B3 Design Approval HF4631

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Minnesota's Climate is Already Changing

Minnesota's climate is already changing rapidly and will continue to do so into the foreseeable future.

These changes are impacting Minnesota's wildlife, plants, waters, historic resources, infrastructure, and available outdoor recreation activities.

We have a responsibility to adapt to these changes.

We take mitigation steps to reduce our carbon dioxide and other greenhouse gas emissions.

We need your help to adapt to the changing climate and reduce its impact on Minnesota's resources and people.

Action starts with you.

Find out more! mndnr.gov/climate

DEPARTMENT OF NATURAL RESOURCES

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13%

increase in the size of the heaviest rainfall of the year.

more damaging CO 20% rains

increase in the number of 1" rains

65% increase in the number of 3" rains

since 2000

widespread rains of more than 6" are 4x more frequent than in the previous three decades.

*

The length of the frost-free season is increasing over time and is expected to continue to increase through the century. Nights have warmed 55% faster than days since 1970.

our climate is becoming Warmer and wetter

Average temperatures in Minnesota have warmed by nearly 3°F since 1895.

The 10 warmest and wettest years on record have all occurred in the past 20 years.

Increases in temperature and precipitation are expected to continue through the century.

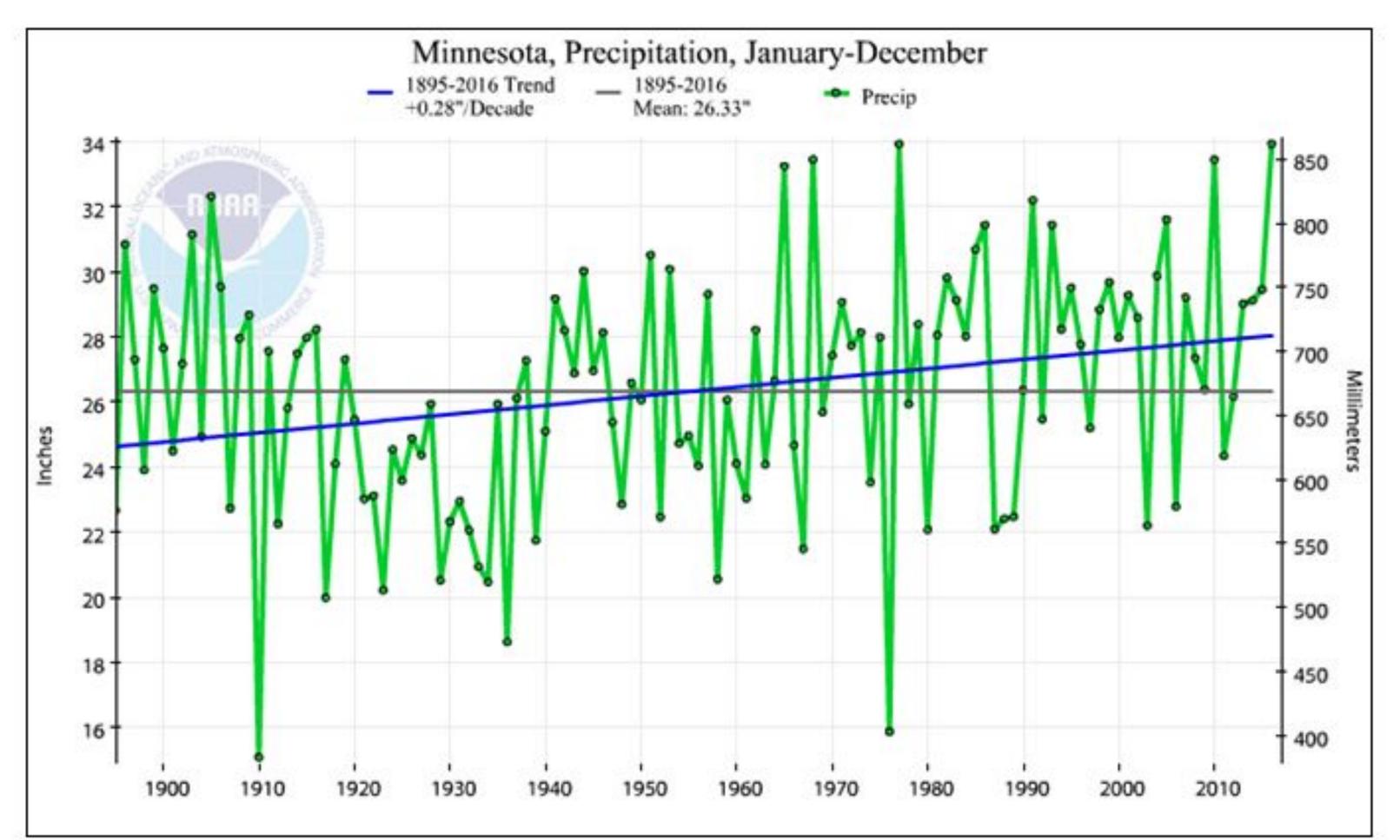
winter is warming

much faster than summer with fewer days and nights of extreme cold.



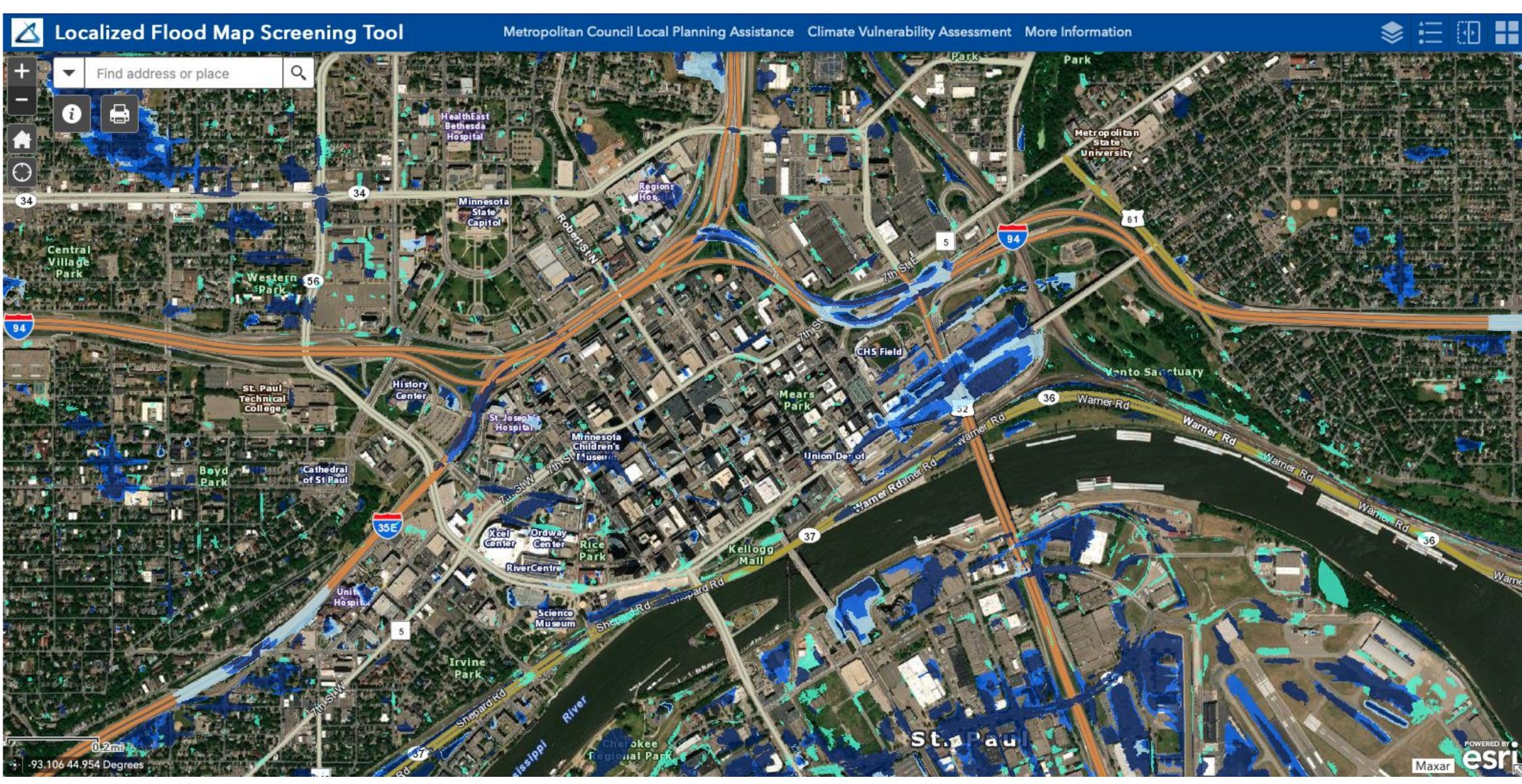
EMR: 507.18

Precipitation has been increasing in Minnesota over the last century, as shown in the Figure below, which illustrates historic annual precipitation, from 1865-2016.



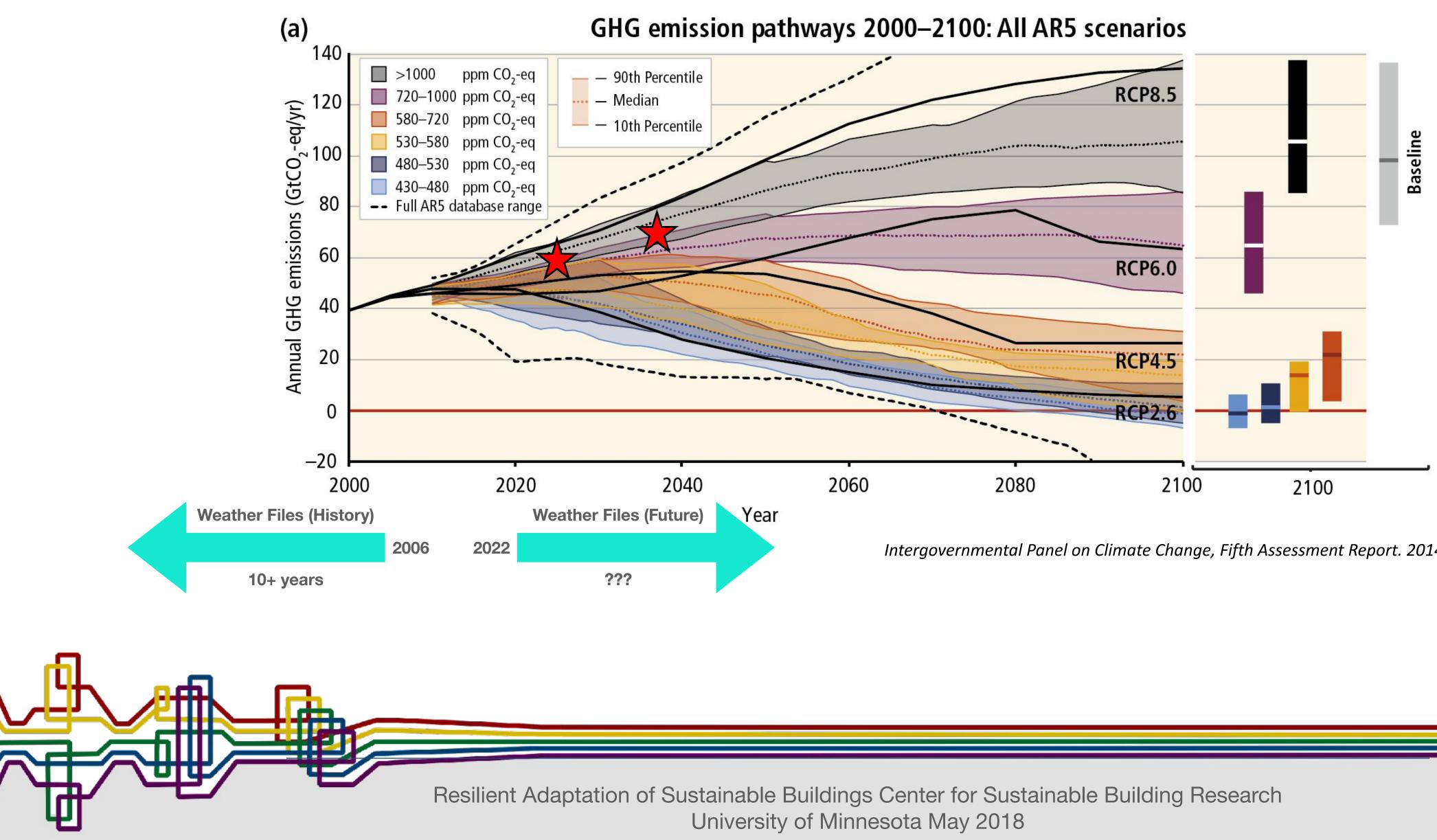
Between 1958 and 2012, the Midwest has already experienced a 37% increase in larger rain events of 2.5 inches or greater.

National Weather Service: https://www.weather.gov/wrh/Climate?wfo=mpx



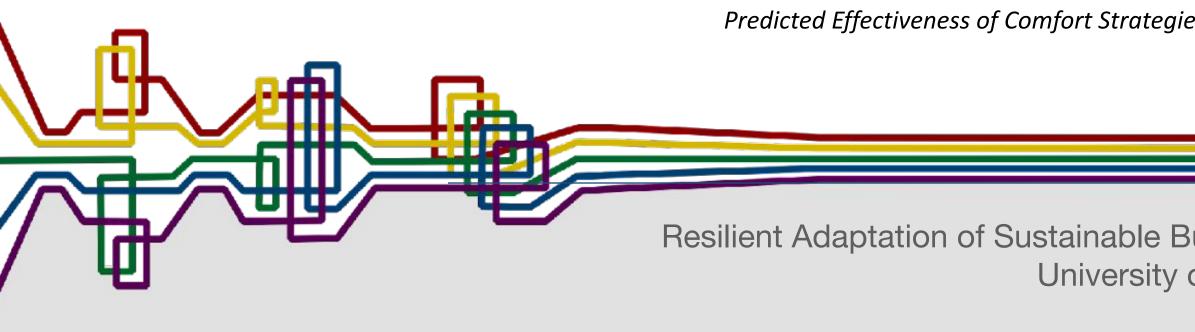
https://metrocouncil.maps.arcgis.com/apps/webappviewer/index.html?id=100fa3012dcc4e288a74cbf4d95027bf





Intergovernmental Panel on Climate Change, Fifth Assessment Report. 2014

Strategy						
Comfort						
Sun Shading of Windows						
High Thermai Wass	t					
High Thermal Mass Night Flushed						
Direct Evaporative Cooling						
Two-Stage Evaporative Cooling						
Natural Ventilation Cooling						
Fan-Forced Ventilation Cooling						
Internal Heat Gain						
Passive Solar Direct Gain Low Mass						
Passive Solar Direct Gain High Mass						
Wind Protection of Outdoor Spaces						
Humidification Only						
Debumidification Only	Τ					
Cooling, add dehumidification if needed						
Heating, add humidification if needed	T					



Hours: Actual and Percentage							
Now		2030		2040			
942	11%	885	10%	936	11%		
586	7%	778	9%	817	9%		
154	۷%	217	2%	240	3%		
154	2%	228	3%	256	3%		
109	1%	179	2%	198	2%		
111	1%	192	2%	216	2%		
104	1%	162	2%	170	2%		
72	1%	104	1%	106	1%		
1589	18%	1353	15%	1361	16%		
899	10%	826	9%	796	9%		
624	7%	559	6%	539	6%		
259	3%	254	3%	249	3%		
0	0%	0	0%	0	0%		
491	6%	659	8%	692	8%		
305	3%	549	6%	604	7%		
4791	55%	4545	52%	4436	51%		

Predicted Effectiveness of Comfort Strategies for Minneapolis / Saint Paul – Climate Consultant, UCLA Energy Design Tools Group

Needed Research

- Apply new and emerging downscaled climate data to minnesota
- Model the impact of changing climate on energy efficiency and design
- Understand the impact of changing climate on site and water design to increase resilience
- Assess additional risks and impacts and develop the role infrastructure can play to reduce those impacts



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