

Climate Resilience Zoning Task Force Technical Presentation on Resilient Zoning Options

October 10, 2019 | City Hall Annex



Principles

1. people, communities, equity
2. differentiation and choice
3. new construction & existing development
4. performance-based & prescriptive standards
5. flexibility in changing circumstances
6. actions with co-benefits
7. effectiveness
8. best available data and science

Objectives

1. elevate & floodproof
2. design to recover
3. green infrastructure
4. preserve vegetation
5. create vegetation
6. limit paved areas
7. provide shading
8. use reflective surfaces
9. promote passive resilience
10. shelter in emergencies
11. create emergency plans
12. implement area-wide strategies
13. produce co-benefits

Objectives of Resilient Zoning

1. Elevate and Floodproof
2. Design to Protect/Recover
3. Promote Passive Resilience

RESILIENT BUILDINGS

4. Green Infrastructure
5. Preserve Vegetation
6. Create Vegetation
7. Limit Paved Areas
8. Provide Shading
9. Use Reflective Surfaces

SITE/COOL FACTOR

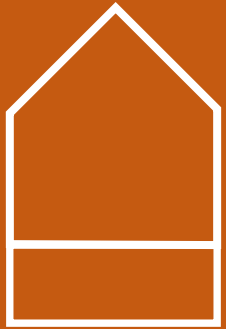
10. Shelter in Emergencies
11. Create Emergency Plans
12. Implement Area-Wide Strategies (Social Resilience)

EMERGENCY RESPONSE PLANNING

13. Produce Co-Benefits

Types of zoning approaches

zoning tool	review
Prescriptive standards: <ul style="list-style-type: none">• Use• Dimension	'As-of-right' administrative review
Performance standards	Staff review (CDD, DPW)
Design guidelines and special permit criteria	Staff review (CDD, DPW) and/or Planning Board review
Incentives	Could be 'as-of-right' or by special permit



zoning strategies
Flooding

Goal:

Adapt Cambridge's buildings for future flood risks by regulating dimensional and use requirements under zoning

The Flood Overlay District does not always capture the extent of **present-day flooding**

Precipitation Flooding - Present Day - 100-Year Storm

Present Day - 100 Year - Extent of Flooding



Precipitation Flooding - Present Day - 10-Year Storm

Present Day - 10 Year - Extent of Flooding

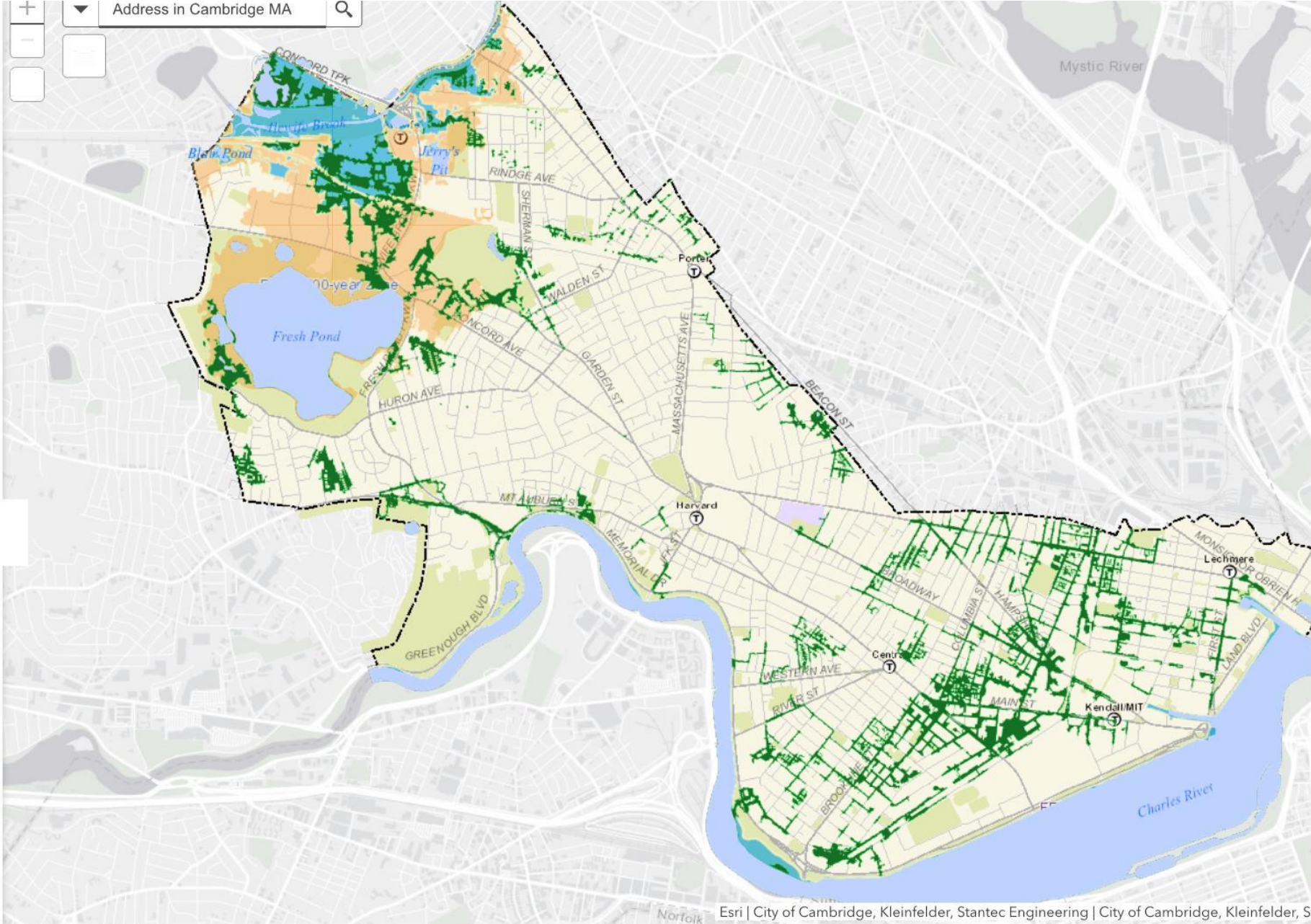


FEMA 100-year & FEMA 500-Year Flood Zones

FEMA 500-Year Flood Zone



FEMA 100-Year Flood Zone



The Cambridge FloodViewer includes the extent of *Future* flooding

Sea Level Rise / Storm Surge Flooding - 2070 - 100-Year Storm

2070 - 100 Year - SLR/SS Flooding Extent

Precipitation Flooding - 2070 - 100-Year Storm

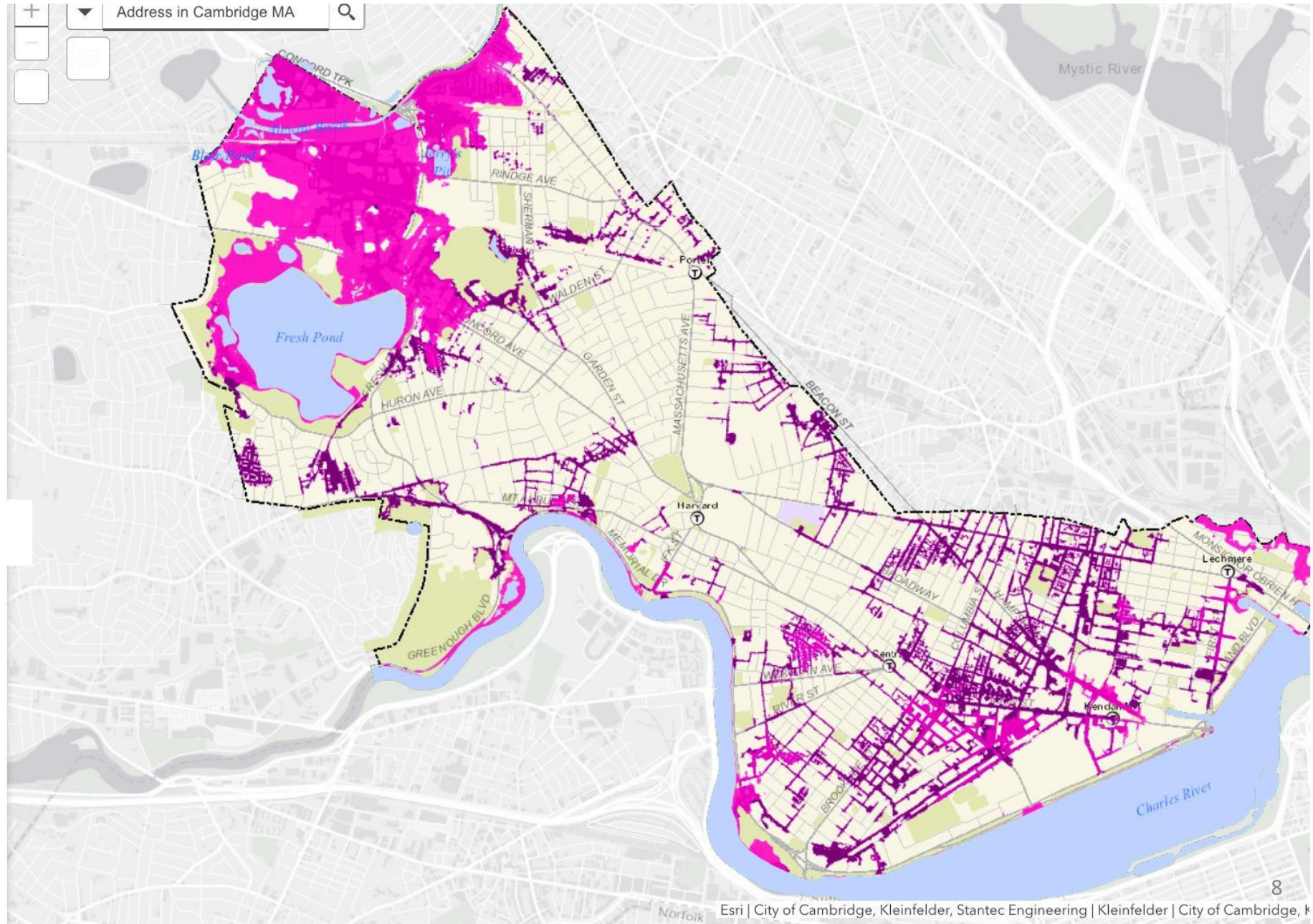
2070 - 100 Year Precip - Extent of Flooding

Sea Level Rise / Storm Surge Flooding - 2070 - 10-Year Storm

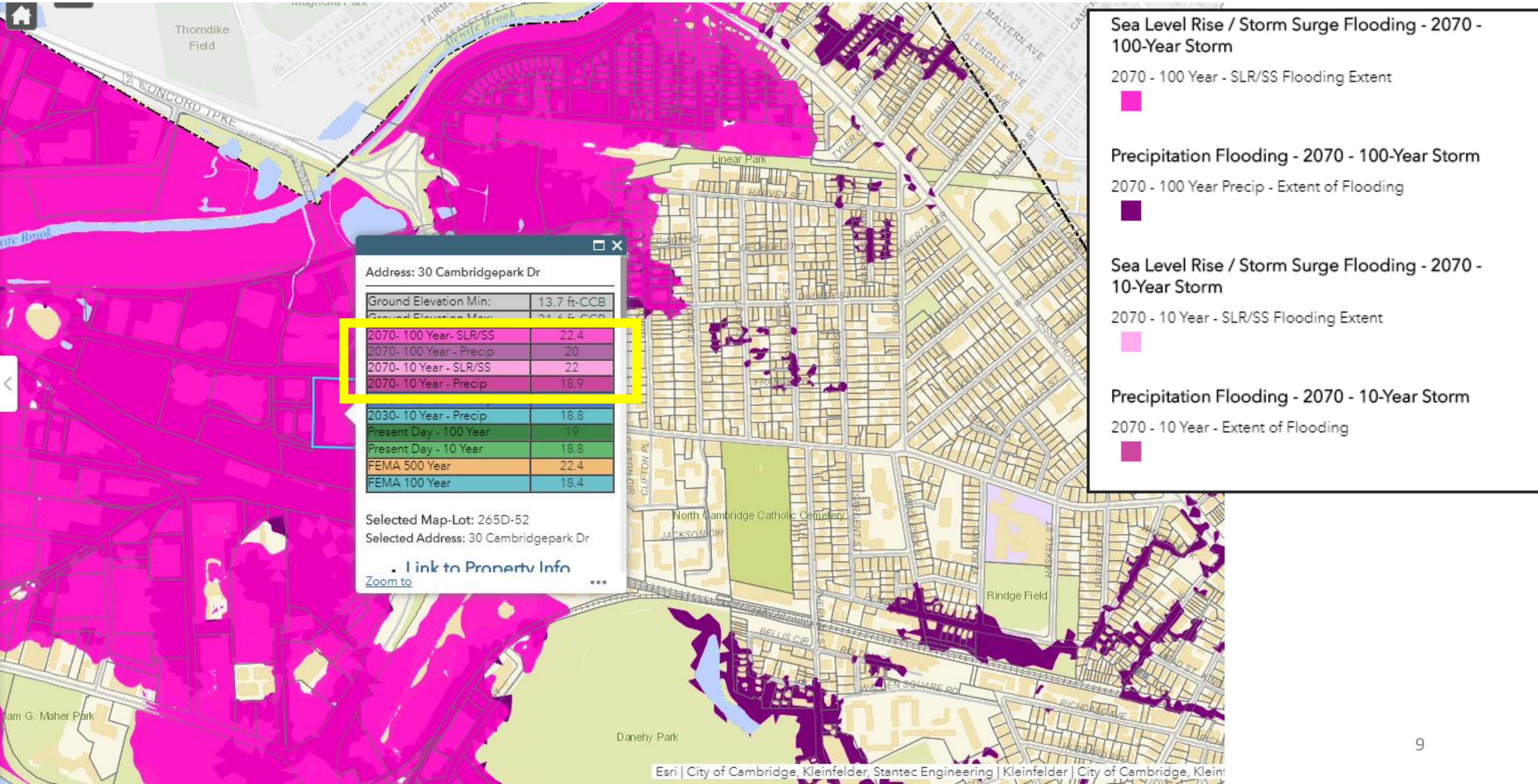
2070 - 10 Year - SLR/SS Flooding Extent

Precipitation Flooding - 2070 - 10-Year Storm

2070 - 10 Year - Extent of Flooding



Property owners will use the FloodViewer to determine their flood elevation



The table tells the property owner their flood elevation for a variety of flood scenarios

Address: 30 Cambridgepark Dr

Ground Elevation Min:	13.7 ft-CCB
Ground Elevation Max:	21.6 ft-CCB
2070- 100 Year- SLR/SS	22.4
2070- 100 Year - Precip	20
2070- 10 Year - SLR/SS	22
2070- 10 Year - Precip	18.9
2030- 100 Year - Precip	19.1
2030- 10 Year - Precip	18.8
Present Day - 100 Year	19
Present Day - 10 Year	18.8
FEMA 500 Year	22.4
FEMA 100 Year	18.4

Selected Map-Lot: 265D-52
Selected Address: 30 Cambridgepark Dr

Zoning will refer to the **2070 10-year flood elevation and the 2070 100-year flood elevation** to regulate dimensions and uses

Note:

10-year flood = 10% annual chance of occurrence

100-year flood = 1% annual chance of occurrence

Which flood elevation applies to which property, the **2070 10-year flood elevation** or the **2070 100-year flood elevation**?

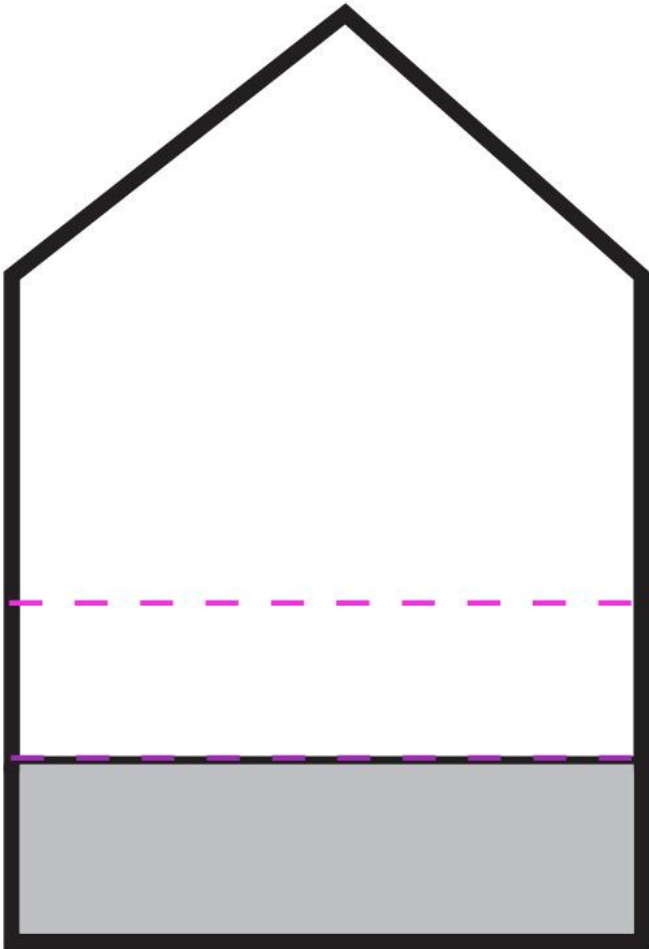
Critical Structures and utilities must be **BUILT TO / PROTECT**

*includes fire stations, hospitals, police stations, residential space (bedroom, kitchen, bathroom)

2070 100-year flood

Structures must be **BUILT TO / PROTECT**

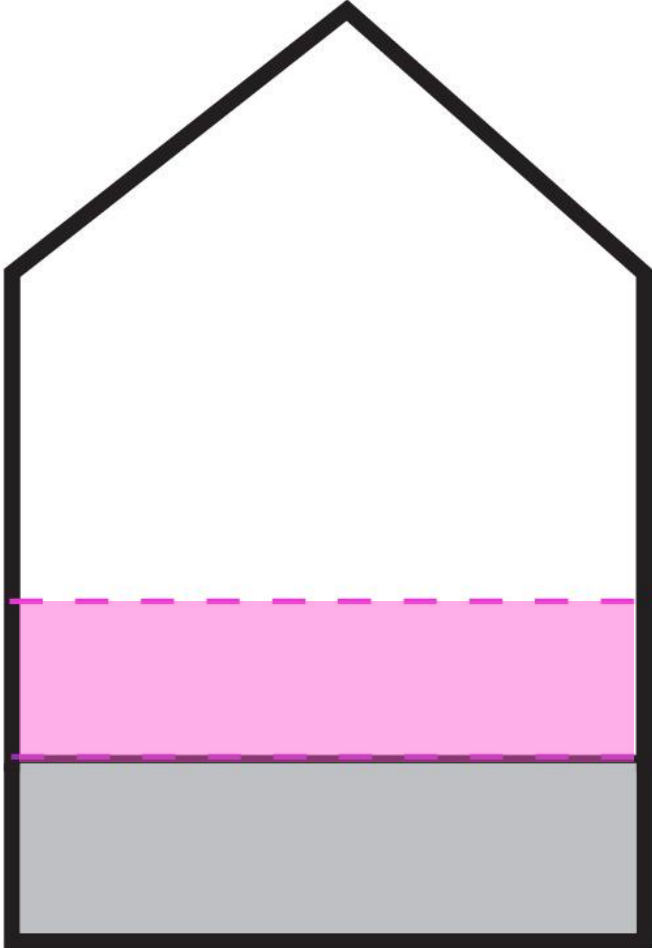
2070 10-year flood



Property built to/ protect for the **2070 10-year flood elevation** must be able to recover from

Structures must be designed to **RECOVER** from **2070 100-year flood**

2070 10-year flood



How should you
Built to
Protect
Recover from flooding?

- Build-to:** lift **habitable uses** or **critical systems** above the flood elevation
- Protect:** provide mechanical protection for **critical systems** or **protect allowed building uses from flooding** (e.g. providing for dry floodproofing.)
- Recover:** allow flooding of non habitable areas and install materials that can be easily cleaned or repaired **after** an event . (e.g. providing for wet floodproofing.)

Which building uses are appropriate for the 10-year or 100-year 2070 flood elevations?

RESIDENTIAL

NON-RESIDENTIAL

ENVISION PROTOTYPES

RESIDENTIAL

MIXED-USE RESIDENTIAL

MIXED-USE COMMERCIAL

MIXED-USE INDUSTRIAL

HOUSING MUST BE ELEVATED

HOUSING MUST BE ELEVATED

OFFICE USES CAN FLOODPROOFED

OFFICE USES CAN FLOODPROOFED

GARAGE LEVELS CAN BE WATERPROOF OR FLOODABLE

COMMERCIAL OR RETAIL USES CAN BE FLOODPROOFED

COMMERCIAL OR RETAIL USES CAN BE FLOODPROOFED

COMMERCIAL, INDUSTRIAL OR RETAIL USES CAN BE FLOODPROOFED

ELEVATE OR PROTECT UTILITIES AND MAJOR EQUIPMENT

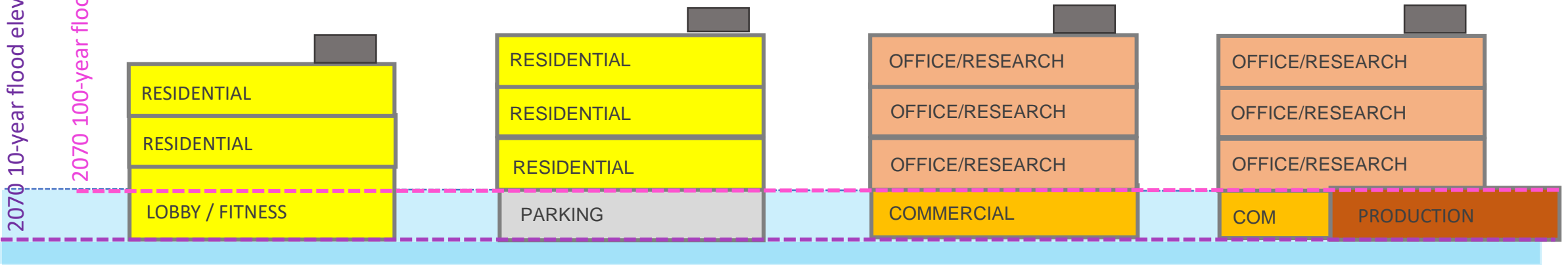
ELEVATE OR PROTECT UTILITIES AND MAJOR EQUIPMENT

ELEVATE OR PROTECT UTILITIES AND CHEMICAL STORAGE

ELEVATE OR PROTECT UTILITIES AND MAJOR EQUIPMENT AND CHEMICAL STORAGE

2070 10-year flood elevation

2070 100-year flood elevation



Example of building constructed to the recommended flood elevation

Flood Elevation Legend (feet-CCB):

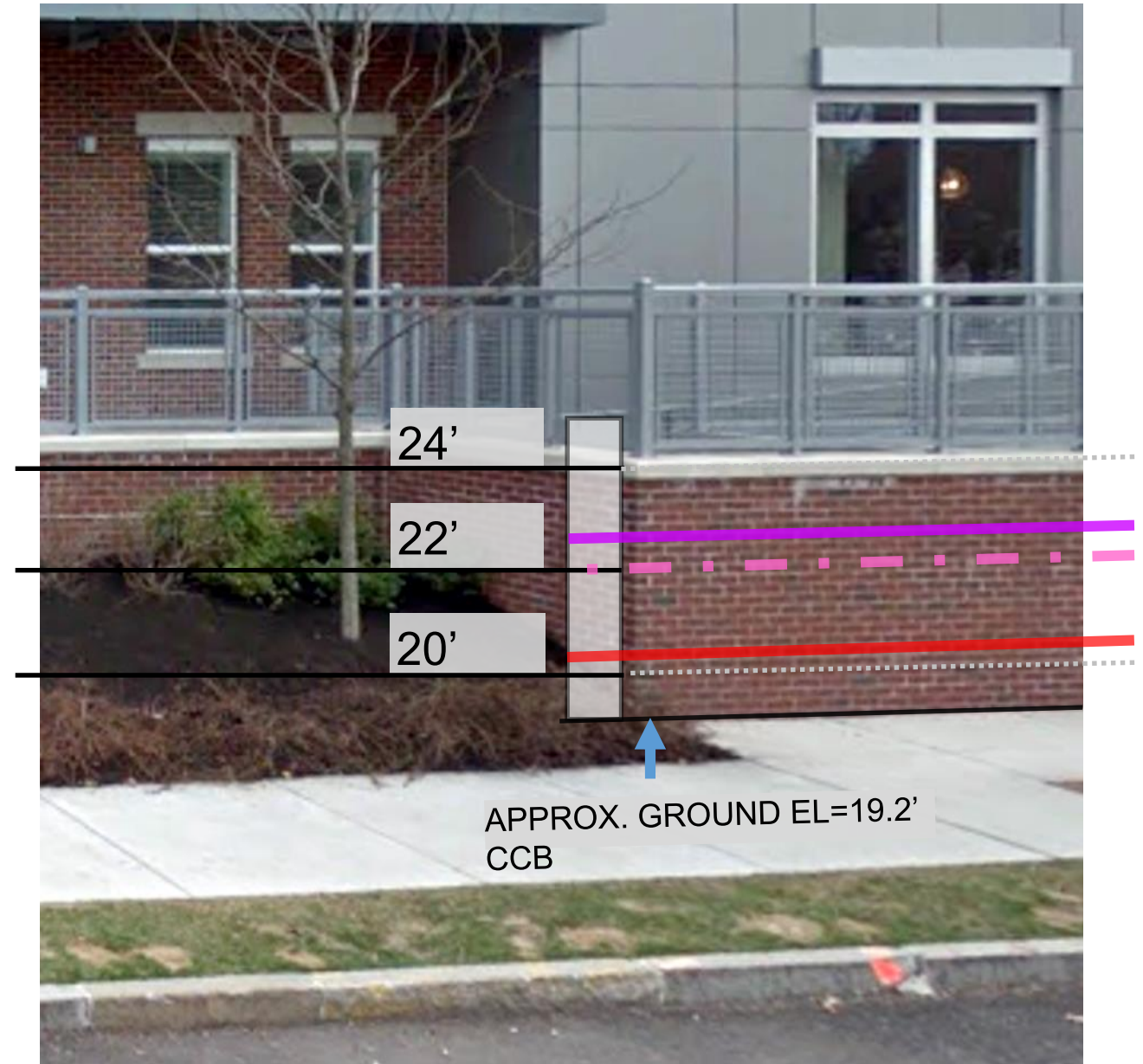
2070 100 YR SLR/SS = 22.5' 

2070 10 YR SLR/SS = 22.0' 

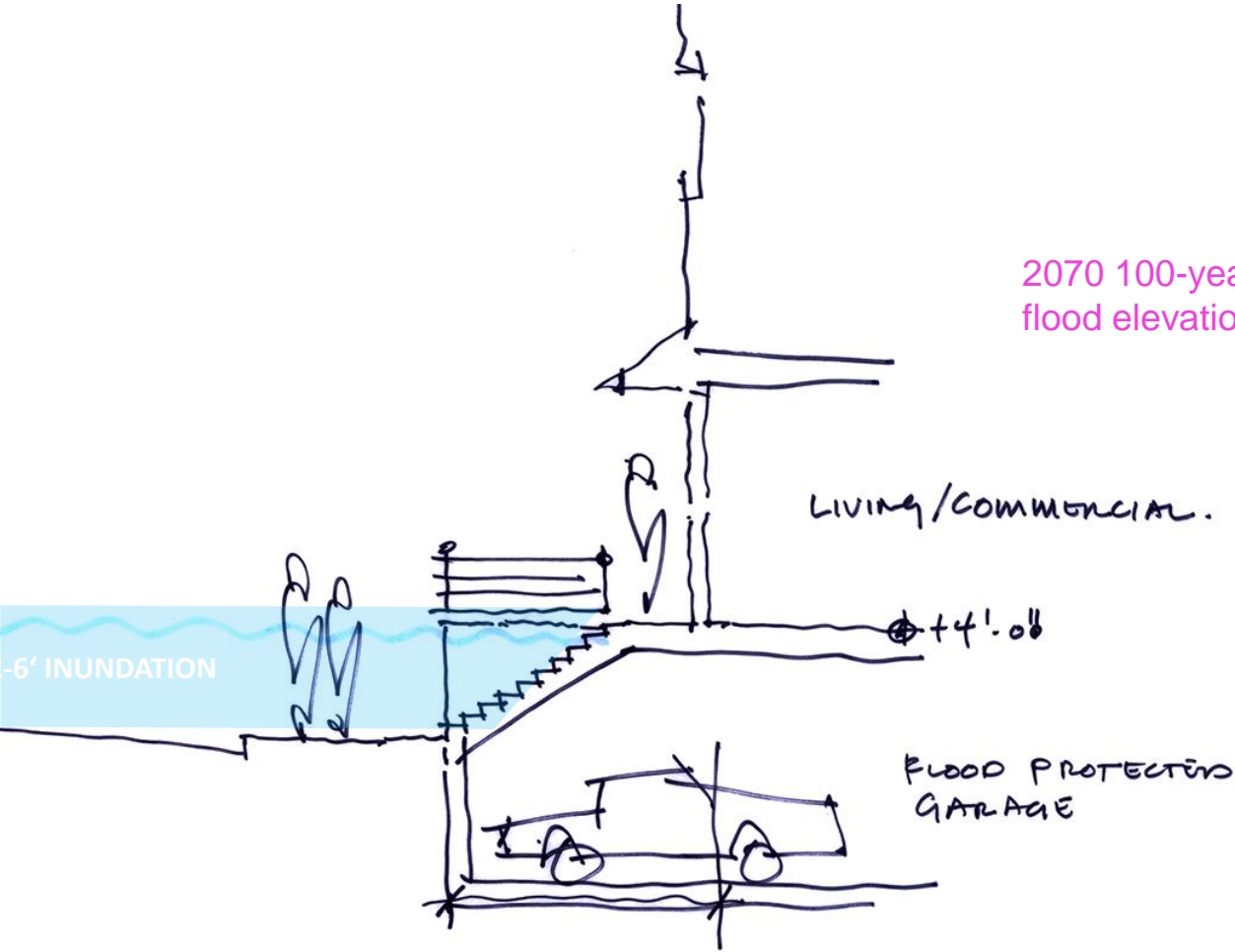
2070 100 YR PRECIP = 20.3' 

FEMA 100 YR = DRY (18.7') 

This building is built to the **2070 100-year SLR/SS elevation**



What are the implications of 'build to' for a *residential multi-family* building use?



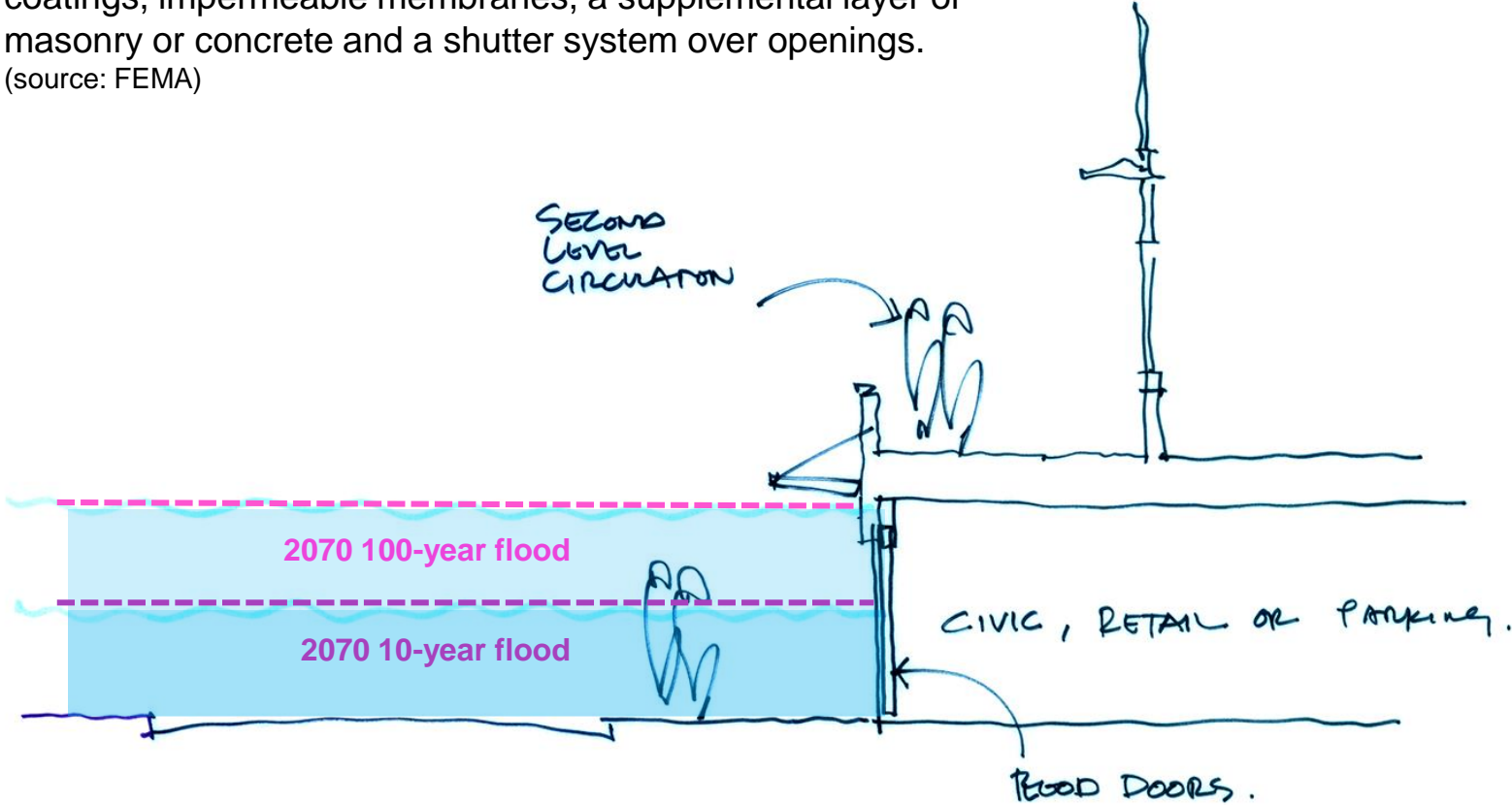
What are the implications of ‘protect to’ 2070 10-year flood elevation for a *commercial* building use?



Flood protection shutters



A dry floodproofed structure is made watertight below the level that needs flood protection to prevent floodwaters from entering. This requires sealing the walls with waterproof coatings, impermeable membranes, a supplemental layer of masonry or concrete and a shutter system over openings. (source: FEMA)

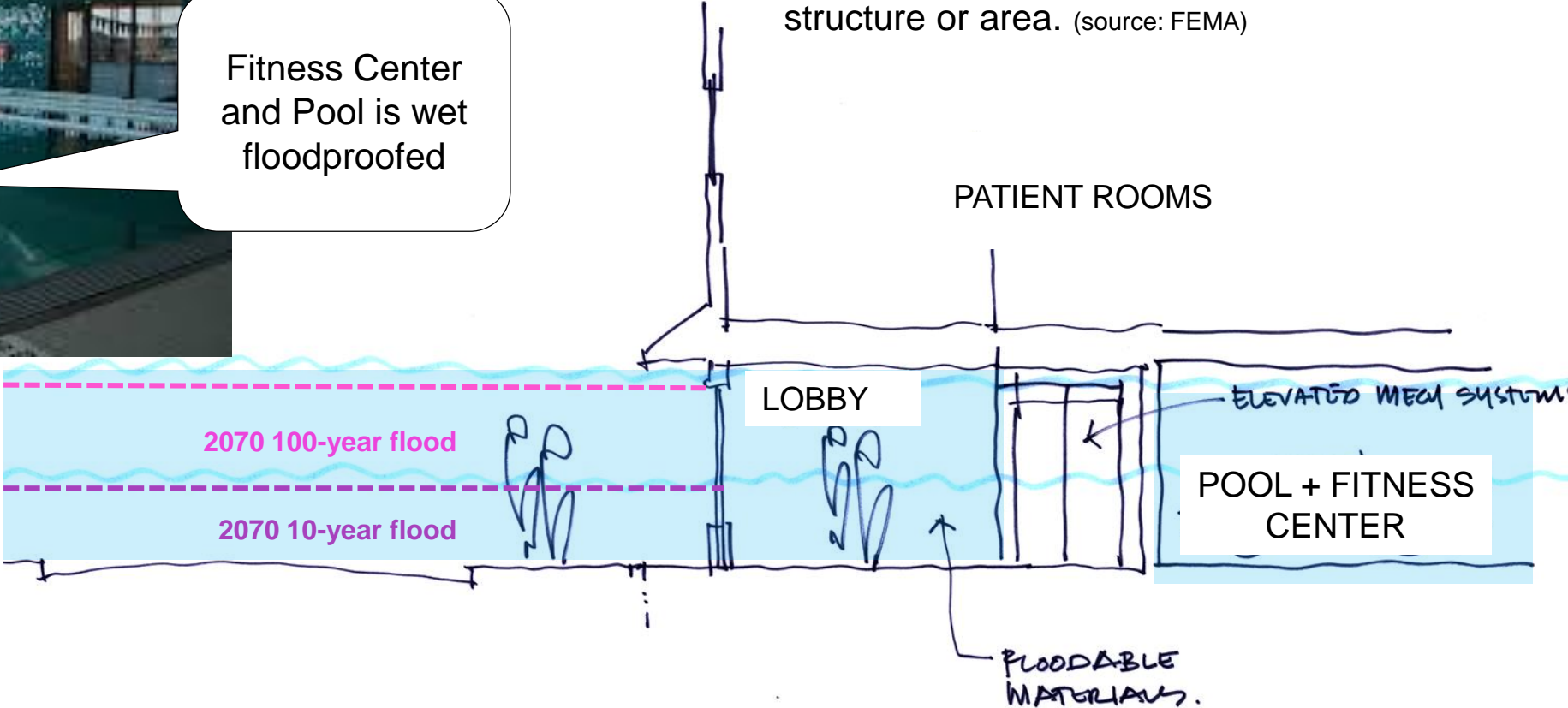


What are the implications of 'recover from' the 2070 100-year flood elevation for a *hospital/rehabilitation center* building use??



Fitness Center and Pool is wet floodproofed

Wet Floodproofing includes measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area. (source: FEMA)



Questions for the Task Force on Flood Strategies

1. How do these approaches meet the principles established by the Task Force? Where are there potential conflicts with these principles?
2. Under what development scenarios should these standards be applied (large-scale vs. small-scale, residential vs. non-residential, new construction vs. renovation)?
3. When should these apply as prescriptive standards (eg: elevating to a specific datum) versus performance standards with options (e.g., dry or wet floodproofing)?
4. When should these be requirements and/or when could they be incentivized?



Cool Factor

Goal:

Implement site and building strategies that reduce urban heat island effects while also helping to manage storm water

Cool Factor strategies

Encourage light color materials for facades to reflect solar energy

Reflect solar gain with green and light color roofs

Encourage shade structures

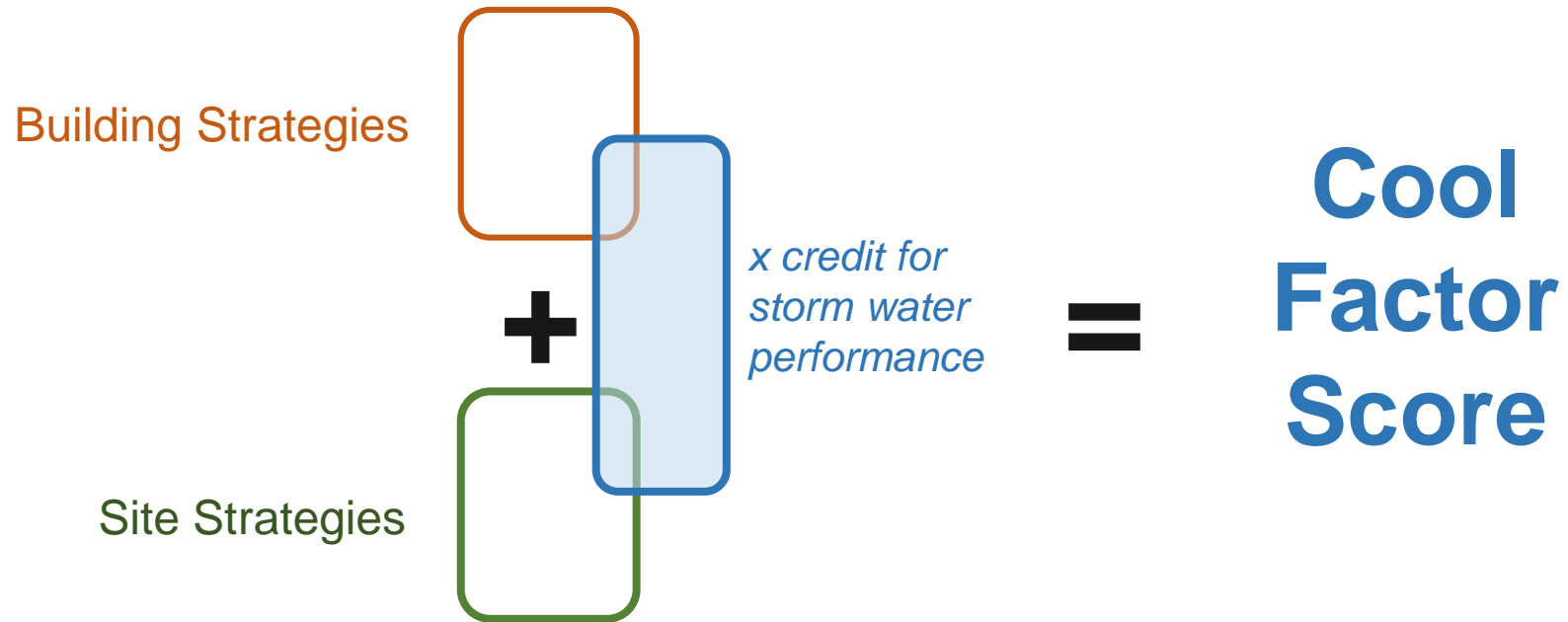
Protect and expand the urban forest

Reduce impermeable surfaces and plant where possible

Encourage multi-benefit green infrastructure stormwater strategies

A performance based approach

A property owner selects and implements several strategies to reduce heat from a menu of options in order to meet a set score, the *cool factor*.



Building Strategies

Green Roof



X credit for storm water performance

White Roof



Green Façades



High SRI Façades



X credit for Public Realm Cooling

Shade Structures



Site Strategies

Preserved Trees



X credit for Public Realm Cooling

Canopy Trees



Medium Trees



Small Trees



Planting Areas



X credit for storm water performance

Paving with high SRI



X

Area or Quantity

÷

Lot Area

=

SPECIAL PERMITS
(vary by district type)

BASELINE REQUIREMENTS
(vary by district type)

Buildings can help cool the City

CCPR study of cool roofs showed: “Effective implementation of white roofs in the Alewife area can reduce average ambient air temperature by 2.4°F”

The Port Preparedness Plan estimated 1.7°F decrease from impervious area reduction and white roof implementation.



White Roof installation in New York City | Source: Business Insider

The building materials we choose can **reduce** rather than contribute to **urban heat island impacts**.

Solar Reflective Index (SRI)— a measure of the constructed surface's ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation.

(<https://www.usgbc.org/glossary/term/5590>)

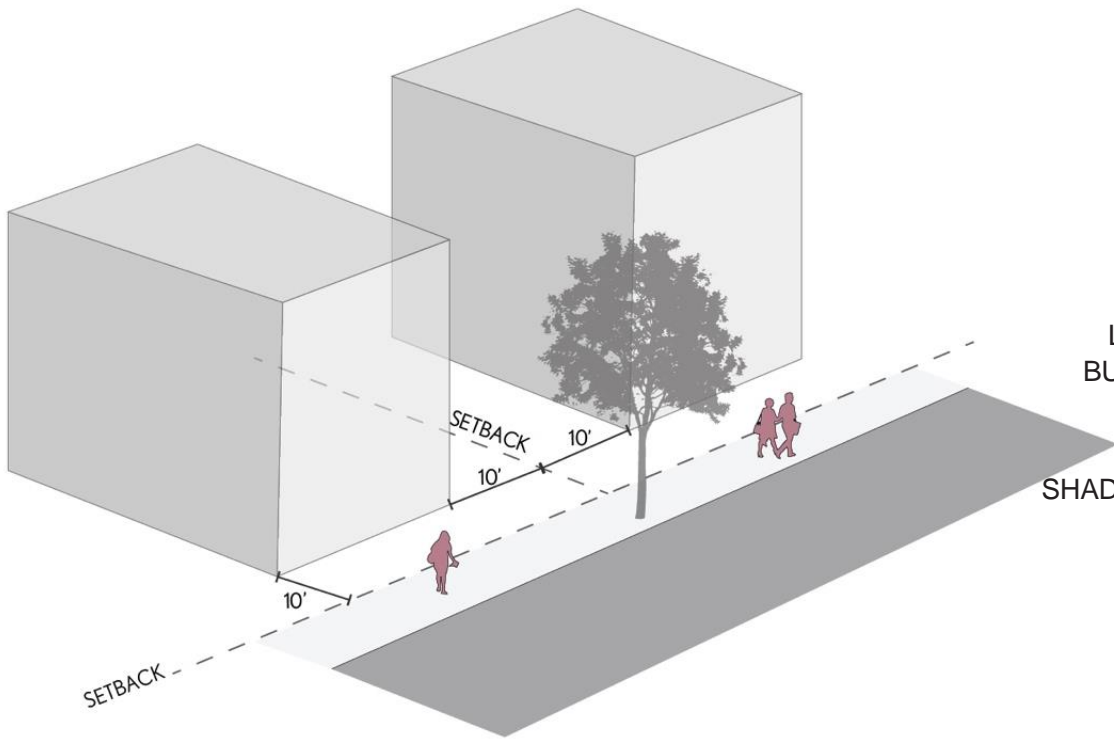
Albedo—the amount of solar radiation reflected from an object or surface, usually expressed as a percentage.

(<https://www.climate-change-guide.com/albedo-definition.html>)

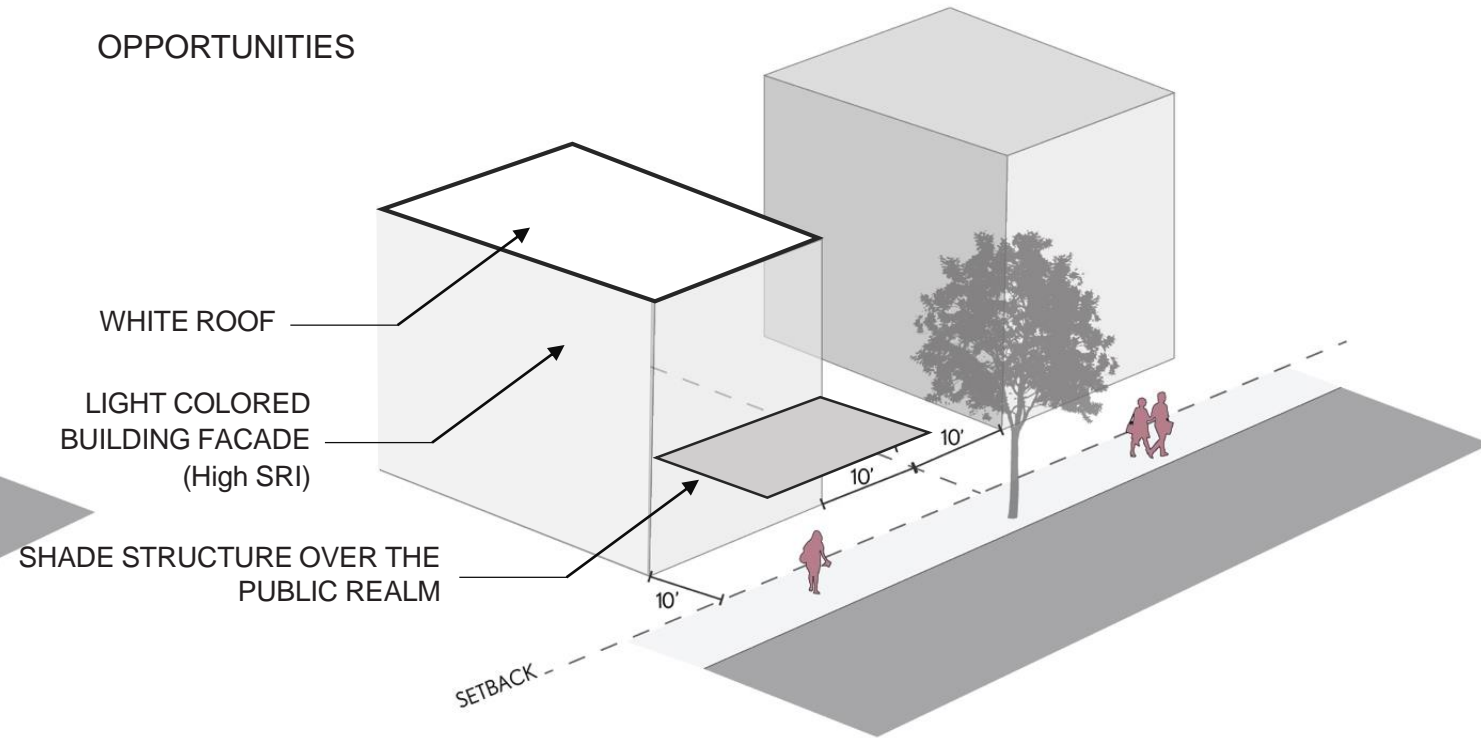
Building performance standards can be integrated into the cool factor.

Resilient building design to reduce heat island effects might include **white roofs and facades and structures that shade the public realm.**

EXISTING



OPPORTUNITIES

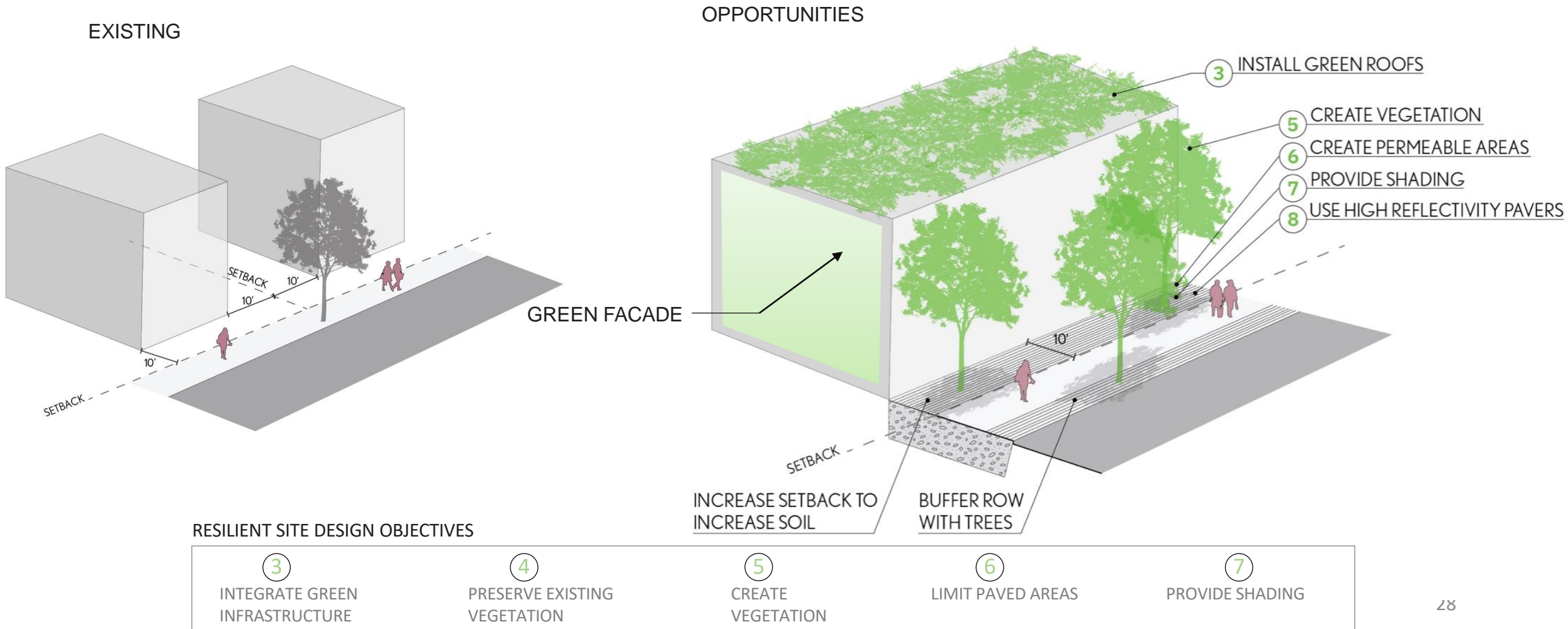


RESILIENT SITE DESIGN OBJECTIVES



Building performance standards can be integrated into the cool factor.

Resilient building design to reduce heat island effects might include **green facades and roofs.**



Because the Urban Forest is key to Cooling the City

The City must Protect and Expand the Urban Forest

There are two primary approaches to reversing the current trend of urban forest contraction

Curb the loss of existing trees

Grow canopy by planting new trees and nurturing tree growth



Zoning is just part of the picture

Existing

MA Chapter 87 Public Shade Tree law

Evolving

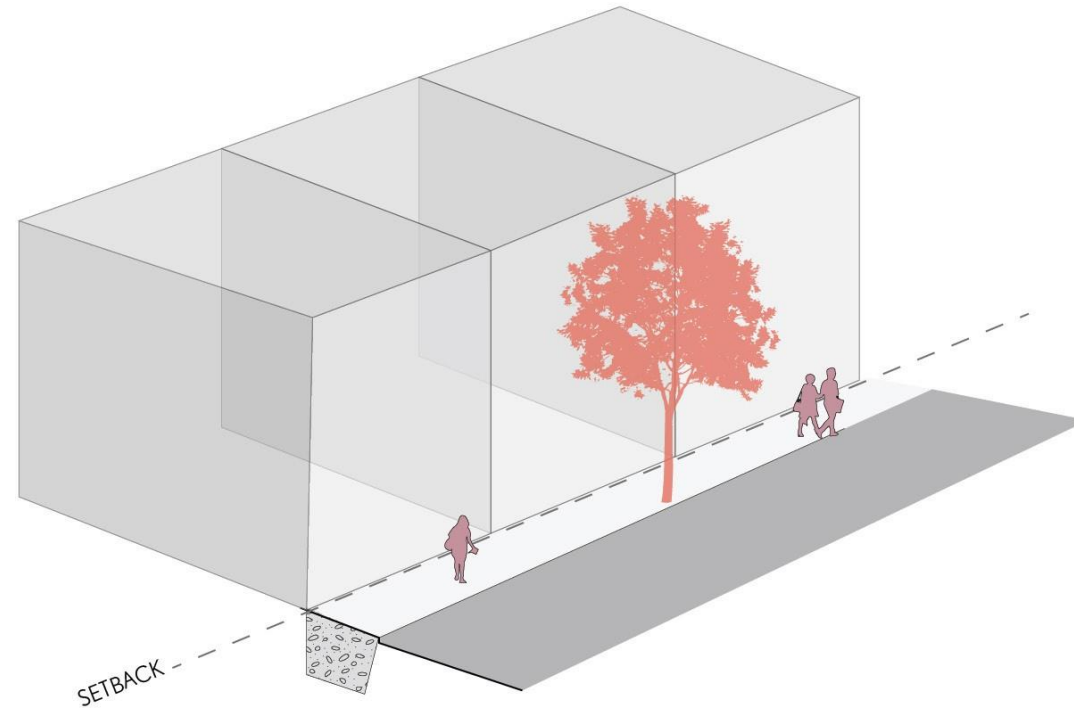
City Tree Protection Ordinance

City Zoning Code

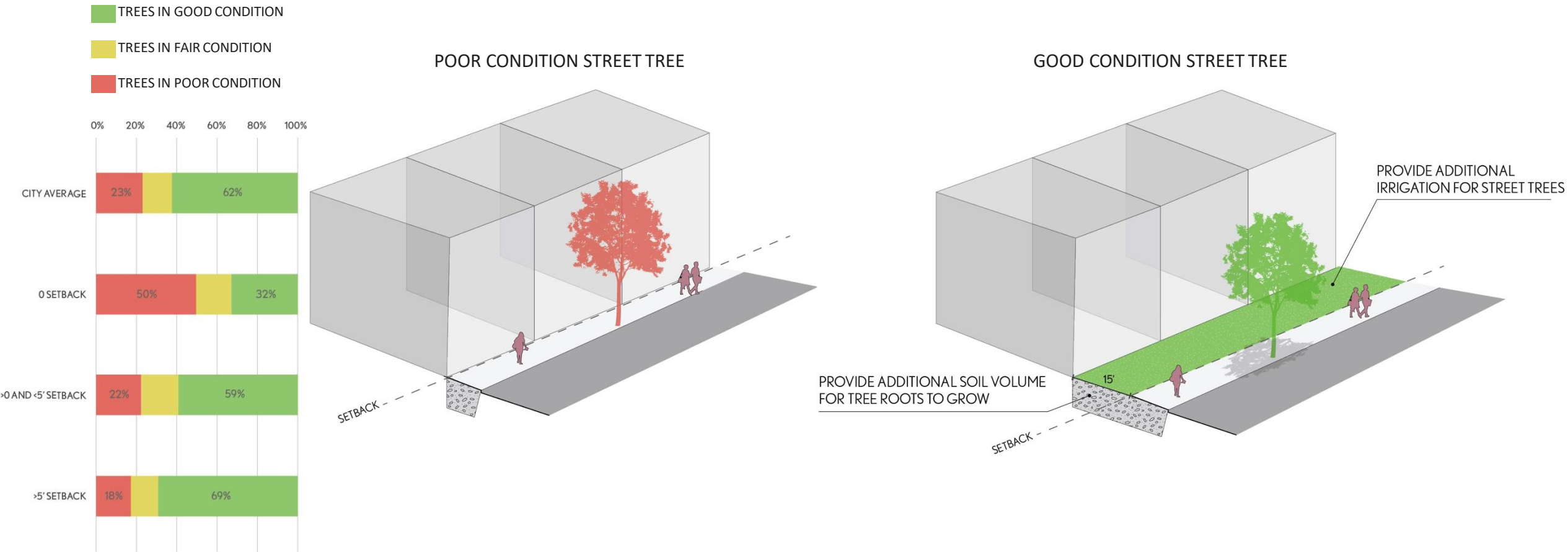
Article 19 Urban Design Guidelines



Zoning can make room for canopy trees



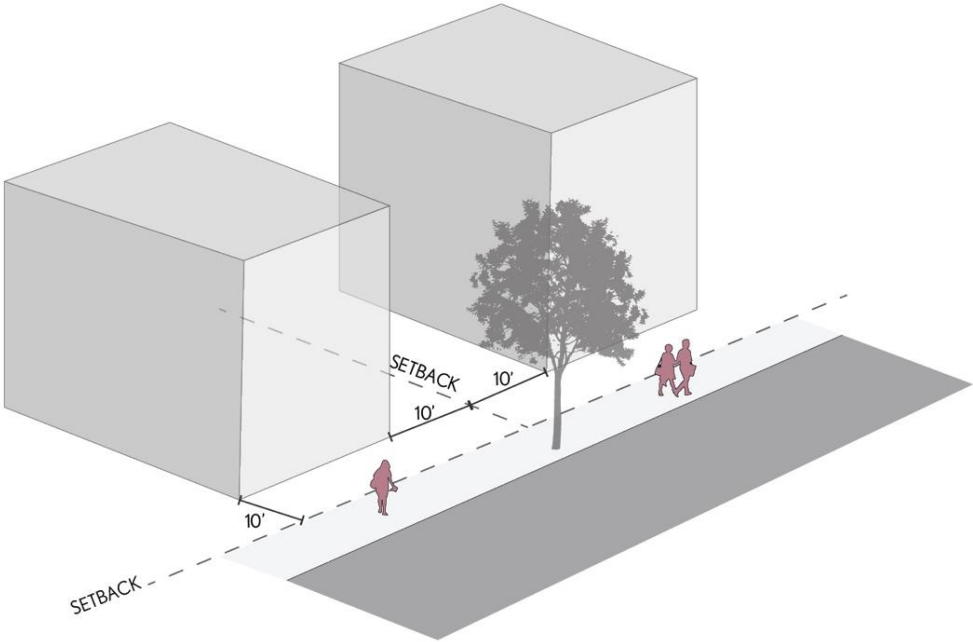
Provide 5' minimum front yard setbacks to support street tree health (e.g. business zoning districts)



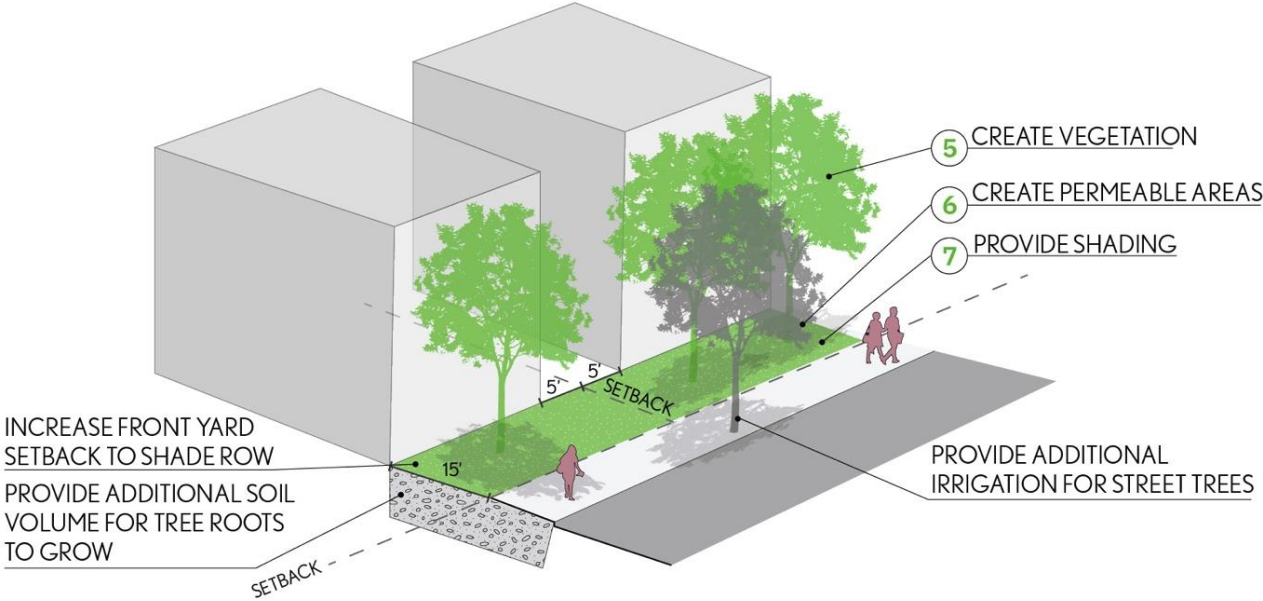
50% of street trees with no setbacks are in poor condition.

Provide 10' minimum front yard **setbacks** to allow front yard trees that shade the public realm (e.g. residential and industrial districts)

EXISTING



OPPORTUNITIES

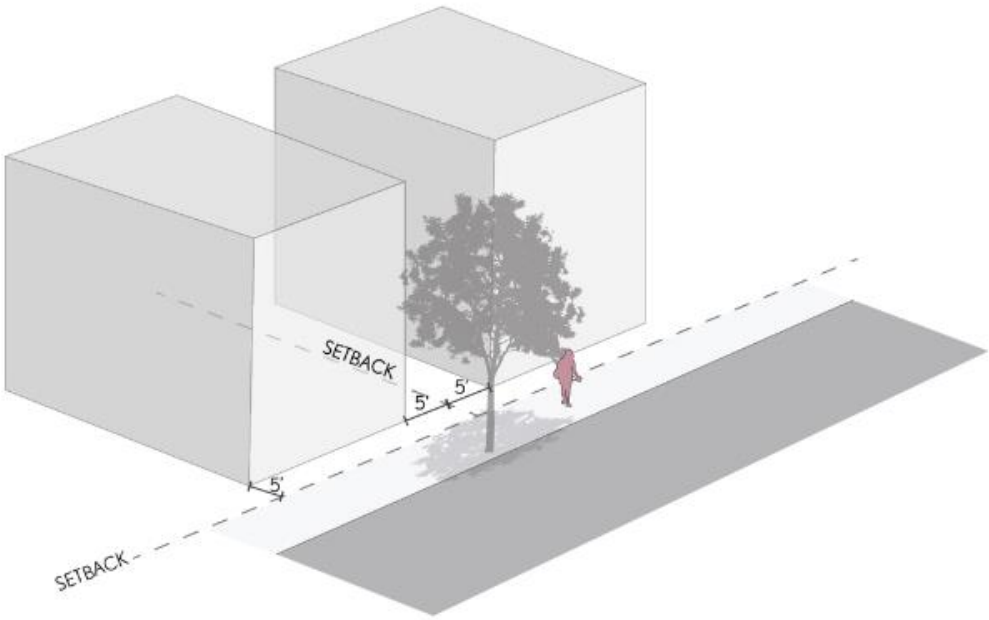


RESILIENT SITE DESIGN OBJECTIVES

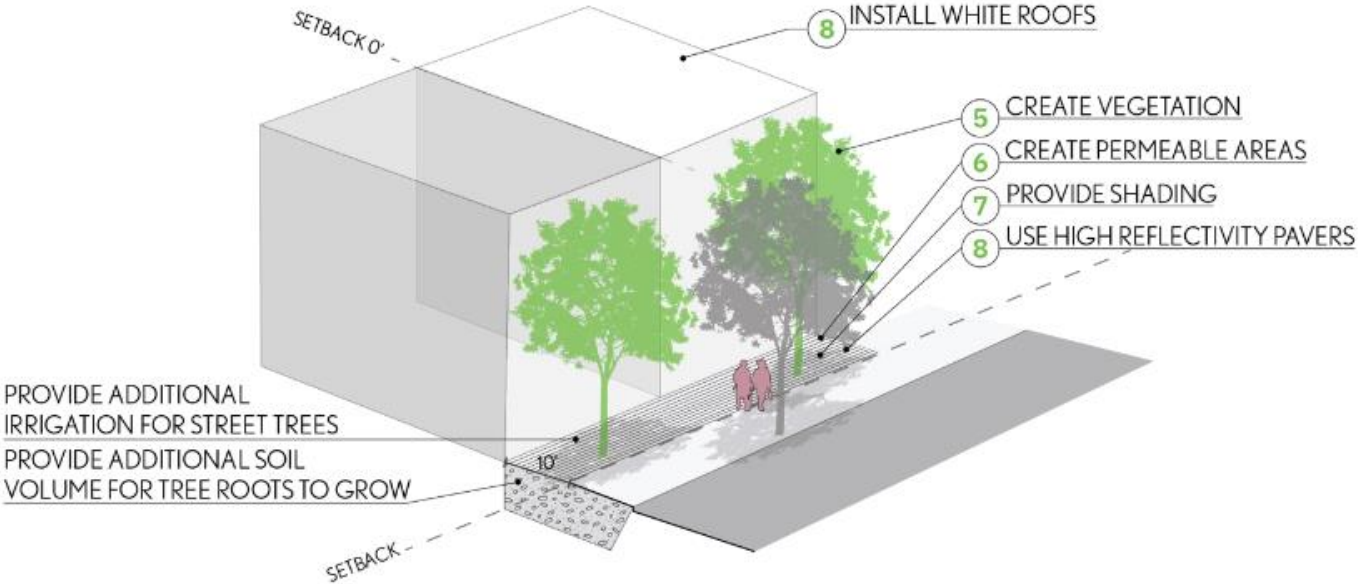
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|--|--|-----------------------------------|-----------------------------------|---------------------------------|
| <p>3</p> <p>INTEGRATE GREEN INFRASTRUCTURE</p> | <p>4</p> <p>PRESERVE EXISTING VEGETATION</p> | <p>5</p> <p>CREATE VEGETATION</p> | <p>6</p> <p>LIMIT PAVED AREAS</p> | <p>7</p> <p>PROVIDE SHADING</p> |
|--|--|-----------------------------------|-----------------------------------|---------------------------------|

Shift open space to **front yards** and provide **optimal growing conditions**.

EXISTING



OPPORTUNITIES



RESILIENT SITE DESIGN OBJECTIVES

- ③

INTEGRATE GREEN INFRASTRUCTURE
- ④

PRESERVE EXISTING VEGETATION
- ⑤

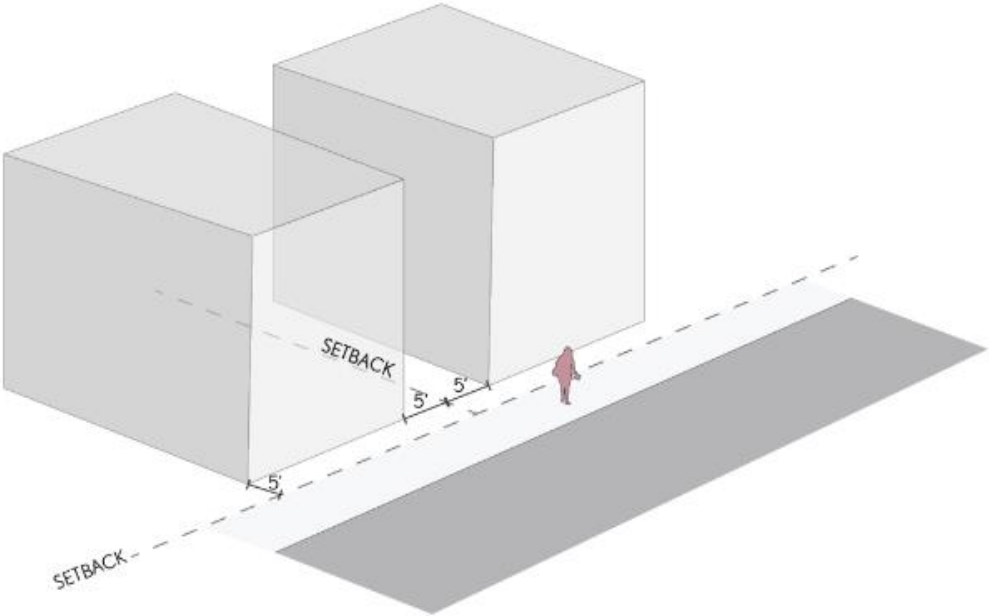
CREATE VEGETATION
- ⑥

LIMIT PAVED AREAS
- ⑦

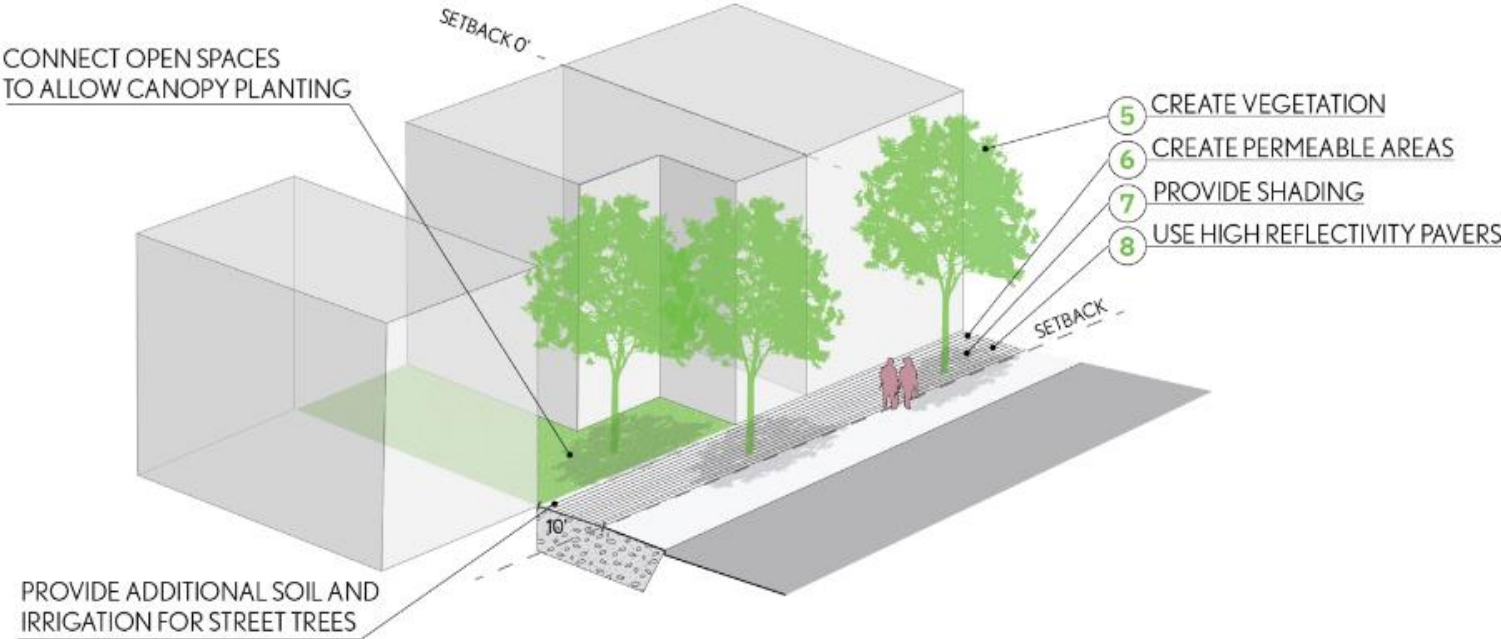
PROVIDE SHADING

Increase overall **open space** by land use type (for example, industrial districts)

EXISTING



OPPORTUNITIES



RESILIENT SITE DESIGN OBJECTIVES

- ③

INTEGRATE GREEN INFRASTRUCTURE
- ④

PRESERVE EXISTING VEGETATION
- ⑤

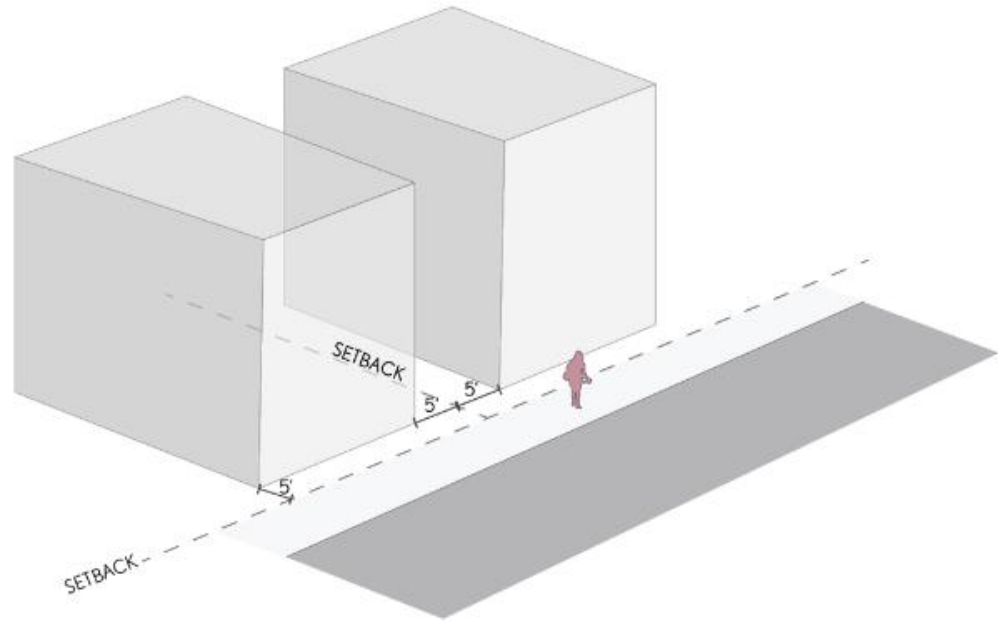
CREATE VEGETATION
- ⑥

LIMIT PAVED AREAS
- ⑦

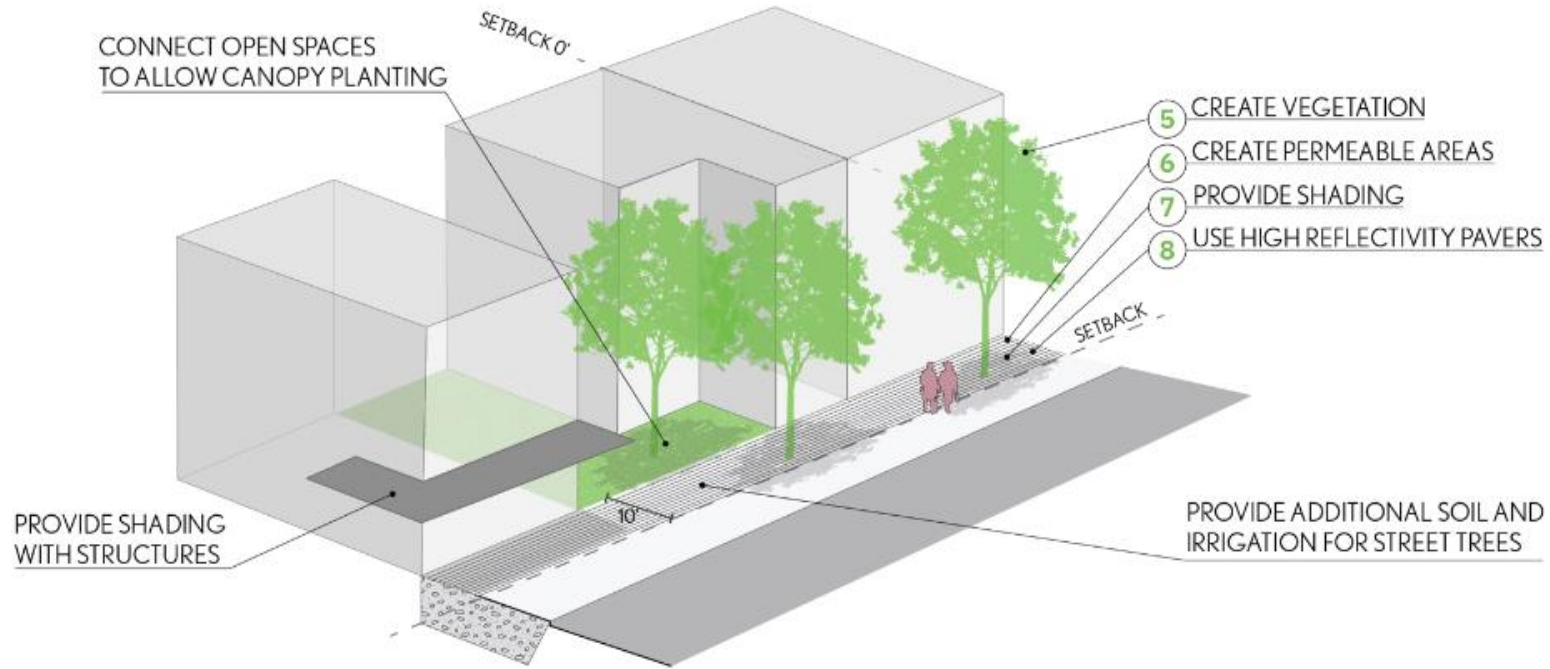
PROVIDE SHADING

Shade **50% of unbuilt space** and encourage adjacency of open space.

EXISTING



OPPORTUNITIES

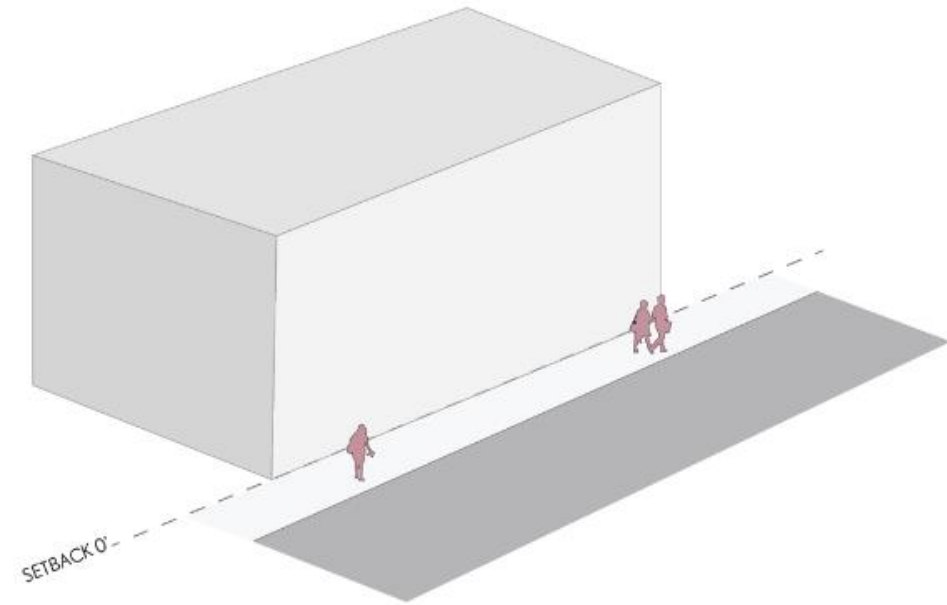


RESILIENT SITE DESIGN OBJECTIVES

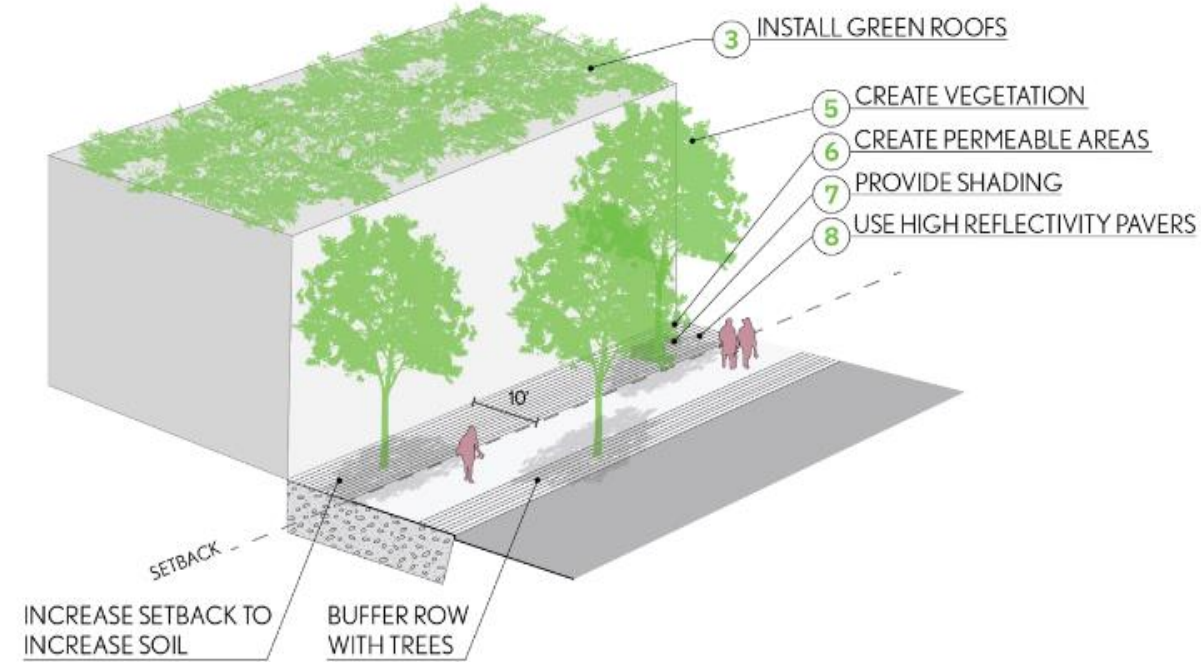
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CREATE VEGETATION</p> | <p>6
LIMIT PAVED AREAS</p> | <p>7
PROVIDE SHADING</p> |
|---|---|--------------------------------|--------------------------------|------------------------------|

Pair building strategies and landscape strategies to increase **district-wide cooling**.

EXISTING



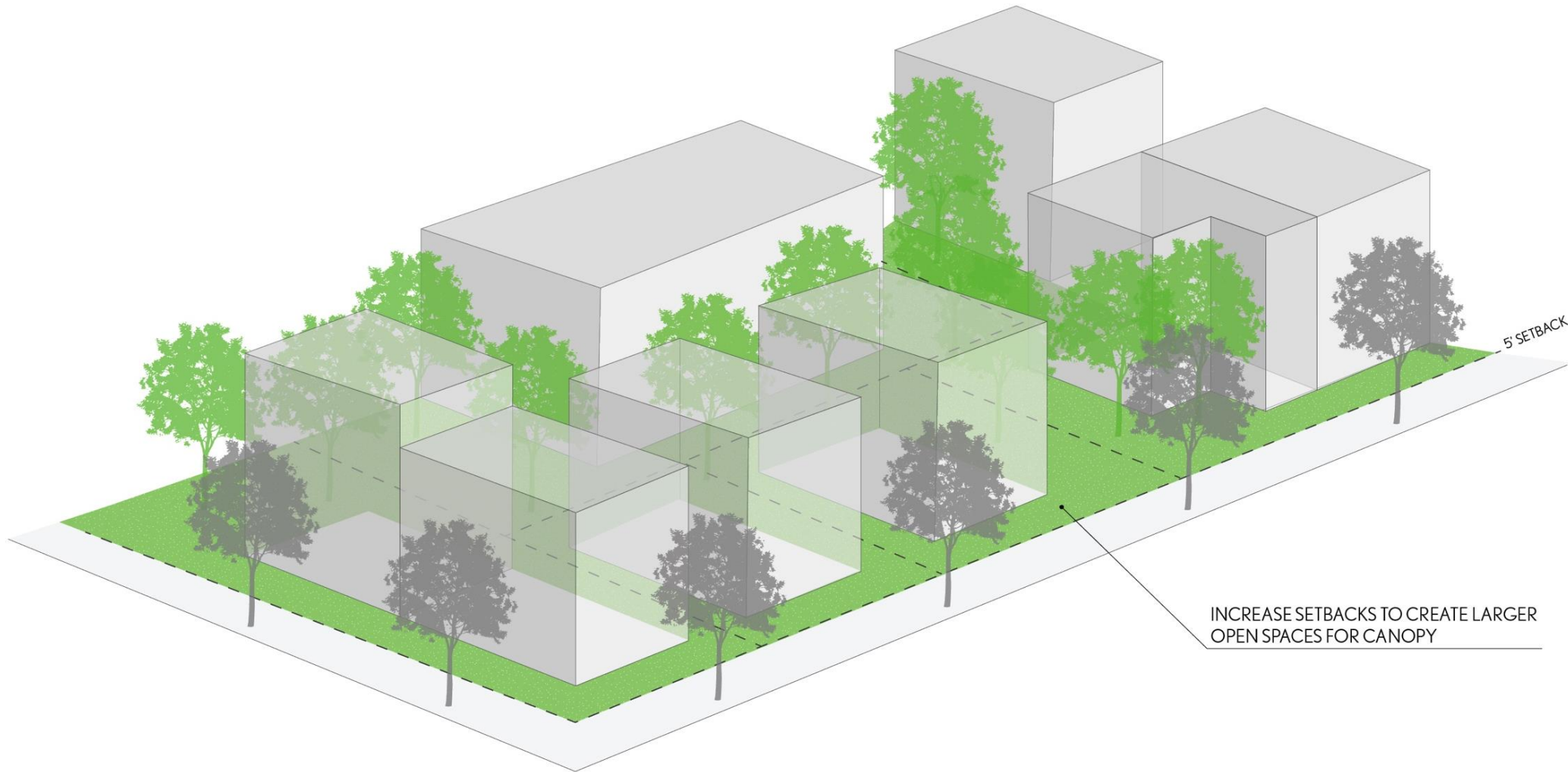
OPPORTUNITIES



RESILIENT SITE DESIGN OBJECTIVES

<p>3</p> <p>INTEGRATE GREEN INFRASTRUCTURE</p>	<p>4</p> <p>PRESERVE EXISTING VEGETATION</p>	<p>5</p> <p>CREATE VEGETATION</p>	<p>6</p> <p>LIMIT PAVED AREAS</p>	<p>7</p> <p>PROVIDE SHADING</p>
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Connect adjacent open space
to create a **network of cool spaces**.



Additional strategies include

Incorporate trees, shading, and open space into **urban design objectives**



Site strategies incorporated through cool factor can enhance the Public Realm

Increased tree canopy

White facade

Green roof

The Urban Forest Master Plan estimated 1.1°F decrease in East Cambridge and 0.5°F city wide from tree planting.

Effective and significant implementation of green infrastructure in the Alewife area can reduce average ambient air temperature by 1.7°F

Median planting

Cool pavement



Building strategies incorporated through cool factor can enhance the Public Realm



Questions for the Task Force on a “Cool Factor”

1. How do these approaches meet the principles established by the Task Force? Where are there potential conflicts with these principles?
2. Under what development scenarios should these standards be applied (large-scale vs. small-scale, residential vs. non-residential, new construction vs. renovation)?
3. When should these apply as prescriptive standards (e.g. requiring minimum tree planting) versus performance standards with options (e.g. meeting the cool factor through a variety of means)?
4. When should these be requirements and/or when could they be incentivized?



community-based strategies
Emergency Planning

Goal:

Help communities plan and prepare for climate impacts and emergencies as a provision of large-scale development

Emergency Response vs. Emergency Planning

Emergency Response – Providing immediate services to those impacted by disaster or trauma to limit the negative impacts they experience.

Emergency Planning – Better preparing residents for emergency scenarios by providing resources that educate them and connect them with their community in the instance of an emergency event

When is **Emergency Planning** applicable?

- **Build-to:** lift habitable uses or critical systems above the flood elevation
- **Protect:** provide mechanical protection for habitable spaces or critical systems
- **Emergency Planning:** improve human comfort and safety during an emergency with stand-alone or passive life support systems that do not depend upon external
- **Recover:** allow flooding of non habitable areas and install materials that can be easily cleaned or repaired **after** an event



Protected community room

As a provision of zoning for large-scale developments:

- Elevated emergency egress
- back-up power
- programming to enhance social resilience
- food and water supply
- a communication system that works even in an outage



Concord Highlands, Alewife Quadrangle

Resilience Room

As a provision of zoning for large-scale developments to have a community room with:

- Publicly accessible cell phone charging stations
- Information boards about emergencies
- Is provided with backup energy supply (for AC and refrigerators for medication and basic food supply)



Questions for the Task Force on Emergency Planning

1. How do these approaches meet the principles established by the Task Force? Where are there potential conflicts with these principles?
2. Under what development scenarios should these standards be applied (large-scale vs. small-scale, residential vs. non-residential, new construction vs. renovation)?
3. When should these be requirements (e.g. requiring an emergency response plan as a provision of zoning) versus when could they be incentivized (e.g. providing an emergency community room for additional development rights)?

Next Steps