The Chicago Climate Action Plan adopted in 2008 stresses the importance of both reducing greenhouse gas emissions in Chicago and preparing for climate changes that may be unavoidable. The City of Chicago has made a commitment to research, education, and action to support both mitigation of greenhouse gas emissions and adaptation to climate change in Chicago that will secure a high quality of life for Chicagoans far into the future. With the help of corporate, foundation, public interest, and government partners, Chicago is positioned to be resilient, competitive, and attractive over the next century. We hope you will stay in touch with our progress by checking in at **www.chicagoclimateaction.org**.

Appendix I

Development and Demonstration of Prioritization Protocol for Adaptation Tactics

MWH identified adaptation tactics through interactive workshops with staff of City of Chicago departments and sister agencies, as well as from global best practices obtained from a library of source data, which were collected and reviewed for viable options. These tactics were evaluated against the expected impacts that have been identified by the Climate Change Impacts Analysis (Hayhoe/Weubbles). An initial list of over 150 adaptation tactics was passed through a series of filters, as follows:

- Each tactic was consolidated to eliminate redundancies and adjacencies; then,
- Each tactic was assessed as to its feasibility; and, finally,
- Each tactic was assessed for its current applicability to the City of Chicago.

The remaining tactics were then prioritized using the capabilities of the prioritization tool used for this project, mPlanner. mPlanner is an MWH-developed, Web-based tool that can be used for data management and features an interactive, menu-driven data entry capability, as well as user-defined prioritization protocols. The tool can also be used to rank and sort data and create color-coded reports. The entire data set developed by MWH in mPlanner has been provided separately to the City of Chicago in MSExcel format.

Prioritization Categories

Each tactic was evaluated against a set of criteria shown in the table below:

Adaptation Tactics – Prioritization Criteria	
Expected Benefits	**Implementation Issues**
Benefit Type	Implementation Cost
Benefit Magnitude	Current Ability to Implement
Benefit Timing	Barriers to Implementation (Gaps)
Mitigation Potential	Project Type (Act, Study, Plan)
Catalytic Potential	Benefit/Cost Ratio

Additional details of each criterion and the metrics used to score the tactics follow:

Expected Benefits

Benefit Type

Assumptions: Benefit of adaptation measure implementation, created as checkboxes so that multiple benefits could be selected. Benefit is likely to be a reduction in expected impact associated with a “business as usual” approach.

Metrics: Value assigned, 1 being most important; Life safety (1), human health (3), prevent significant infrastructure damage (3), prevent major economic disruption (3), uninterrupted city services (4), prevent minor economic impact (7), maintain or increase revenue

(7), reduce costs (7), maintain quality of life (5), ecosystem health (4) and tourism (7).

Benefit Magnitude

Assumptions: Assumes benefit to the City of Chicago at this time over 100-year period.

Metrics: Order-of-magnitude basis approximations, e.g., $10K - $100K, $100K - $1M, etc.

Benefit Timing

Assumptions: Qualitative measurement of when benefits would begin to be realized.

Metrics: Immediate; Near Term - within 10 years; Mid Term - 10 to 30 years; and Long Term - greater than 30 years

Mitigation Potential

Assumptions: Qualitative measurement of how adaptation measure complements (positive) or hinders (negative) actions the City is proposing to lower overall carbon footprint.

Metrics: Highly positive; Slightly positive; Neutral; Slightly negative; Highly negative

Catalytic Potential

Assumptions: Qualitative measurement of the level by which an adaptation measure may promote decisions and actions by others that will reduce the City's risks to climate change.

Metrics: Low; Medium; High

Implementation Issues

Implementation Cost

Assumptions: Assumes additional cost only to the City at this time. Other costs are qualitatively addressed under the topics of Ability to Respond and Gap Types. Costs aggregated over 100-year period.

Metrics: Order-of-magnitude basis approximations, e.g., $10K - $100K, $100K - $1M, etc.

Current Ability to Implement

Assumptions: Qualitative measurement of how well City is poised to implement adaptive measure.

Metrics: High - City is poised to implement adaptive measure; Medium (minor gaps exist); Low (significant gaps exist)

Gap Types

Assumptions: Checklist of areas requiring focus to ensure success of implementation of adaptive measure.

Metrics: Planning, staff positions, funding, high level support, business process, inter-departmental coordination, public support, research, and technology.

Project Type

Assumptions: Method to differentiate between types of recommended adaptation measures.

Metrics: Study (to identify/support future plans and actions); Plan (With intent to perform future actions); Act (action related projects)

Other Data

Other data captured within the database that can be used for further sorting and analysis purposes include:

Climate Impact Data

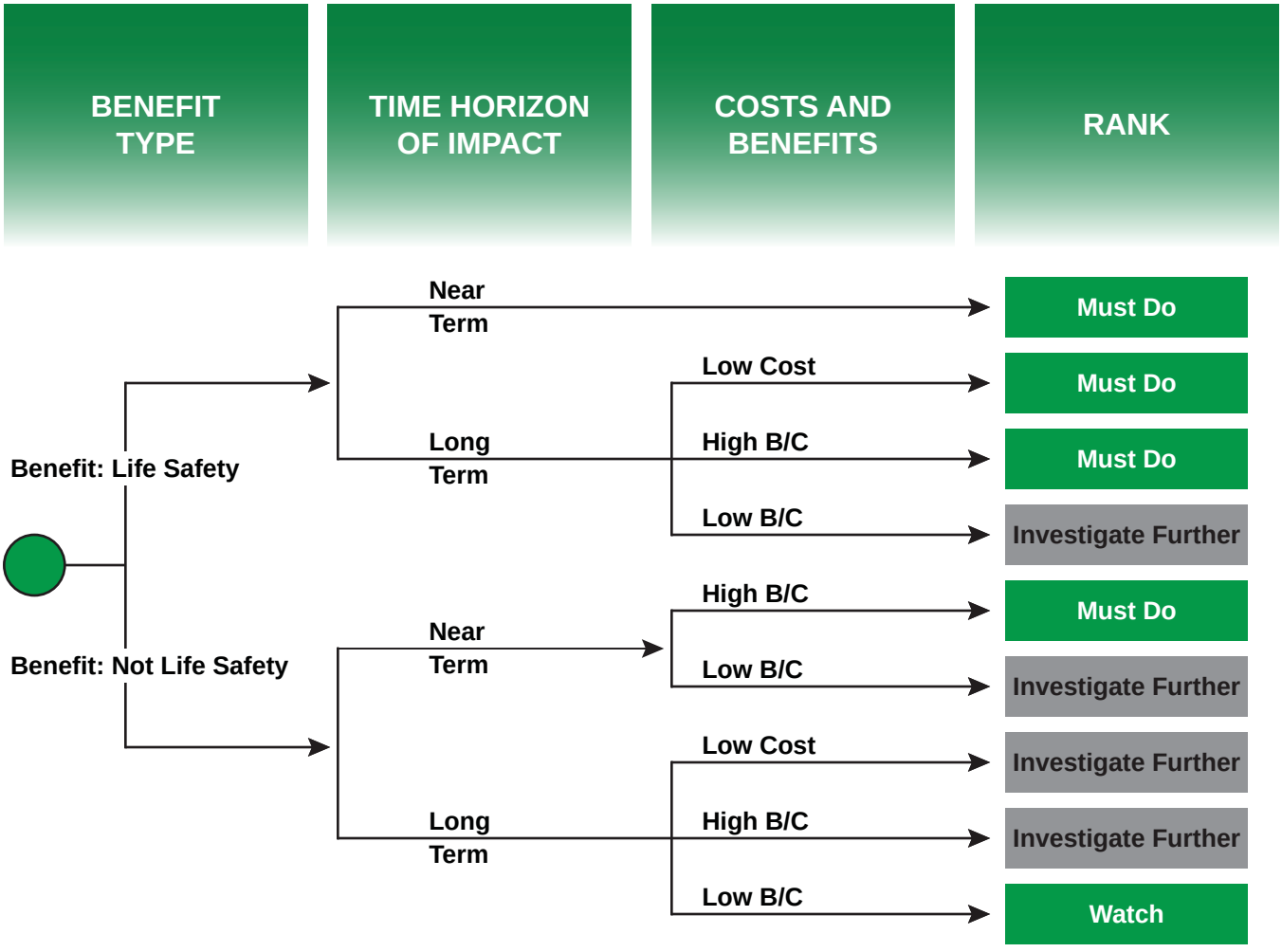
Assumptions: Place to indicate primary climate change prediction or impact that the tactic is designed to combat.

Metrics: Specific climate impacts.

Prioritization protocol

MWH worked with the Department of Environment to develop a preliminary prioritization protocol, based on relative importance of the criteria. The decision tree below shows the criteria of life safety being the primary filter followed by the timing of impact, then followed by benefit to cost ratio. Under this scenario, those adaptation tactics that address human life impacts with the nearest term impacts and greatest benefits and the least cost, would be considered as 'Must Do' tactics.

The titles of 'Must Do,' 'Investigate Further' and 'Watch' are meant to identify the order of recommended implementation according to the ranking assumptions developed in cooperation with the City. Alternatively, titles such as "Tier 1", "Tier 2" and "Tier 3" adap-



tation tactics could be used.

MWH undertook a secondary evaluation in order to identify Early Action Items (i.e., Quick Wins) from those tactics that were designated “Must-Do”. The secondary criteria derived from input from the City were, medium or high ability to respond, total cost less than $1M, and catalytic potential.