

# The Potential of Cloud Computing in Sustainability and Resiliency

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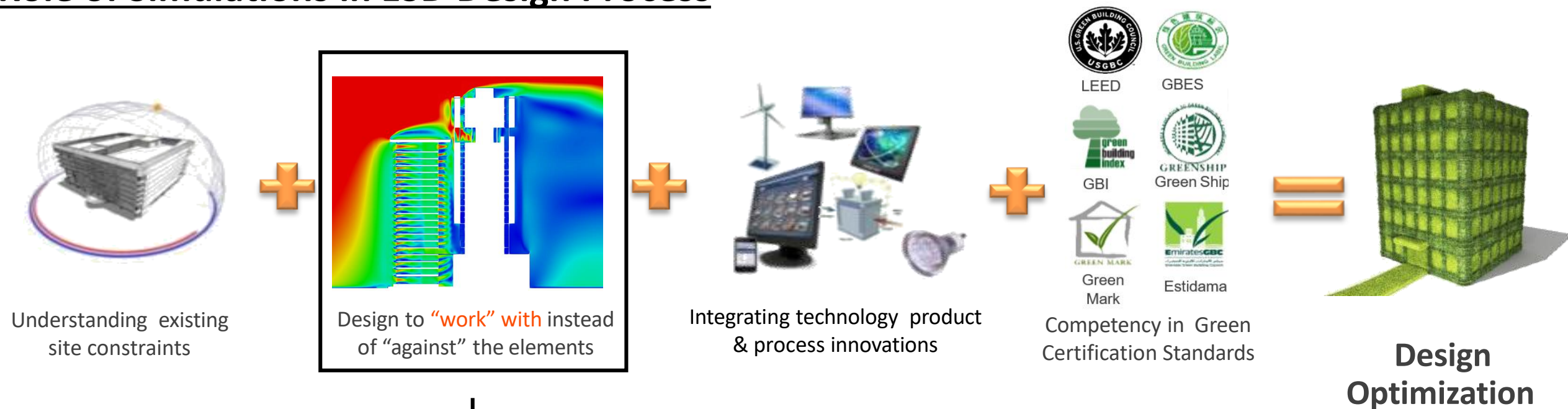
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**5 Mar 2021**

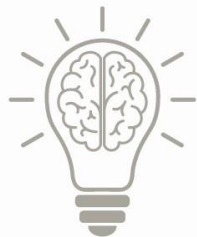
# Role of Simulations in ESD Design Process



- Derive a **climate responsive design** that will use lesser energy and natural resources.



- Explore Potential **Innovative** Solutions



- Saving more **time** compare to conventional design process



- Create **Holistic** Sustainability – Stake holder engagement

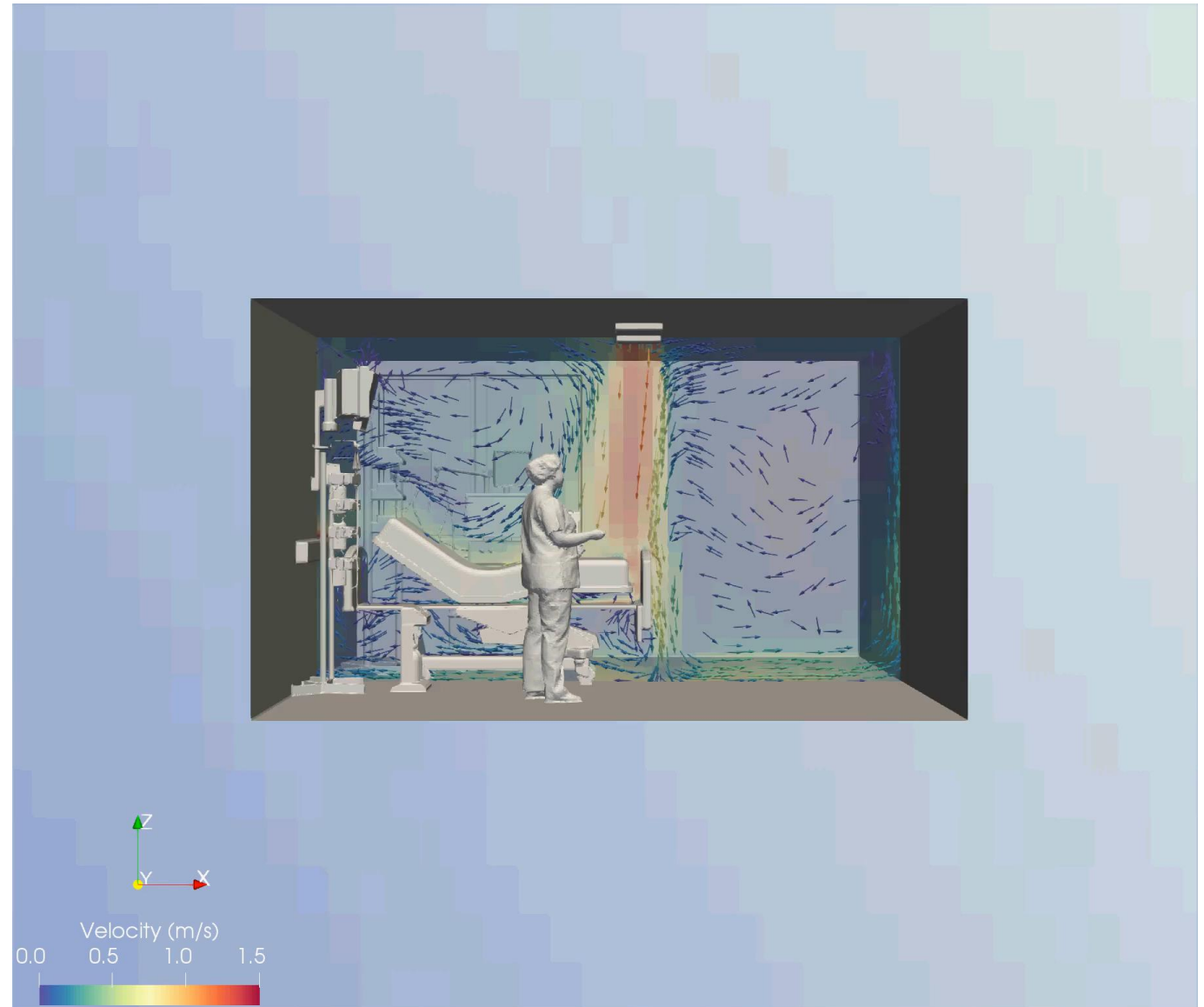
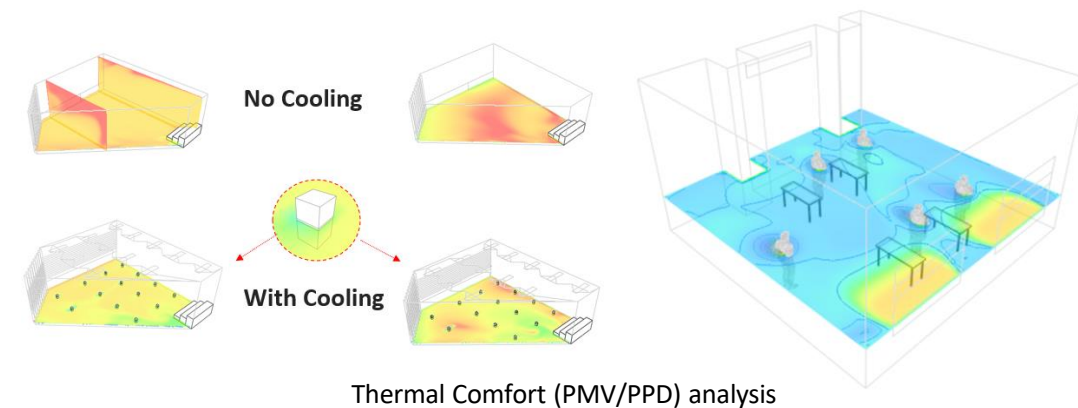




# Types of Simulation

## 1) Computational Fluid Dynamic (CFD) Analysis

- Haze / Pandemic Simulation
- Wind Driven Rain
- Floods
- Thermal Comfort (PMV/PPD)
- External / Internal Wind Flow & Pressure



# Types of Simulation

## 2) Energy Benchmarking

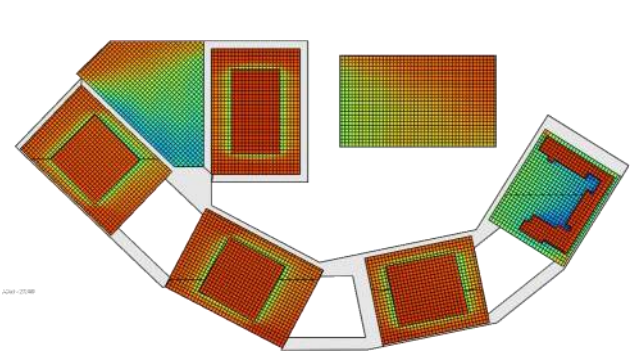
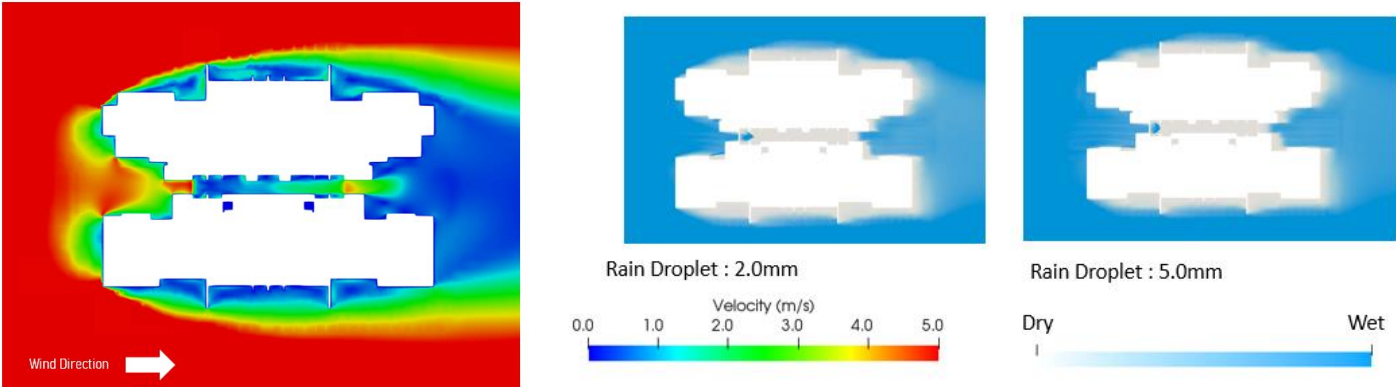
- Energy Benchmarking
- Passive Design Strategies
- Energy Audit
- Performance Based ETTV

## 3) Daylighting and Glare Analysis

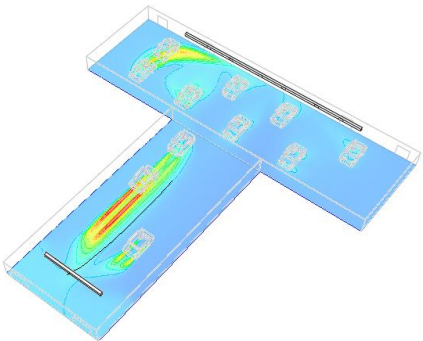
- Daylight / Solar Rays
- Glare

## 4) Solar and Shadow Analysis

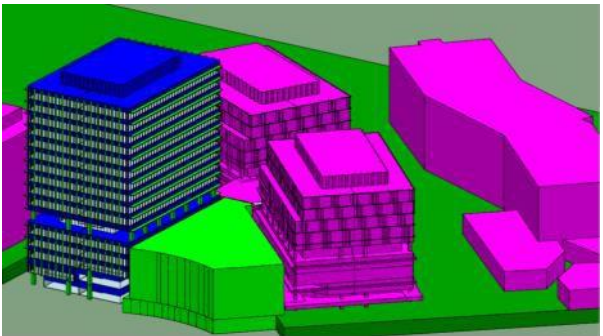
- Sun Path / Shadow Range / Shading Devices
- Solar Exposure / Solar Radiation
- PAR



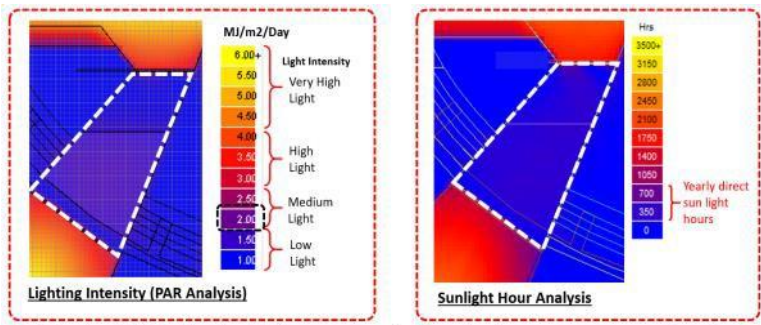
Solar Insolation



Carpark Ventilation



Performance based ETTV Simulation



Note: The above light intensity and sunlight hours are measured at ground level

PAR Simulation

# Cloud Computing

vs

# High Performance Cloud Computing

## 1) Require Strong Computing Power



- Complicated geometry and high LOD meshing might take days to finish
- Normal desktops might not handle the task and crashed, which leads to abortive work and more man-hrs

## 1) Flexible Computing Power

Write interval	1000	<p>Selecting more processor cores will speed up the simulation process. Choosing a smaller computation instance will save core hours.</p> <p><a href="#">in more.</a></p>
Number of processors <span>PRO</span>	Automatic (up to 16)	
Maximum runtime	Automatic (up to 16)	
Decompose algorithm	1 Cores	
	2 Cores	
	4 Cores	
	8 Cores	
	16 Cores	
	32 Cores	
	64 Cores	
	96 Cores	

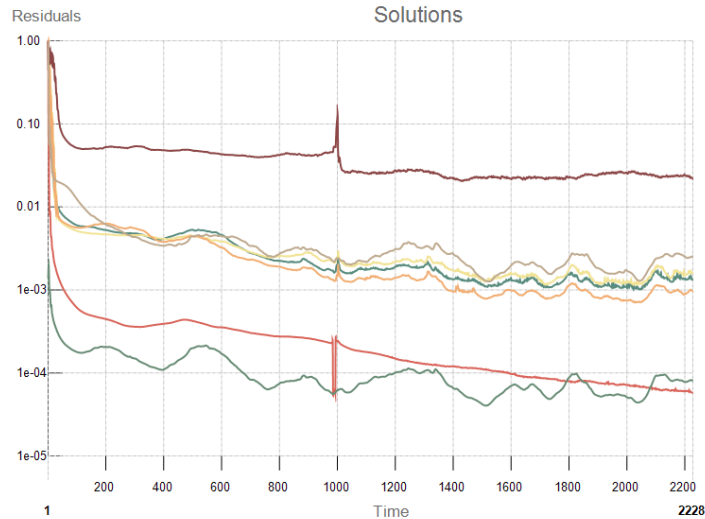
- Able to choose the most suitable computing power based on the complexity
- Offers stronger computing power than conventional PC

# Cloud Computing

vs

# High Performance Cloud Computing











## 2) Multi-tasking



- Simulations can be done in parallel
- System can be turned off once the project is uploaded to the cloud
- Testing different scenarios becomes easier

## 2) Complex Multi-tasking

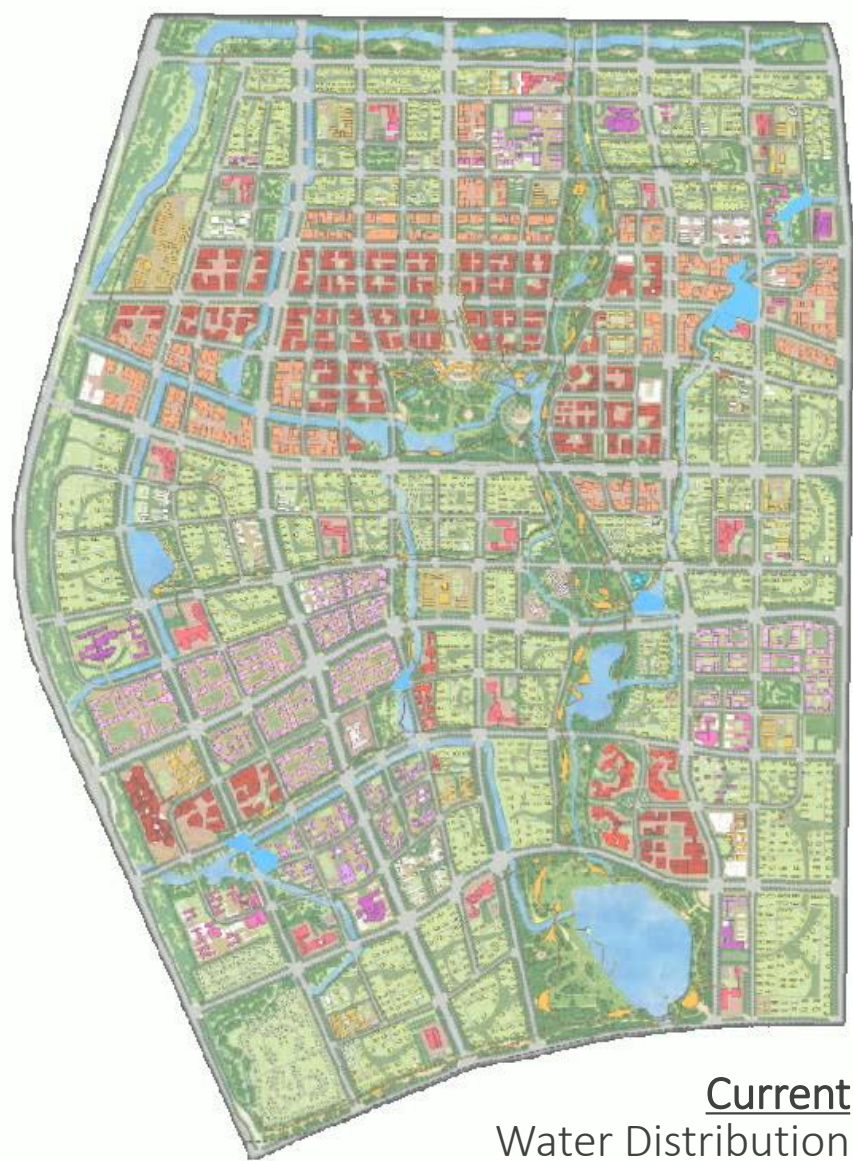
### My Latest Jobs

	<b>Sprint - spot cooling</b> Simulation 64 min - 34.7 CPUh		<b>Sprint - spot cooling</b> Simulation 33 min - 18.1 CPUh
	<b>Sprint - spot cooling</b> Simulation 64 min - 34.7 CPUh		<b>Sprint - spot cooling</b> Mesh operation 26 min - 13.9 CPUh
	<b>Sprint - spot cooling</b> Simulation 53 min - 28.3 CPUh		<b>Sprint - spot cooling</b> Mesh operation 9 min - 0.7 CPUh
	<b>Sprint - spot cooling</b> Simulation 45 min - 24.0 CPUh		<b>Sprint - spot cooling</b> Geometry operation 0 min - 0.0 CPUh
	<b>Sprint - spot cooling</b> Simulation 47 min - 25.6 CPUh		<b>Sprint - spot cooling</b> Geometry operation 0 min - 0.0 CPUh

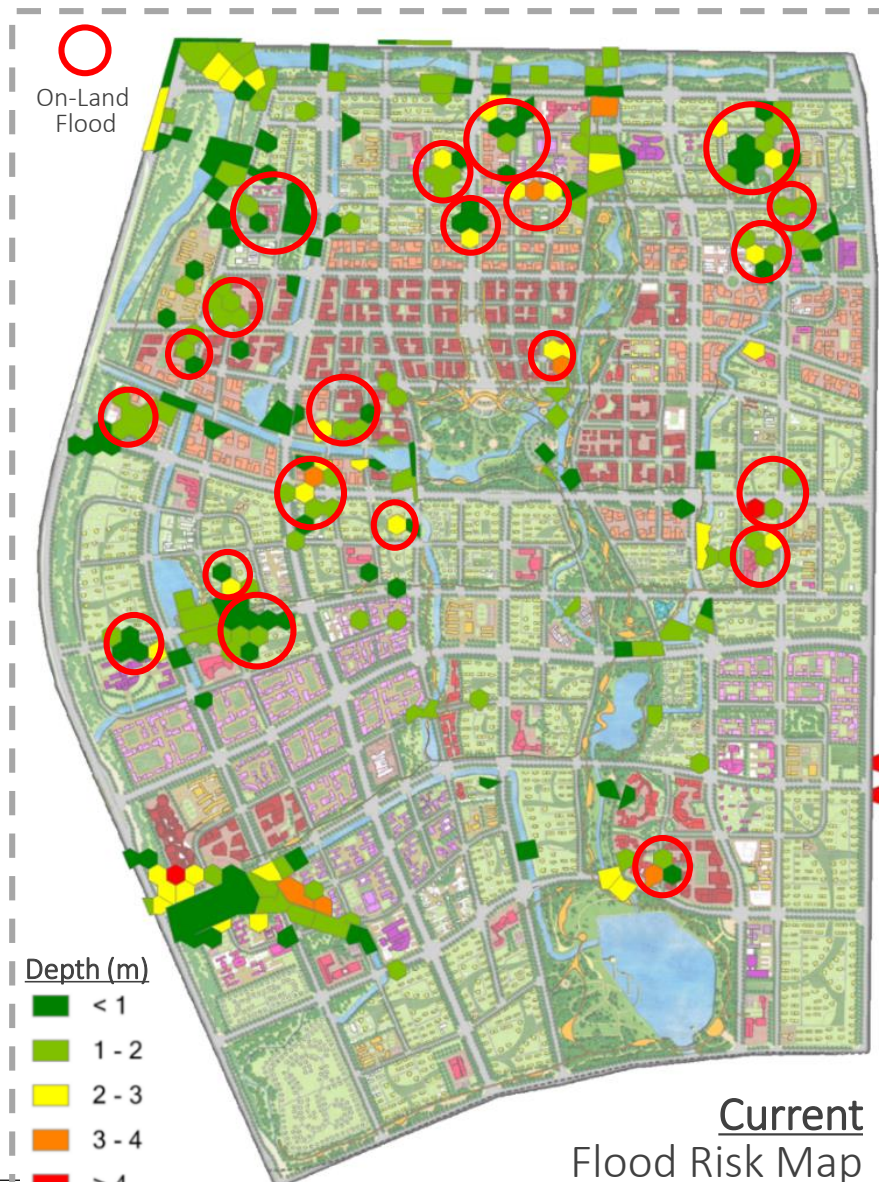
- Many complex simulations can be done in parallel
- Compound Data can be used
- Testing different complex scenarios becomes easier and must faster



## Current Scenario - "Before" (1 in 50 Years Return Period)



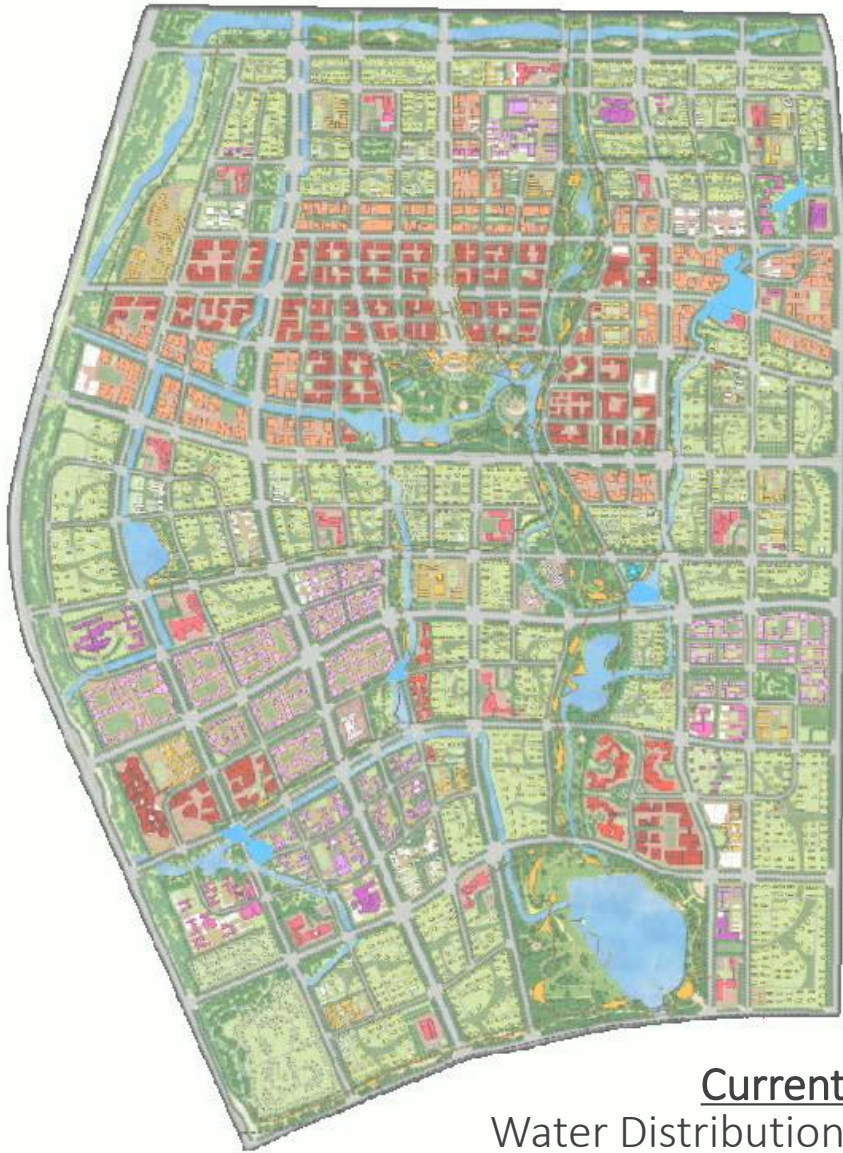
Current  
Water Distribution



Current  
Flood Risk Map



## “After” Analysis (1 in 50 Years Return Period)



Current  
Water Distribution



Final Solution  
Water Distribution



# Digital Twinning – City Wide Cloud Computing



[Video Link](#)



Thank You

