RESILIENCY

RISK MANAGEMENT BY DESIGN

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LIKELIHOOD
SEVERITY
IMPACT
ASSESS
RISKS
PLAN
& IMPLEMENT
RESILIENT STRATEGIES
FORECAST
RISKS

Recent Earthquakes Near Northern California

Sorted: Recent | Filter By Magnitude | Nearby Places

Northern California has had: *(M1.5 or greater)*

9 earthquakes in the past 24 hours
71 earthquakes in the past 7 days
318 earthquakes in the past 30 days
3,879 earthquakes in the past 365 days

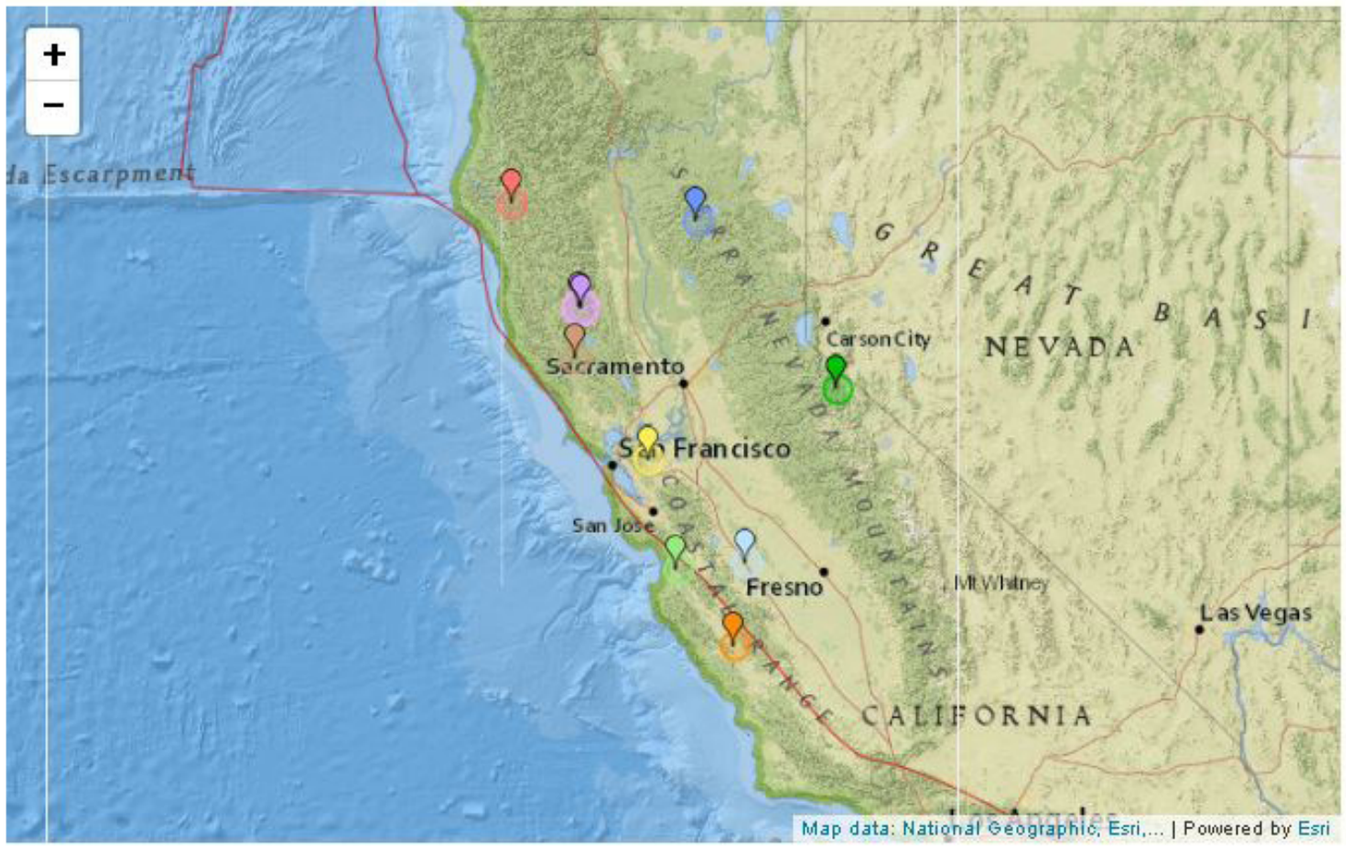
The largest earthquake in Northern California:

today: 3.0 in Upper Lake, California, United States
this week: 4.0 in Cobb, California, United States
this month: 4.0 in Cobb, California, United States
this year: 5.7 in Hawthorne, Nevada, United States

California
Earthquake Alerts via Twitter:

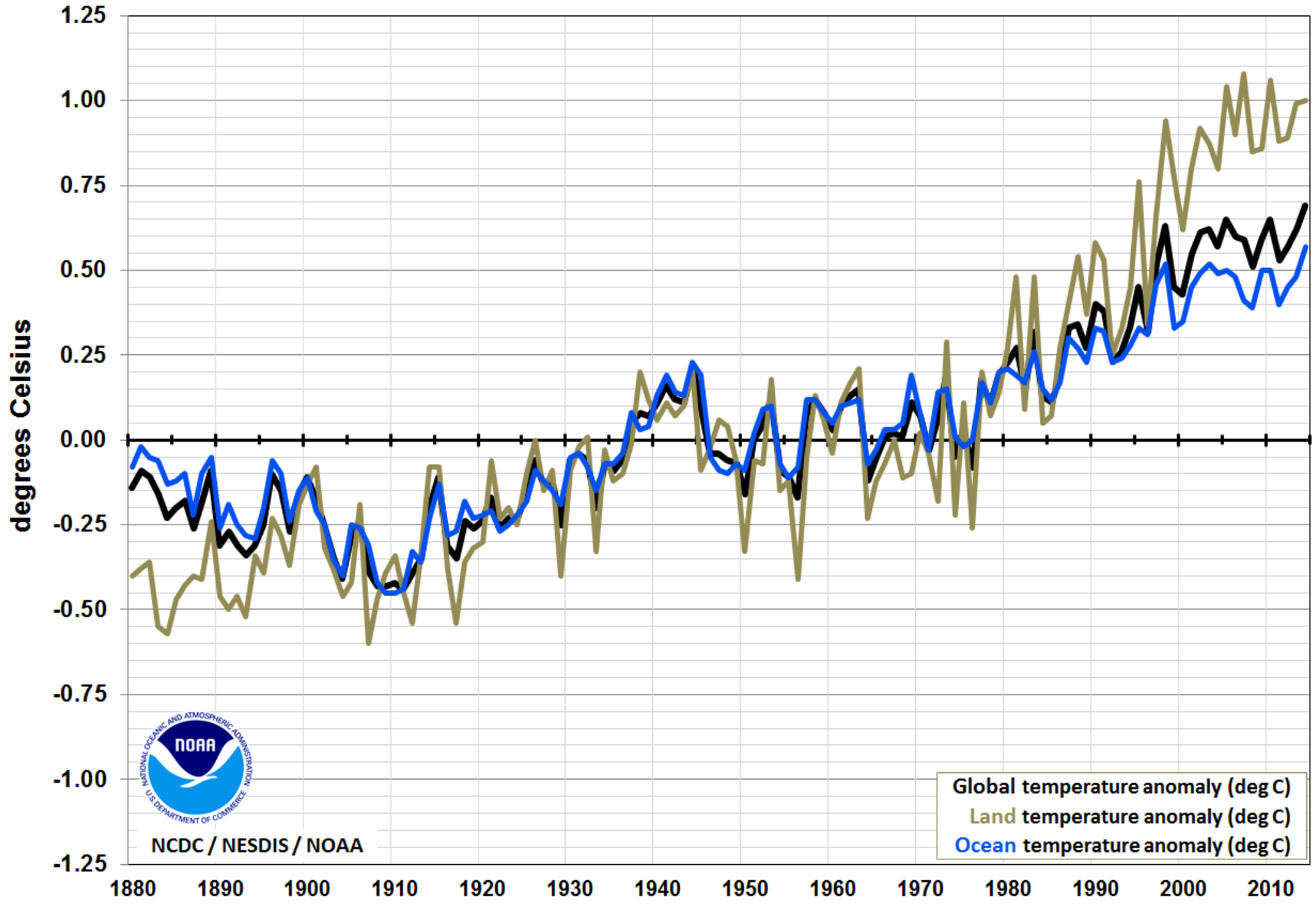
Follow @QuakesInCA

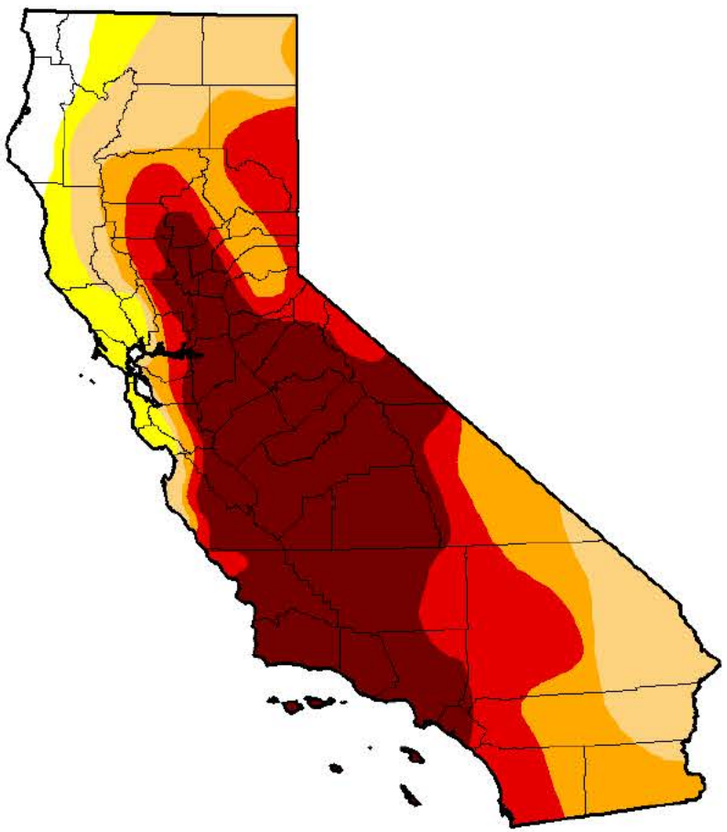
Sorted: Recent | Filter By Magnitude | Nearby Places



- about an hour ago 1.8 magnitude, 8 km depth
  Lake Nacimiento, California, United States
- about an hour ago 2.1 magnitude, 9 km depth
  Diablo, California, United States
- about 3 hours ago 1.5 magnitude, 1 km depth
  Prunedale, California, United States
- about 5 hours ago 1.5 magnitude, 0 km depth
  Smith Valley, Nevada, United States
- about 5 hours ago 2.0 magnitude, 9 km depth
  Chester, California, United States
- about 7 hours ago 2.0 magnitude, 7 km depth
  Upper Lake, California, United States
- about 7 hours ago 3.0 magnitude, 7 km depth
  Upper Lake, California, United States
- about 17 hours ago 1.7 magnitude, 5 km depth
  South Dos Palos, California, United States
- about 18 hours ago 1.8 magnitude, 2 km depth
  Cobb, California, United States
- a day ago 2.0 magnitude, 26 km depth
  Redway, California, United States

Annual Global Temperature (Land, Ocean, and Combined)





FORECASTING RISKS
Climate

mechanical engineers
ASHRAE design data, weather files in .epw and .tmy format (1990-2005)

civil engineers
'Technical Paper' TP-40 (1960s), Atlas 14

structural engineers
Structural Design Guideline Manuals

PROJECT TEAM

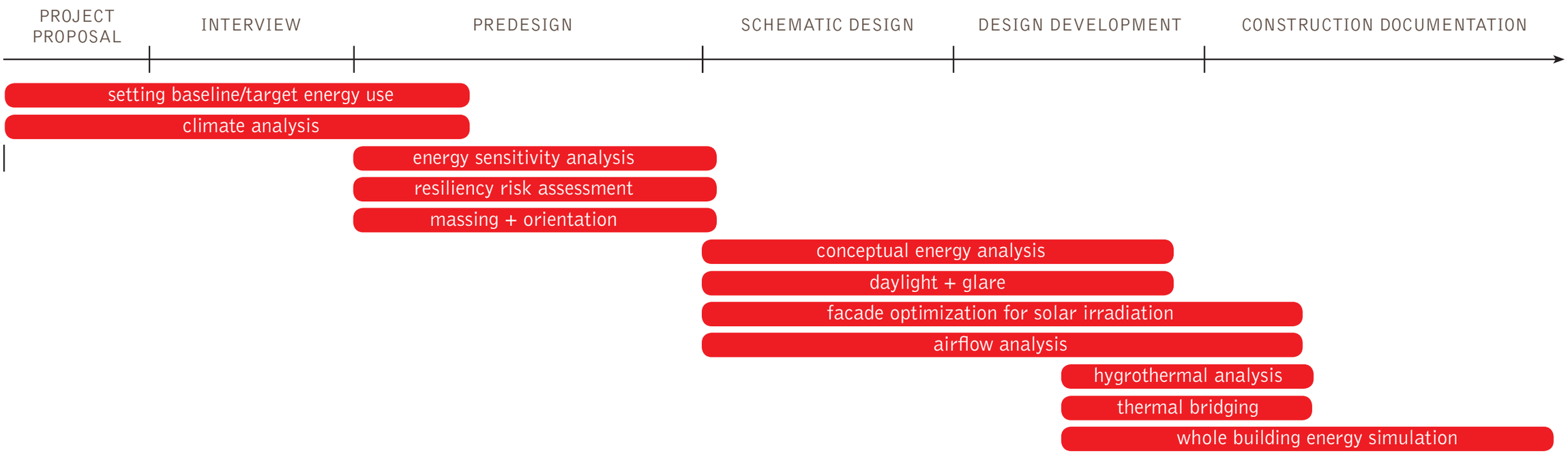
interior architects

lighting designers
Perez All-Weather Sky Model (Energy Plus weather files)

architects
weather files in .epw and .tmy format (1990-2005) (Dept. of Energy)

landscape architects
National Weather Service (historical data), FEMA, irrigation company data

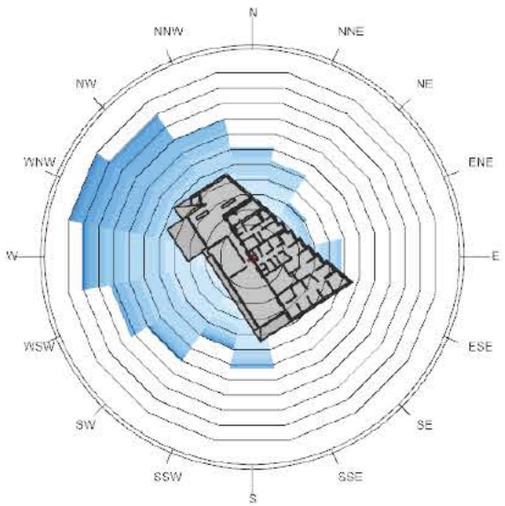
USING WEATHER DATA IN DESIGN

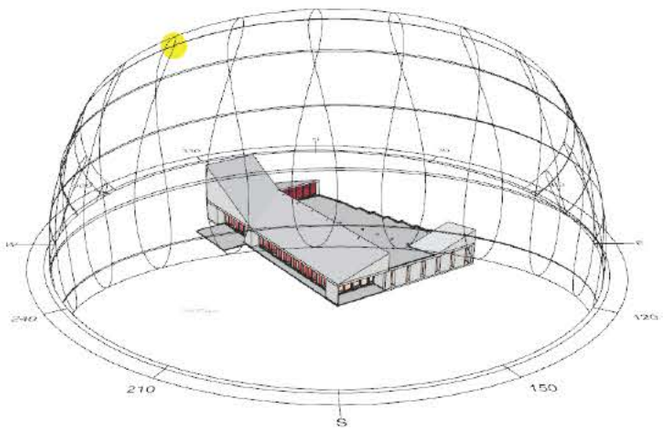


UNDERSTANDING PLACE & SITE

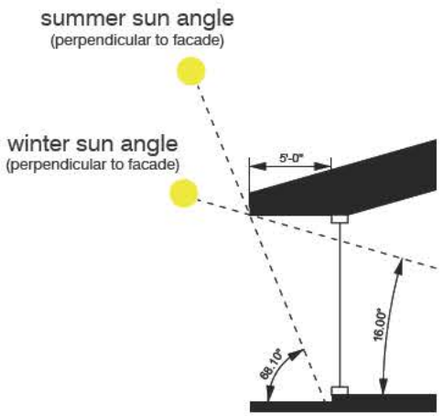
PROJECT PROPOSAL | INTERVIEW | PREDESIGN | SCHEMATIC DESIGN | DESIGN DEVELOPMENT | CONSTRUCTION DOCUMENTATION

- setting baseline/target energy use
- climate analysis
- energy sensitivity analysis
- resiliency risk assessment
- massing + orientation
- conceptual energy analysis
- daylight + glare
- facade optimization for solar irradiation
- airflow analysis
- hygrothermal analysis
- thermal bridging
- whole building energy simulation





Sun-Path Diagram - Latitude: 42.18
21 JUL 14:00, ALT = 55.16, AZM = 241.07



BUILDING FORM & ORIENTATION

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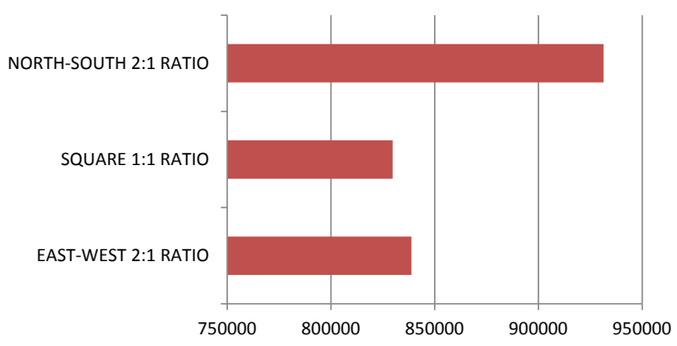
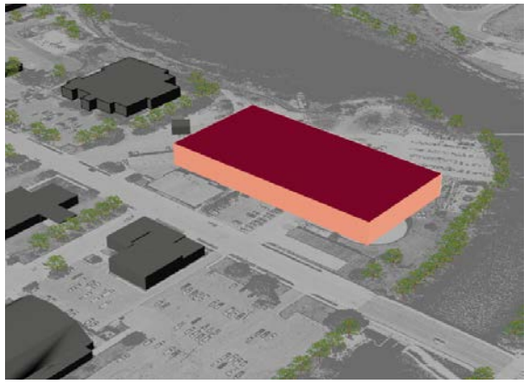
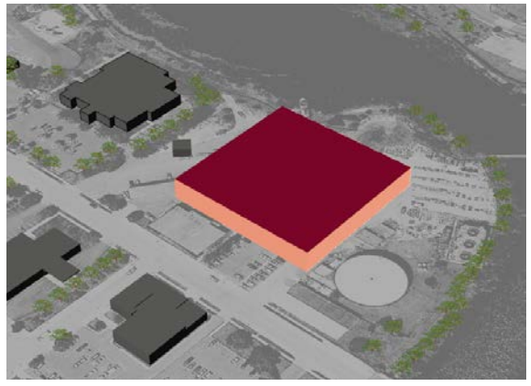
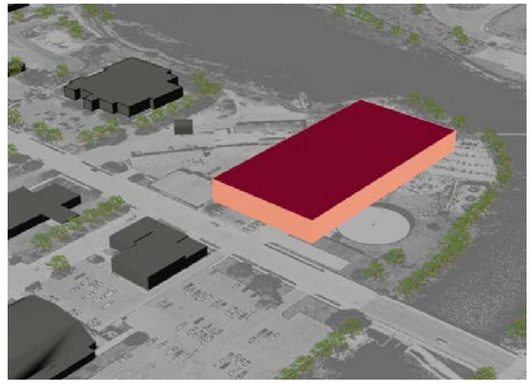




EAST-WEST MASSING



SQUARE MASSING



NORTH-SOUTH MASSING

ONGOING ENERGY ANALYSIS

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- thermal bridging
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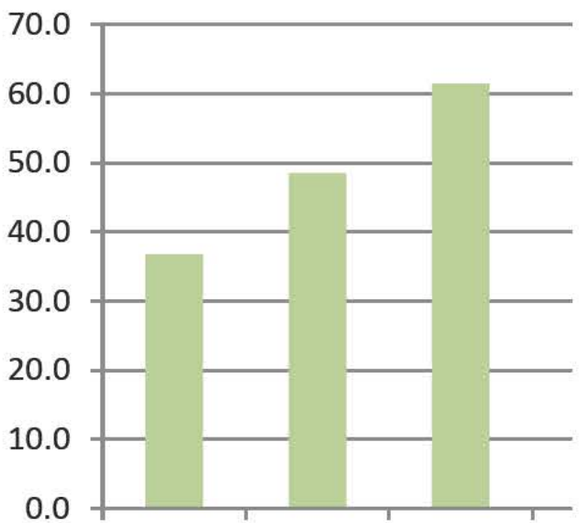
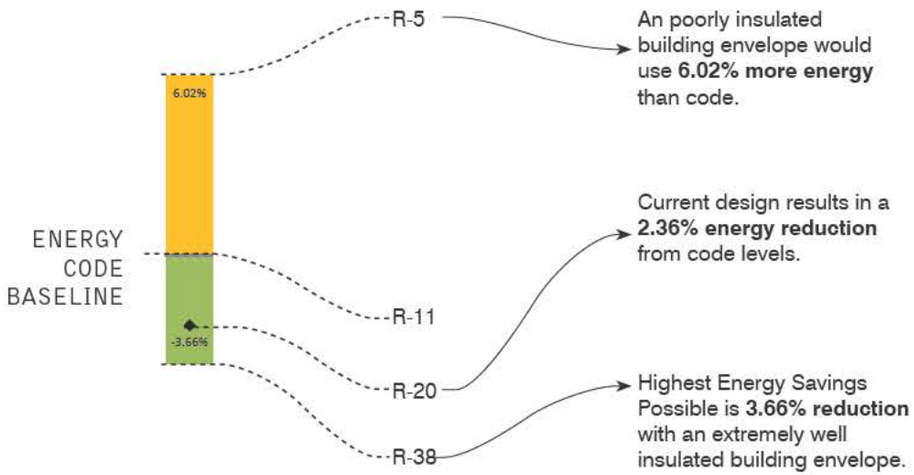
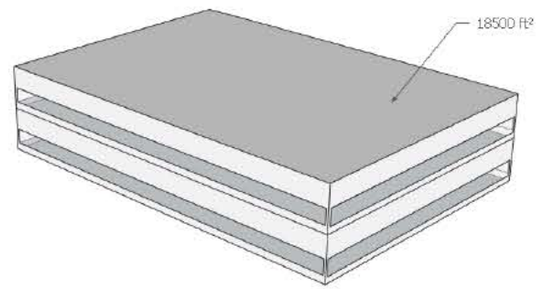


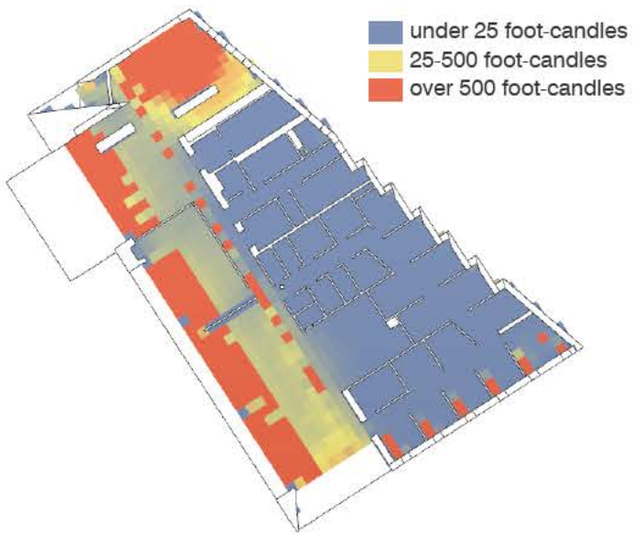


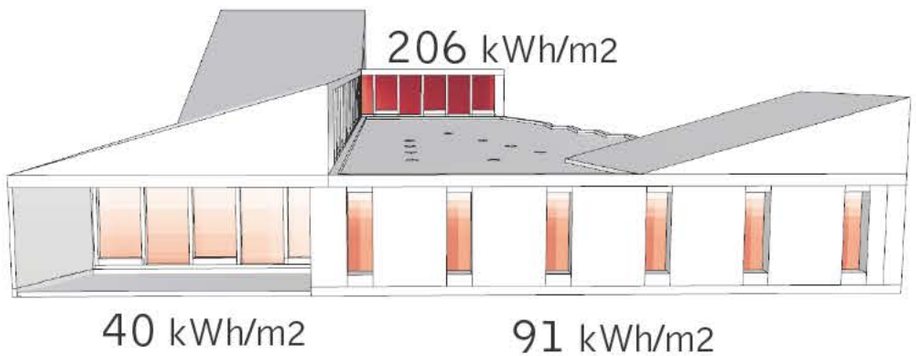


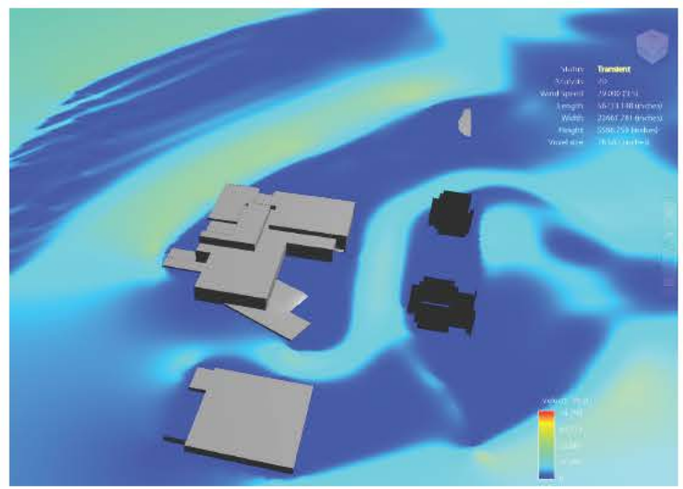
SPECIFIC COMPONENT ANALYSIS

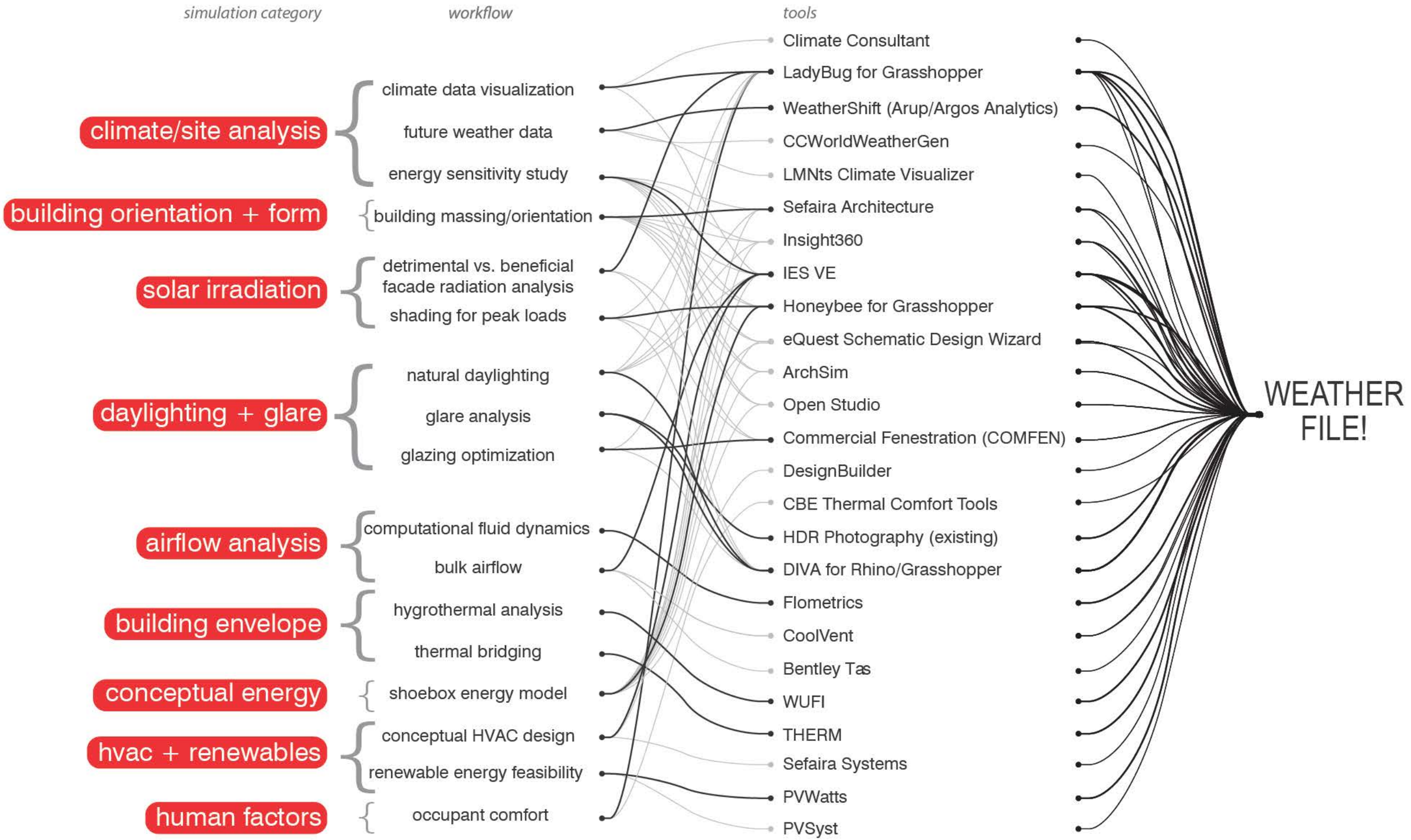
PROJECT PROPOSAL | INTERVIEW | PREDESIGN | SCHEMATIC DESIGN | DESIGN DEVELOPMENT | CONSTRUCTION DOCUMENTATION

- setting baseline/target energy use
- climate analysis
- energy sensitivity analysis
- resiliency risk assessment
- massing + orientation
- conceptual energy analysis
- daylight + glare
- facade optimization for solar irradiation
- airflow analysis
- hygrothermal analysis
- thermal bridging
- whole building energy simulation

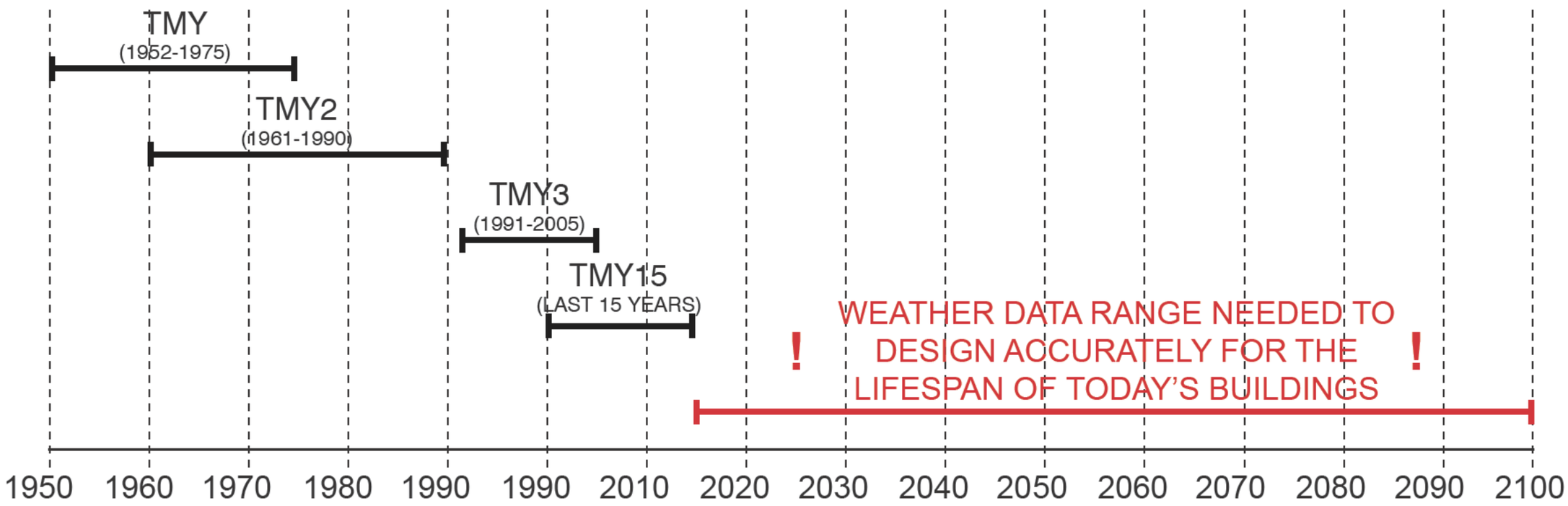




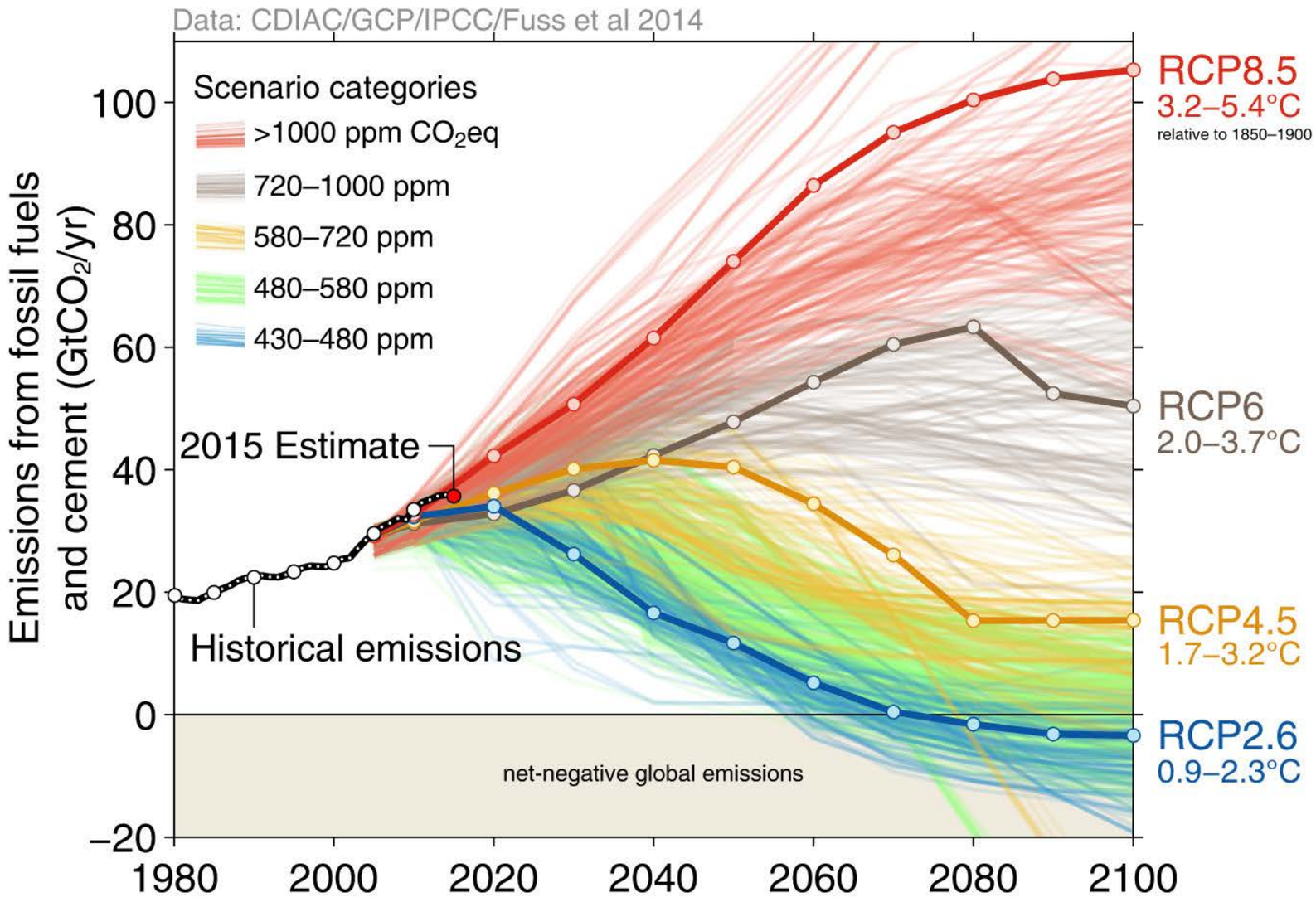



simulation category
workflow
tools
climate/site analysis
climate data visualization
future weather data
energy sensitivity study
building orientation + form
building massing/orientation
solar irradiation
detrimental vs. beneficial facade radiation analysis
shading for peak loads
daylighting + glare
natural daylighting
glare analysis
glazing optimization
airflow analysis
computational fluid dynamics
bulk airflow
building envelope
hygrothermal analysis
thermal bridging
conceptual energy
shoebox energy model
hvac + renewables
conceptual HVAC design
renewable energy feasibility
human factors
occupant comfort
Climate Consultant
LadyBug for Grasshopper
WeatherShift (Arup/Argos Analytics)
CCWorldWeatherGen
LMNts Climate Visualizer
Sefaira Architecture
Insight360
IES VE
Honeybee for Grasshopper
eQuest Schematic Design Wizard
ArchSim
Open Studio
Commercial Fenestration (COMFEN)
DesignBuilder
CBE Thermal Comfort Tools
HDR Photography (existing)
DIVA for Rhino/Grasshopper
Flometrics
CoolVent
Bentley Tas
WUFI
THERM
Sefaira Systems
PVWatts
PVSyst
WEATHER FILE!

CURRENT WEATHER DATA



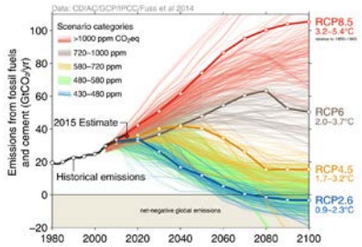
‘FUTURE’ WEATHER DATA



‘FUTURE’ DATA FORMATS FOR DESIGNERS

Free Downloadable EPW files from EnergyPlus + Climate Change World Weather Generator

+



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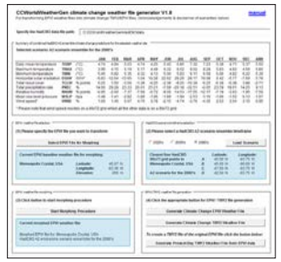


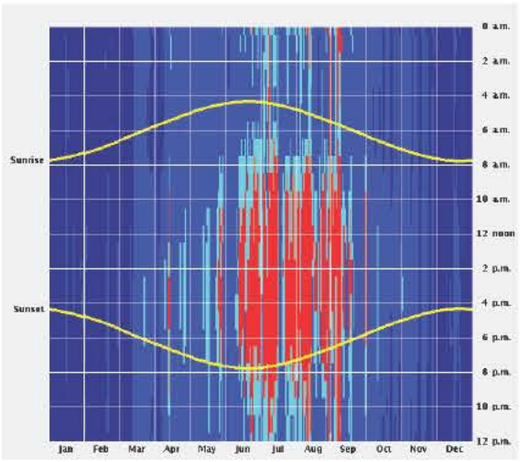
ARUP - WeatherShift

42 packaged weather files for a single location, representing 2 Representative Concentration Pathways

Custom Research Methodologies

seventhwave

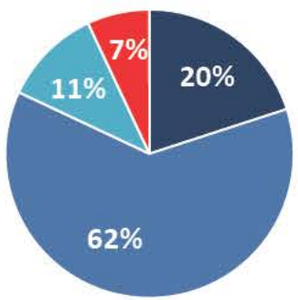
Flexibility with data chosen and metholodogy.

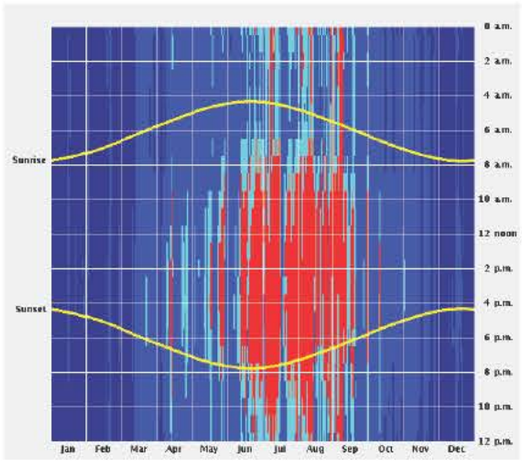


Current

DRY BULB TEMP
(degrees F)

28%	< 32	
52%	32	68
10%	68	75
10%	75	100
0%	> 100	

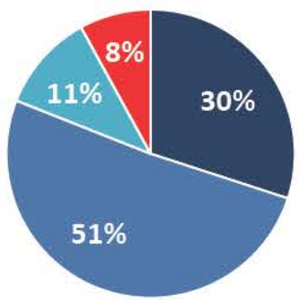


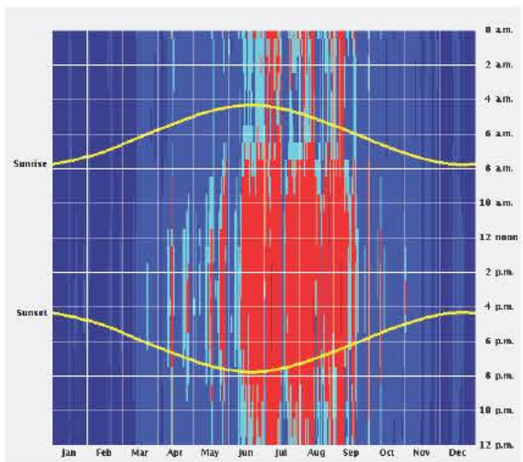


Future - 'Cold'

DRY BULB TEMP
(degrees F)

27%	< 32	
48%	32	68
11%	68	75
14%	75	100
0%	> 100	

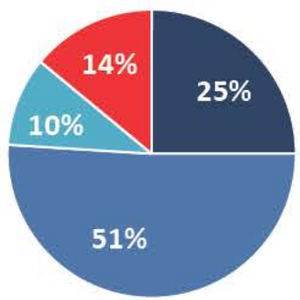


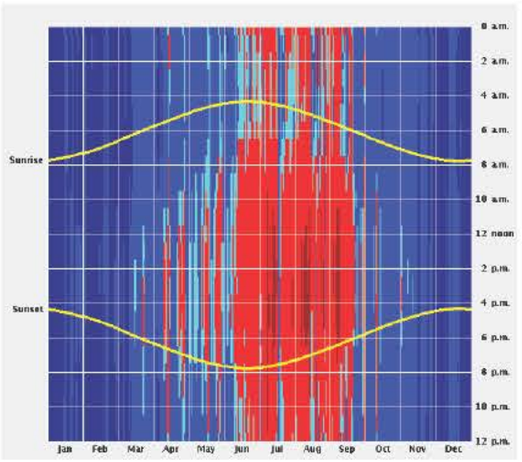


Future - 'Mid'

DRY BULB TEMP
(degrees F)

25%	< 32	
46%	32	68
10%	68	75
18%	75	100
0%	> 100	

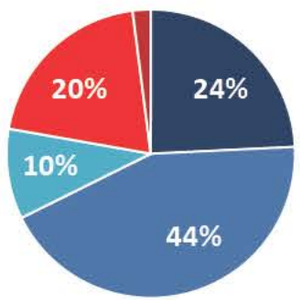




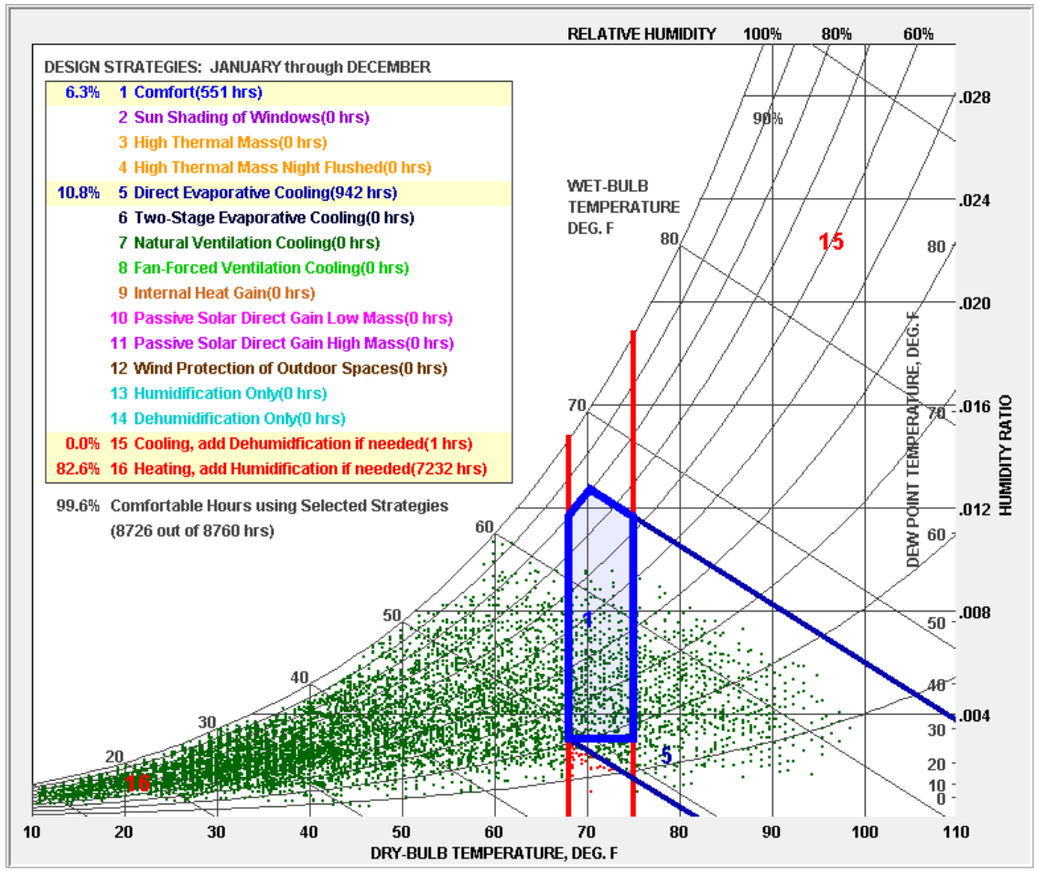
Future - 'Hot'

DRY BULB TEMP
(degrees F)

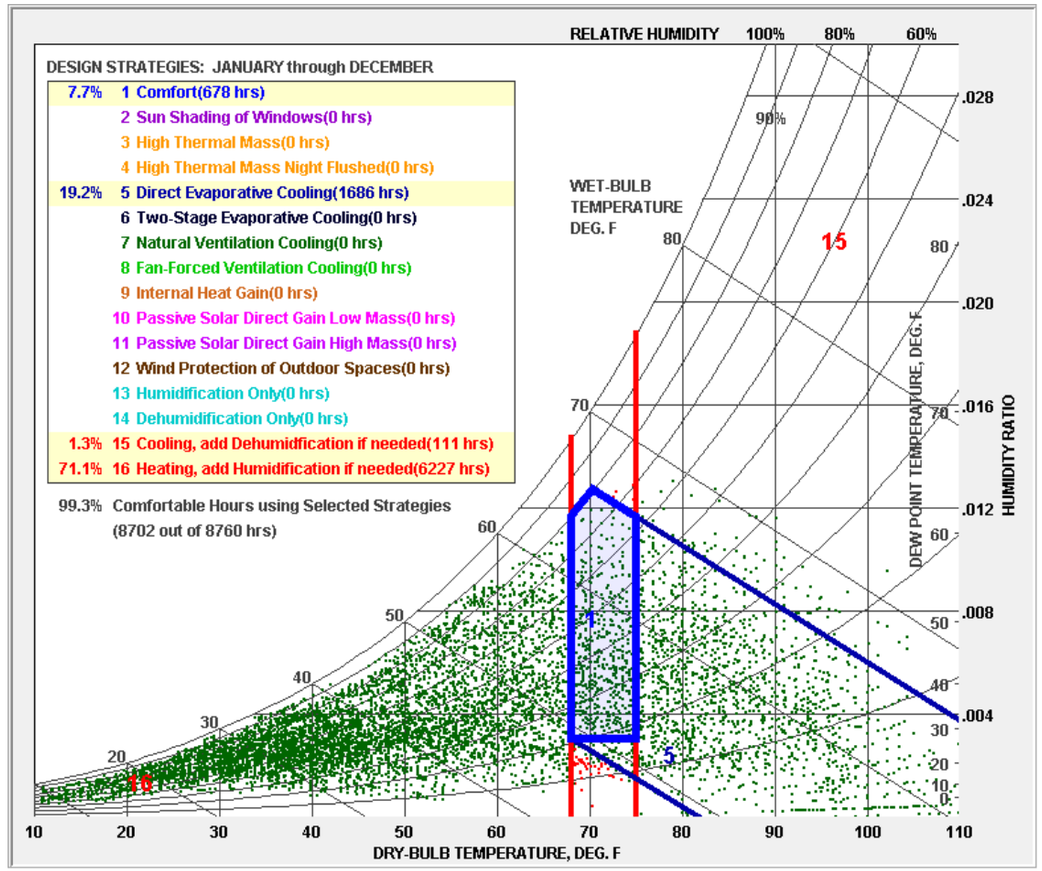
23%	< 32	
44%	32	68
9%	68	75
23%	75	100
2%	> 100	



Casper, WY ‘Today’



Casper, WY - 2080’s



ASSESSING RISKS
Resilience Assessment Tool

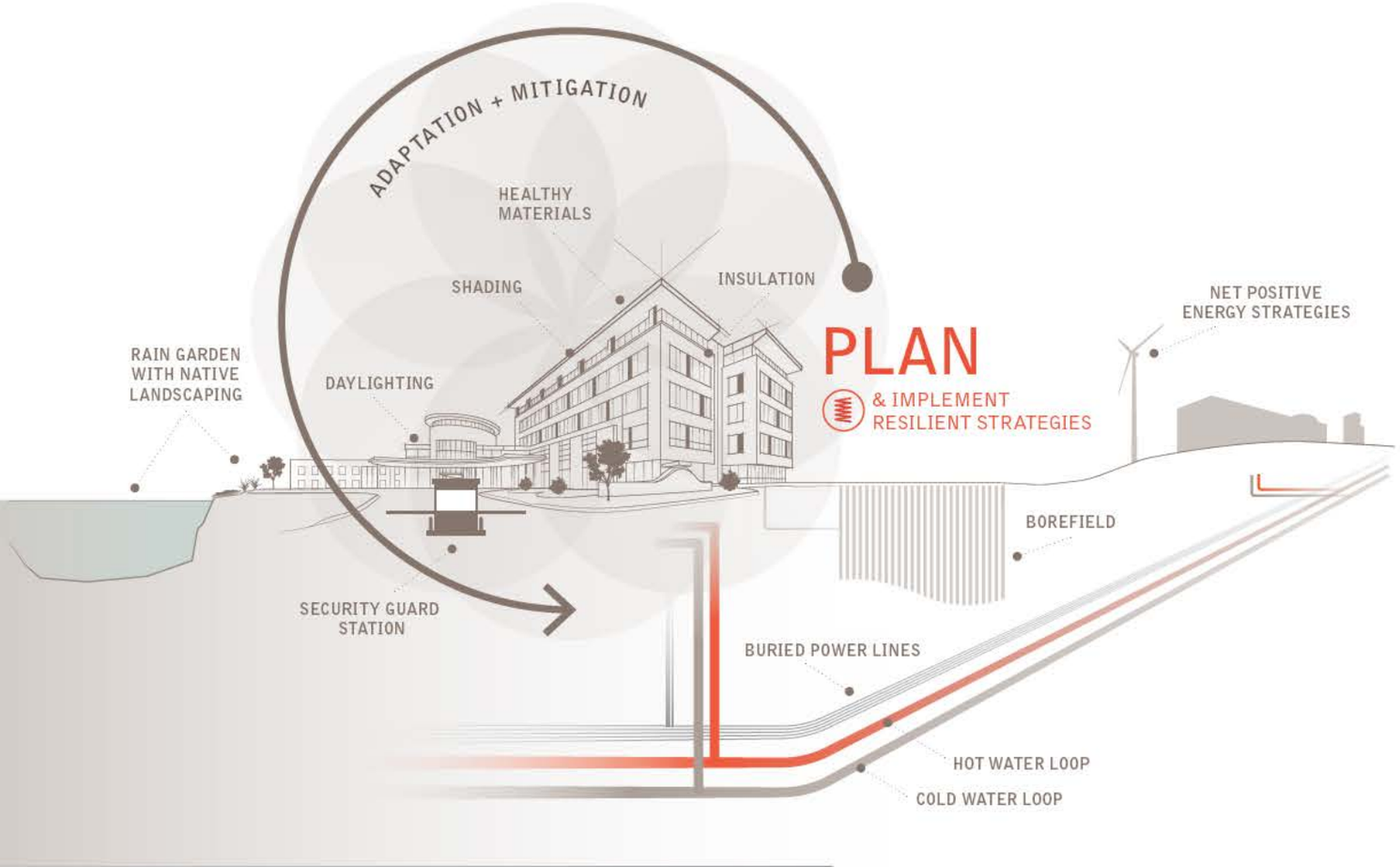
RESILIENCE ASSESSMENT TOOL

RISK		LIKELIHOOD	SEVERITY = (MAGNITUDE - MITIGATION)						RISK
			HUMAN IMPACT	PROPERTY IMPACT	BUSINESS IMPACT	PREPARED-NESS	INTERNAL RESPONSE	EXTERNAL RESPONSE	
		Probability this will occur	*Possibility of death or injury*	*Physical losses and damages*	*Interuption of services*	*Preplanning*	*Time, effectivness, resouces*	*Community/ Mutual Aid staff and supplies*	**Relative threat***
		1 = Low 2 = Moderate 3 = High	*1 = Low 2 = Moderate 3 = High*	*1 = Low 2 = Moderate 3 = High*	*1 = Low 2 = Moderate 3 = High*	*3 = Low 2 = Moderate 1 = High*	*3 = Low 2 = Moderate 1 = High*	*3 = Low 2 = Moderate 1 = High*	**0 - 100%**
CLIMATE	Increased Precipitation	Low	Low	Low	Low	High	High	High	33%
	Temperature Extremes	Low	Moderate	Low	Moderate	Low	Low	High	62%
	Drought	High	Moderate	Moderate	Moderate	Moderate	Low	Low	81%
	Sea Level Rise	High	High	High	High	Low	Low	Moderate	95%
NATURAL DISASTER	Tornado								
	Extreme Winter Storm								
	Flooding								
	Heat Wave								
	Wild fire								
	Severe Thunderstorm								
INFRASTRUCTURE	Power Failure								
	Communications Failure								
	Water								
	Sewer								
	Natural Gas								
	Power Quality								
SECURITY	Bomb Threat								
	Active Shooter								
	Theft								

RESILIENCE ASSESSMENT TOOL

RISK		LIKELIHOOD	SEVERITY = (MAGNITUDE - MITIGATION)						RISK
			HUMAN IMPACT	PROPERTY IMPACT	BUSINESS IMPACT	PREPARED-NESS	INTERNAL RESPONSE	EXTERNAL RESPONSE	
		Probability this will occur	*Possibility of death or injury*	*Physical losses and damages*	*Interuption of services*	*Preplanning*	*Time, effectivness, resouces*	*Community/ Mutual Aid staff and supplies*	**Relative threat***
		1 = Low *2 = Moderate* *3 = High*	*1 = Low* *2 = Moderate* *3 = High*	*1 = Low* *2 = Moderate* *3 = High*	*1 = Low* *2 = Moderate* *3 = High*	*3 = Low* *2 = Moderate* *1 = High*	*3 = Low* *2 = Moderate* *1 = High*	*3 = Low* *2 = Moderate* *1 = High*	**0 - 100%**
CLIMATE	Increased Precipitation	Low	Low	Low	Low	High	High	High	**33%**
	Temperature Extremes	Low	Moderate	Low	Moderate	Low	Low	High	**62%**
	Drought	High	Moderate	Moderate	Moderate	Moderate	Low	Low	**81%**
	Sea Level Rise	High	High	High	High	Low	Low	Moderate	**95%**

...WE HAVE ONLY JUST BEGUN



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