DDC NEW YORK CITY DEPARTMENT OF DESIGN + CONSTRUCTION

RCPT

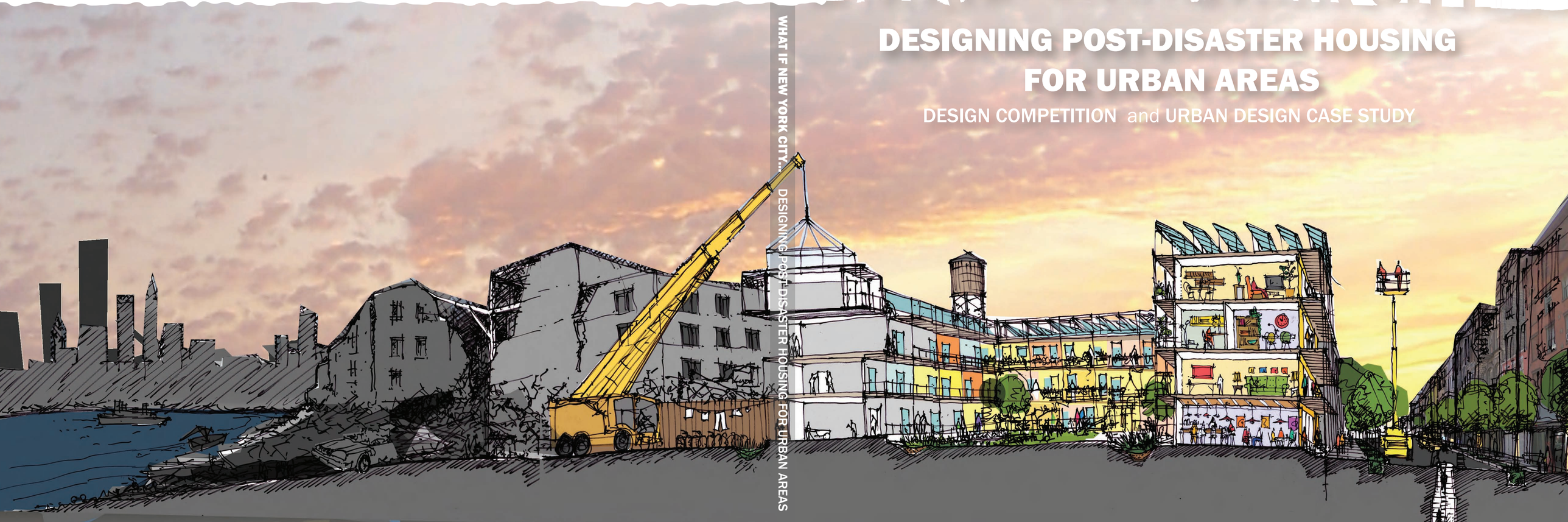
OEM New York City Office of Emergency Management

NYCPLANNING DEPARTMENT OF CITY PLANNING CITY OF NEW YORK

WHAT IF NEW YORK CITY

DESIGNING POST-DISASTER HOUSING FOR URBAN AREAS

DESIGN COMPETITION and URBAN DESIGN CASE STUDY



WHAT IF NEW YORK CITY... DESIGNING POST-DISASTER HOUSING FOR URBAN AREAS

On the day before the hurricane,
Prospect Shore is a thriving, historic waterfront neighborhood

After the storm much of the waterfront has been washed away and many homes
have been lost. Interim housing is carefully deployed, sitting lightly on the ground.

Keeping people close to home has allowed the neighborhood to come back, retaining its character while adapting and becoming more resilient to future storms.

Contents

What is urban interim housing?

Introduction 5

How will interim housing happen in the city?

Process 10

Where will interim housing go in the city?

Site Selection 20

What will interim housing look like in the city?

Design 36

What are the next steps?

Appendix 46

What is Urban Interim Housing?

Introduction

New Yorkers love their neighborhoods second only to their families. Our neighborhoods depend on durable infrastructure, great design, and most importantly a concentration and diversity of people. Before New York City can rebuild itself after a disaster, it will have to rebuild its neighborhoods.

In the wake of a disaster, waves of after-shocks strain cities. The worst among them is the out-migration of people wanting to rebuild their families, homes and jobs away from the destruction. If enough people leave, some estimate about 30%, the city is unlikely to ever regain its pre-event vitality. We will need every New Yorker to be a part of the rebuilding process.

Housing is already in critical short supply in New York City, but after a large catastrophe the demand for safe affordable housing will far outweigh supply. We will need to find a way to fill this gap.

Housing is critical, but the solution will have to do more than just provide housing units. It will have to encompass replacement of the complex social and economic networks that make life in New York what it is. Our functioning neighborhoods provide a place to live, work, learn, play, raise children, make friends, and relax.

This document offers a case study example of the development of post disaster interim neighborhoods for New York City.

We use a fictitious but realistic neighborhood called “Prospect Shore” as the context for our hypothetical case study. We imagine a Category 3 Hurricane has destroyed a much of the housing and infrastructure of Prospect Shore. We also imagine that the City has resolved to aid in the reconstruction of this neighborhood by providing a place for residents to live during the reconstruction.

Project Background

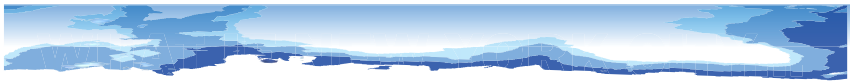
In 2007, with sponsorship from the Rockefeller Foundation, NYC Office of Emergency Management (OEM) hosted a design competition for deployable housing after a major hurricane. The design brief and all entries are posted at: (www.whatifnyc.net). This competition first introduced Prospect Shore and the hypothetical hurricane to hundreds of design teams from around the world.

Using the best competition entries as a basis for the Interim Housing Units (IHUs), OEM and partner agencies including the DDC issued a request for interest to the housing industry to identify a logistics supply chain to build, deliver and install a high volume of NYC IHUs immediately.

To leverage the full capacity of the entire manufactured housing industry, OEM and DDC created a performance specification that is a robust solution for big cities: a universal Interim Housing Performance Specification (IHPS)

The IHPS contains stringent requirements for safety, environmental quality, durability and universal design but is flexible enough that virtually any factory can quickly retool to supply them.

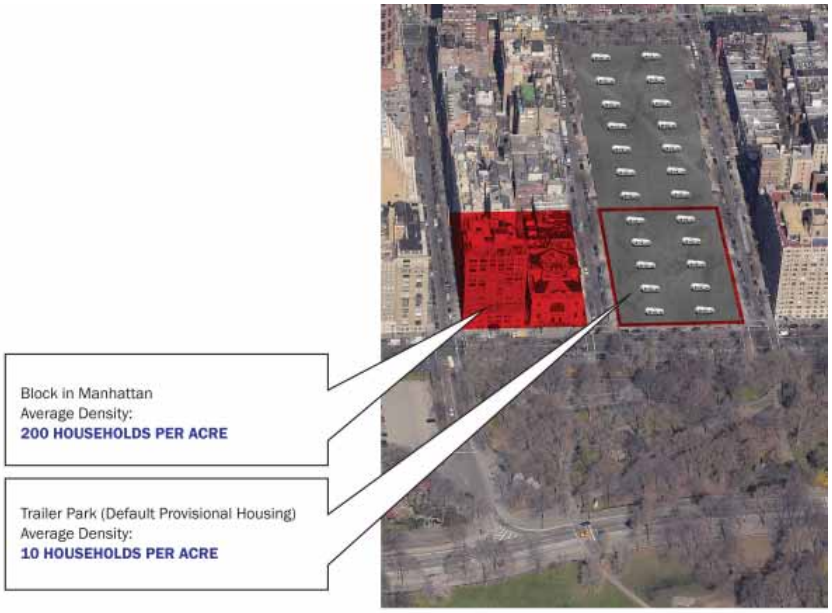
To reflect the best thinking on all aspects of the IHPS, many City and Federal agencies provided expertise, including NYC’s Dept. of Buildings (DOB), NYC’s Fire Dept. (FDNY), ConEd, Dept. of Environmental Protection (DEP), Dept. of Transportation (DOT), Dept. of Health & Mental Hygiene (DOHMH), HUD, FEMA, USACE and more.



Why interim housing?

After the immediate danger of a weather event like a Hurricane is over, some people may not be able to return home right away – their houses may be damaged, or even destroyed, and it may not be possible for them to stay with a relative or friend for an extended period of time, while their home is re-built. Interim housing is temporary, providing a place for people to get on with their lives, while the fabric of their communities is mended. That said, stays in interim housing may last a few weeks to a few years, and such housing will need to provide a high level of comfort and a variety of neighborhood services beyond what might be found in emergency shelters.

During and immediately after an emergency, the City has a plan to provide shelter for people who are evacuated. Those shelters will be located in public buildings and will not be suitable for staying for longer than a few days. Interim housing is for that period in between the immediate aftermath and the finished reconstruction of buildings. It can be from 5 days after the storm to as long as five years, depending on the rate of re-construction of a particular home. Under the FEMA Individuals and Households Program (IHP) Temporary Housing component, interim housing is provided during the intermediate period (generally up to 18 months or the maximum amount of financial assistance available by law) between emergency sheltering and the securing of a permanent housing solution.



Forms of Interim Housing

There are a variety of options for interim housing after a natural disaster. The top priority in New York, will be to identify vacant, undamaged properties, particularly rentals, where individuals can be housed. The following are interim housing options, in order of priority:

1. Utilize available rental vacancies
2. Utilize available non-rental residential
3. Rapidly repair residential properties with minimal damage
4. Adaptive use of non-residential buildings
5. Deploy interim housing units

Our case study focuses on this final option. In the event of a catastrophe such as a category 3 or 4 hurricane the housing demand will almost certainly exceed the available housing options within the city, and people will need to be housed in temporary structures. While some people may leave the city, stay with friends or family, or find some other option, our case plans for people staying close to home, at least in their own neighborhoods.

In the United States, temporary housing constructed after natural disasters has usually been done in areas with large open spaces – resulting in a suburban type of housing. Most homes are trailers or manufactured single-family homes sited individually or within a trailer-park-like context with each unit freestanding. Traditional federal assistance is focused on providing the individual housing and is geared toward homeowners.

As a dense city with little available land for development, only one existing commercial trailer site, and a high percentage of the population being renters rather than homeowners, the traditional approach to post-disaster modular housing would be difficult to deploy in New York City.

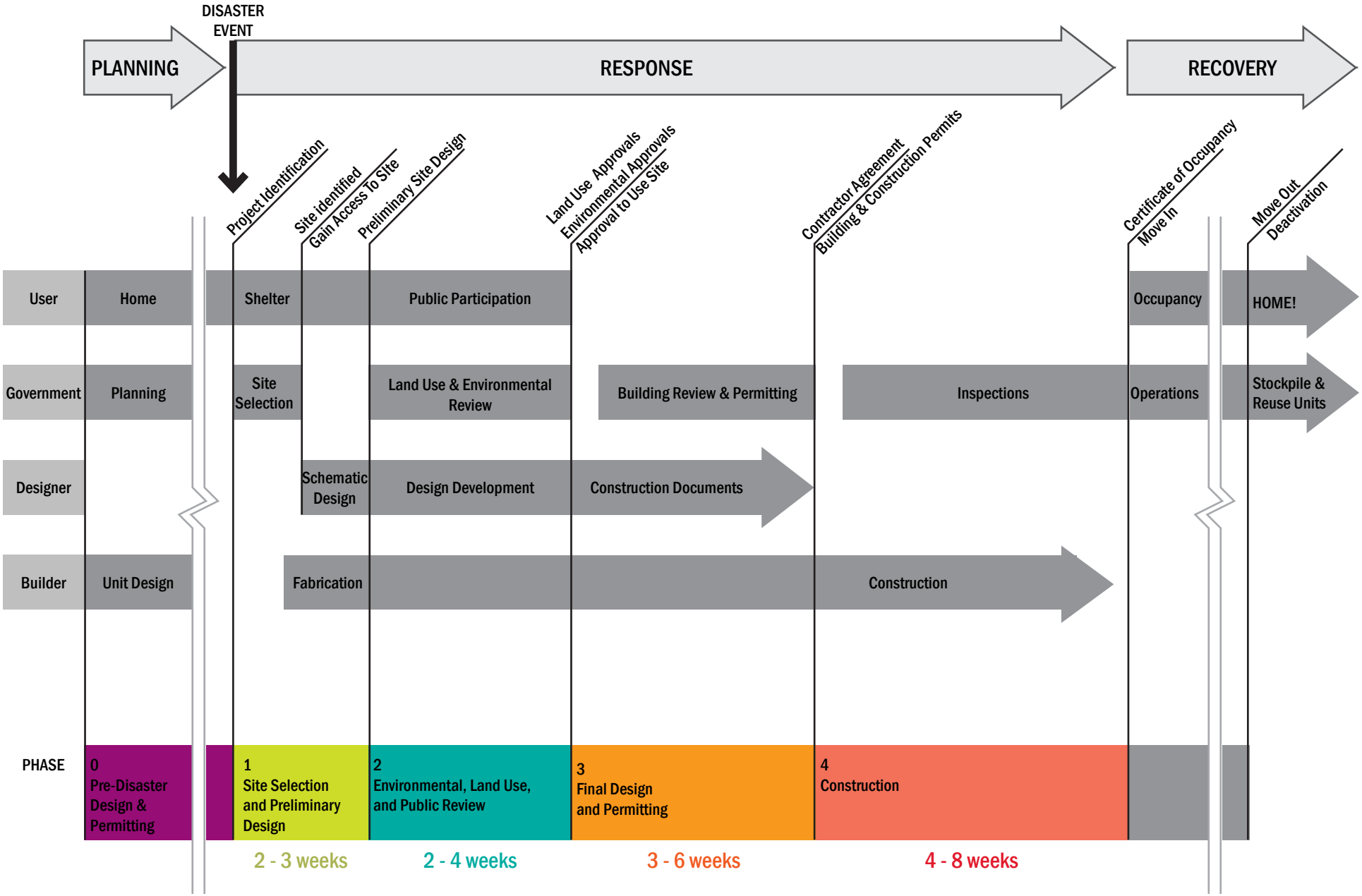
The Goal

Interim Housing should help to heal the city's neighborhoods.

It should be safe, comfortable, and temporary.

The mechanism for insuring that interim does not become permanent housing should be through policy. Poor design should not be used as prod to convince people to find permanent housing elsewhere.

Interim Housing Development Process

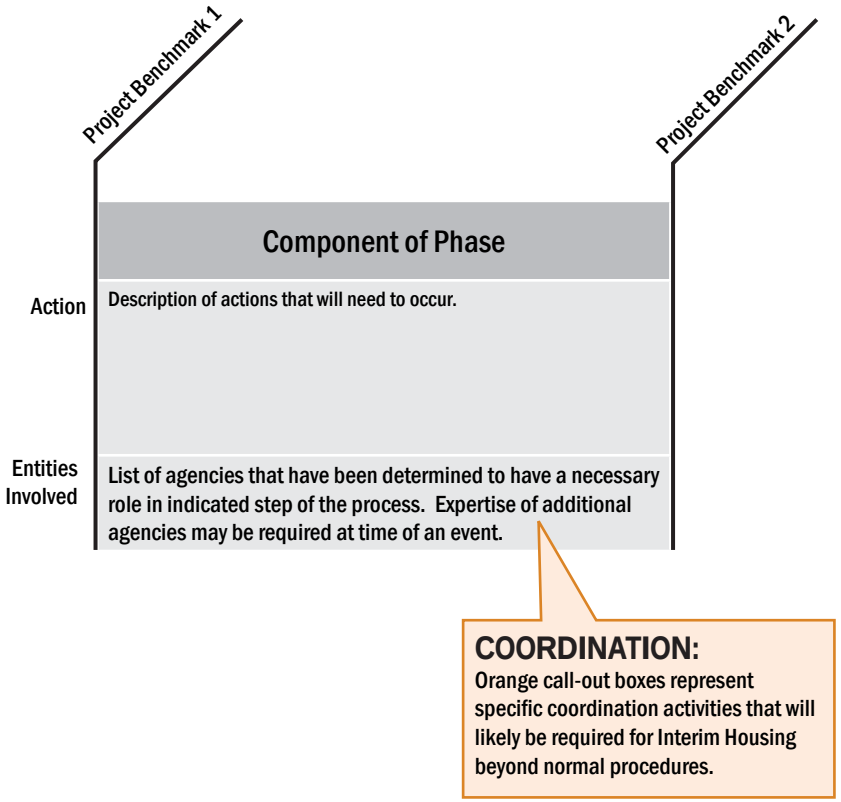


Interim Housing Development

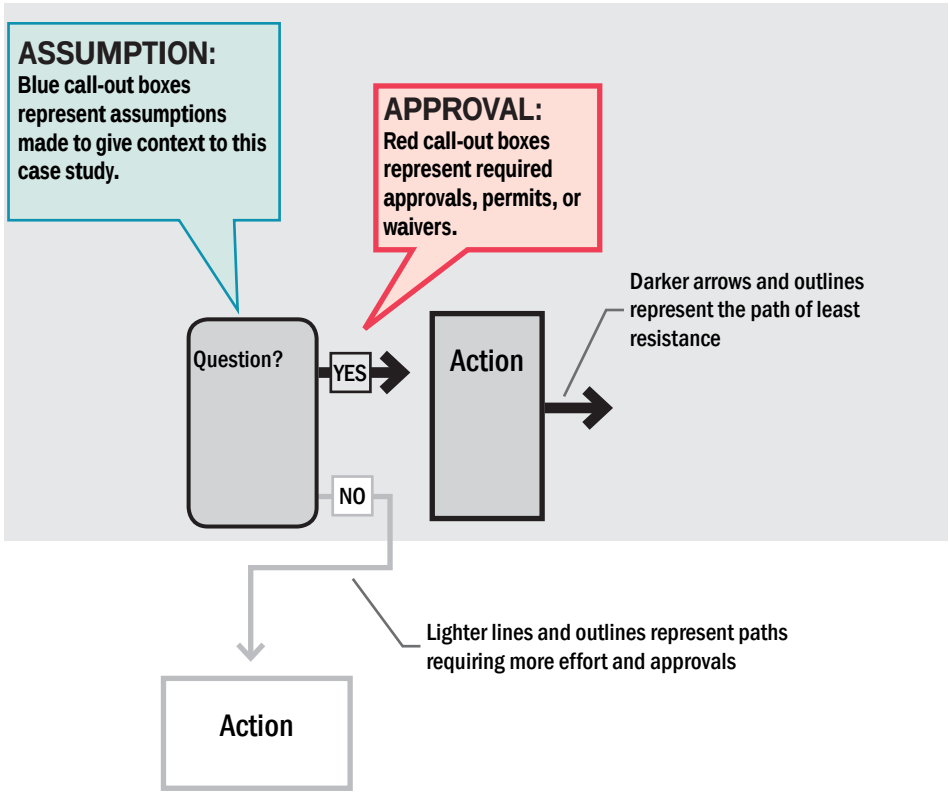
Key to Process Diagrams

The conventions shown below are used on the following pages in order to represent the various components, agency coordination, considerations, and approvals that will likely be required in the process of identifying a site, designing, permitting, and constructing interim housing in New York City.

Components and Coordination:



Considerations and Approvals:



Interim Housing Development Phase 0: Pre-Disaster Design & Permitting

Components and Coordination

COORDINATION:
Establishment of a process for certification and on-going training of architects, urban designers, landscape architects and engineers for Interim Housing could be coordinated with DDC and DCP.

COORDINATION:
Establishment of a pre-disaster review and approvals process for components of the prefabricated units is needed and will require further coordination with DOB.

Project Identified

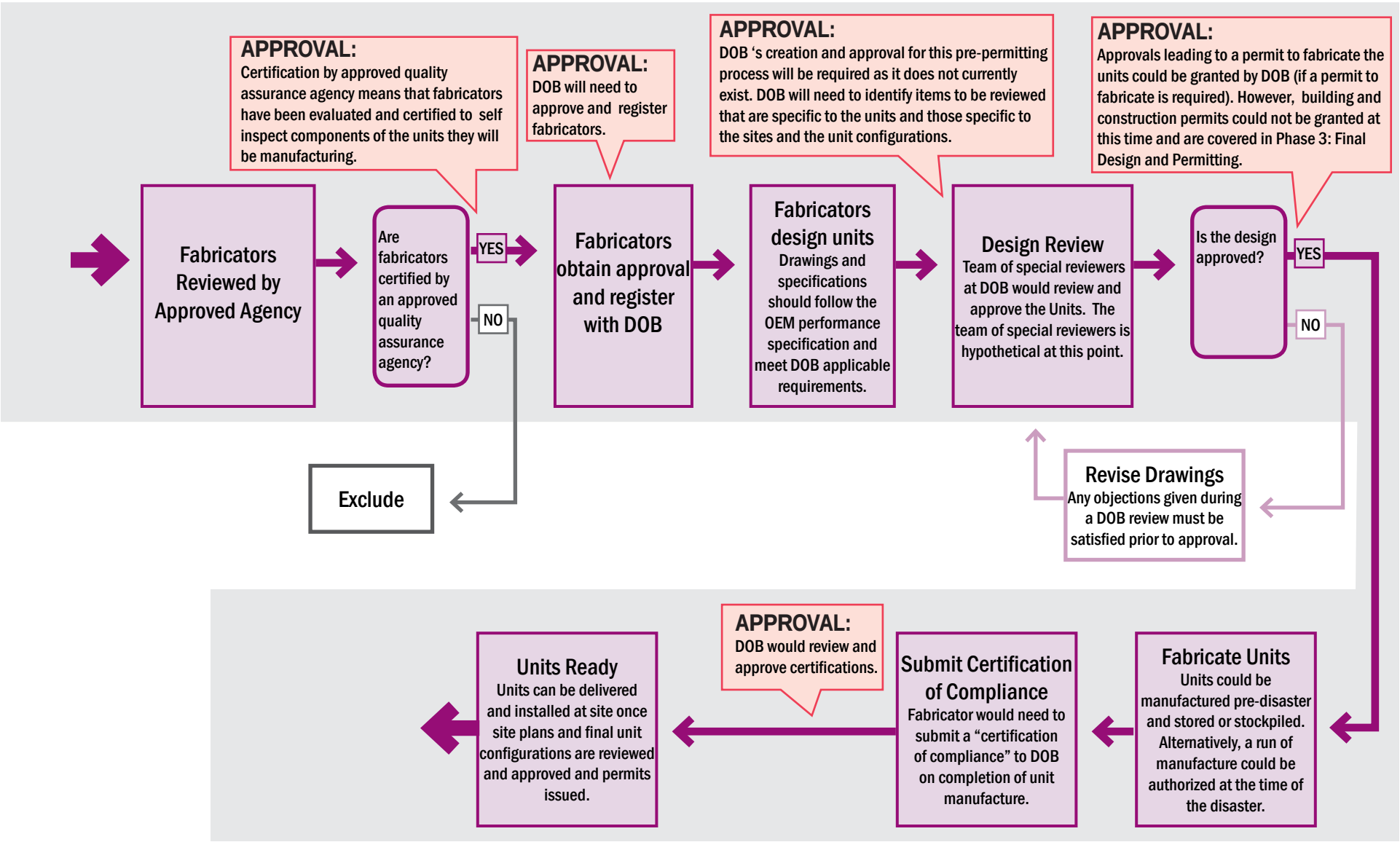
Pre-Approved Modular Units

	Post Disaster Interim Housing Plan	Fabricator Approval	Unit Specification & Design	Unit Review & Approval
Activities	OEM and regional, state and federal partners currently developing post disaster housing plan.	Fabricators of the modular Interim Housing units approved by a certified quality assurance agency and register with DOB's Office of Technical Certification and Research.	Fabricators design units in accordance with NYC OEM Interim Housing Unit Performance Specification and according to NYC Building Code and other applicable regulations.	A task force at DOB reviews modular unit drawings and specifications for compliance with relevant sections of NYC Building Code and Multiple Dwelling Law. Only those components relating to the modular units themselves could be reviewed prior to a site design; this review would not result in a building permit. No such pre-approval process currently exists, but is currently being contemplated.
Entities Involved	OEM, RIC, DCP, DOB, DDC, FEMA, HUD, NYCHA	DOB	Fabricators, OEM, DDC, DOB	DOB, HPD, FNDY

0 Pre-Disaster Planning & Permitting	1 Site Selection and Preliminary Design	2 Environmental, Land Use, and Public Review	3 Final Design and Permitting	4 Construction

Interim Housing Development Phase 0: Pre-Disaster Design & Permitting

Considerations and Approvals



Interim Housing Development Phase 1: Site Selection & Preliminary Design

Components and Coordination

Project Identified

Site Identified
Gain Access to Site

Preliminary Site Design

	Neighborhood Assessment / Site Selection	Urban Design Analysis	Site Survey	Preliminary Design
Activities	Multi-agency mapping of post-storm conditions to identify potential sites. Factors relating to constructability and livability should be considered.	Analysis of site and context including: • adjacencies • access / circulation	Engineering Site Survey Including: • utilities / infrastructure • soil • topography • structures	Implement urban design strategies to produce initial site plan.
Entities Involved	OEM, FEMA, USACE, city agencirs, private sector	OEM, DCP, Designer, site owner	OEM, FEMA, USACE, Engineer, site owner	Designer , OEM, DCP, FEMA, USACE

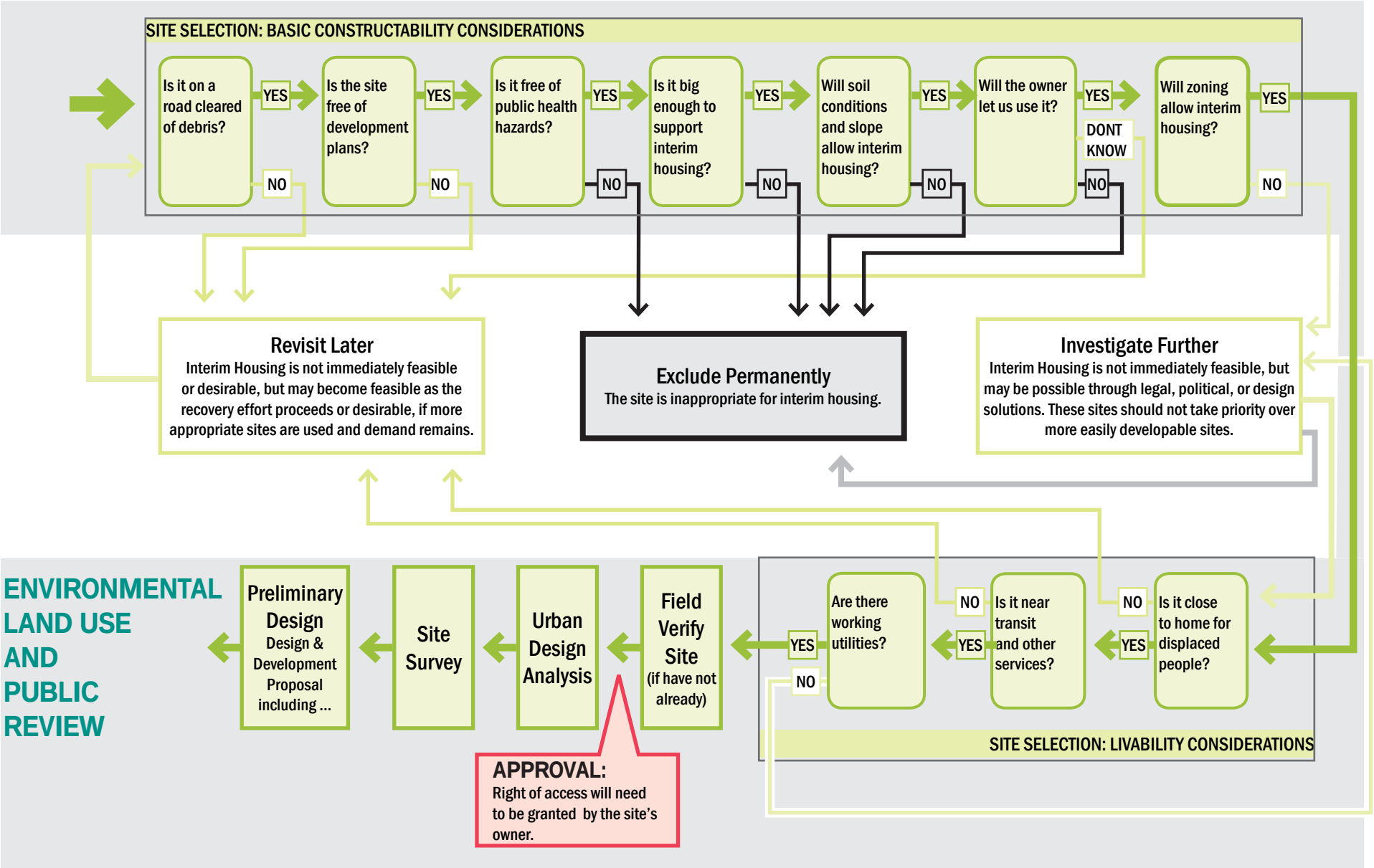
0 Pre-Disaster Planning & Policy	1 Site Selection and Preliminary Design	2 Environmental, Land Use, and Public Review	3 Final Design and Permitting	4 Construction

2 - 3 weeks

Interim Housing Development Phase 1: Site Selection & Preliminary Design

Considerations and Approvals

(p.) Page numbers reference refer to locations in chapter on site selection where additional information and descriptions of each question can be found.



Interim Housing Development Phase 2: Environmental, Land Use, and Public Review

Components and Coordination

Site Development Proposal / Preliminary Site Design

Land Use Approval
Environmental Approval
Approval to Use Site

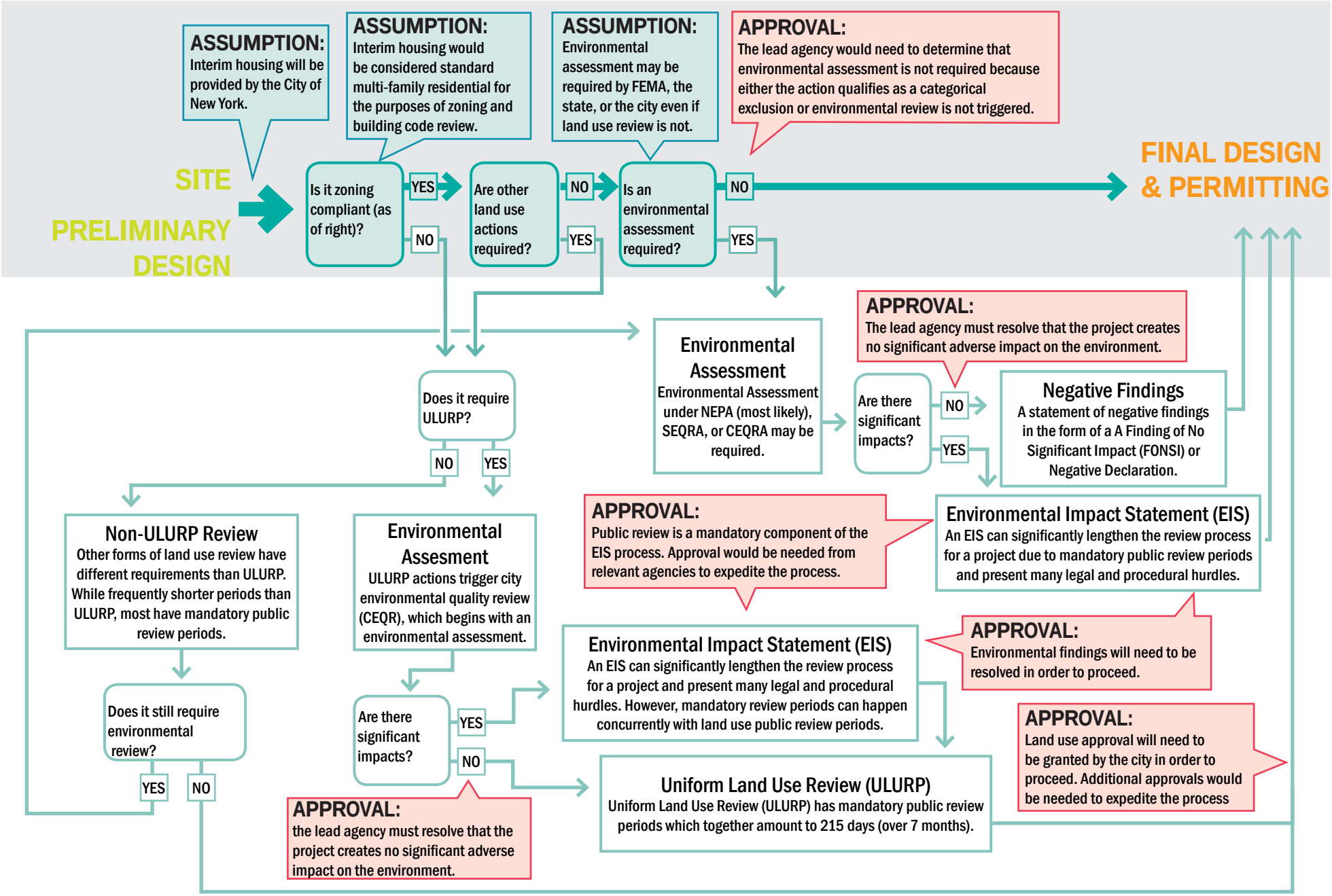
	Land Use Review	Environmental Review	Public Review	Negotiate Right to Use Site
Activities	The proposal will need to be reviewed for compliance with local (New York City) land use laws (zoning resolution) and the necessary approvals obtained: • zoning analysis to determine if the proposed Interim Housing is zoning compliant; if not, land use actions will be required. • determination if other non-zoning land use actions are required. • If land use actions are required, determine whether or not to proceed. • undertake necessary land use review or apply for waivers, rulings or overrides necessary to expedite the process. For the this case study, it was assumed that Interim Housing would be considered standard multi-family residential for the purposes of review and permitting. Note that the zoning code does not define "interim" or "temporary" housing.	The project will need to be reviewed for compliance with applicable environmental and historic preservation laws: • Determine if an environmental assessment is required (under CEQRA, SEQR, or NEPA) • If required, prepare Environmental Assessment Statement based on applicable environmental law (CEQRA, SEQR, or NEPA) • Determine findings and if an environmental impact statement (EIS) is required. If so, determine whether or not to proceed.	Land use and environmental review processes require a period of public comment or review. The length and type of public review may vary. A standard Uniform Land Use Review process takes at least seven months. Public input on permanent redevelopment will be ongoing.	A lease, license, permit, or other agreement with the owner of the property will need to be obtained.
Entities Involved	DCP, FEMA, USACE, CPC, City Council, Borough President's Office, Mayor's Office, EDC	OEC, DEP, FEMA, USACE, DCP, OEM	OEM, DCP, DOB, Community Boards, Borough Presidents, City Council Local NGOs	OEM, FEMA, USACE

0	1	2	3	4
Pre-Disaster Planning & Policy	Site Selection and Preliminary Design	Environmental, Land Use, and Public Review	Final Design and Permitting	Construction

2 - 4 weeks

Interim Housing Development Phase 2: Environmental, Land Use, and Public Review

Considerations and Approvals



Interim Housing Development Phase 3: Final Design and Permitting

Components and Coordination

Construction Documents & Specifications

COORDINATION:
Establishment of a pre-disaster review and approvals process for components of the design relating only to the prefabricated units will require further coordination with DOB.

Contractor Agreement
Building Permit
Construction Permits

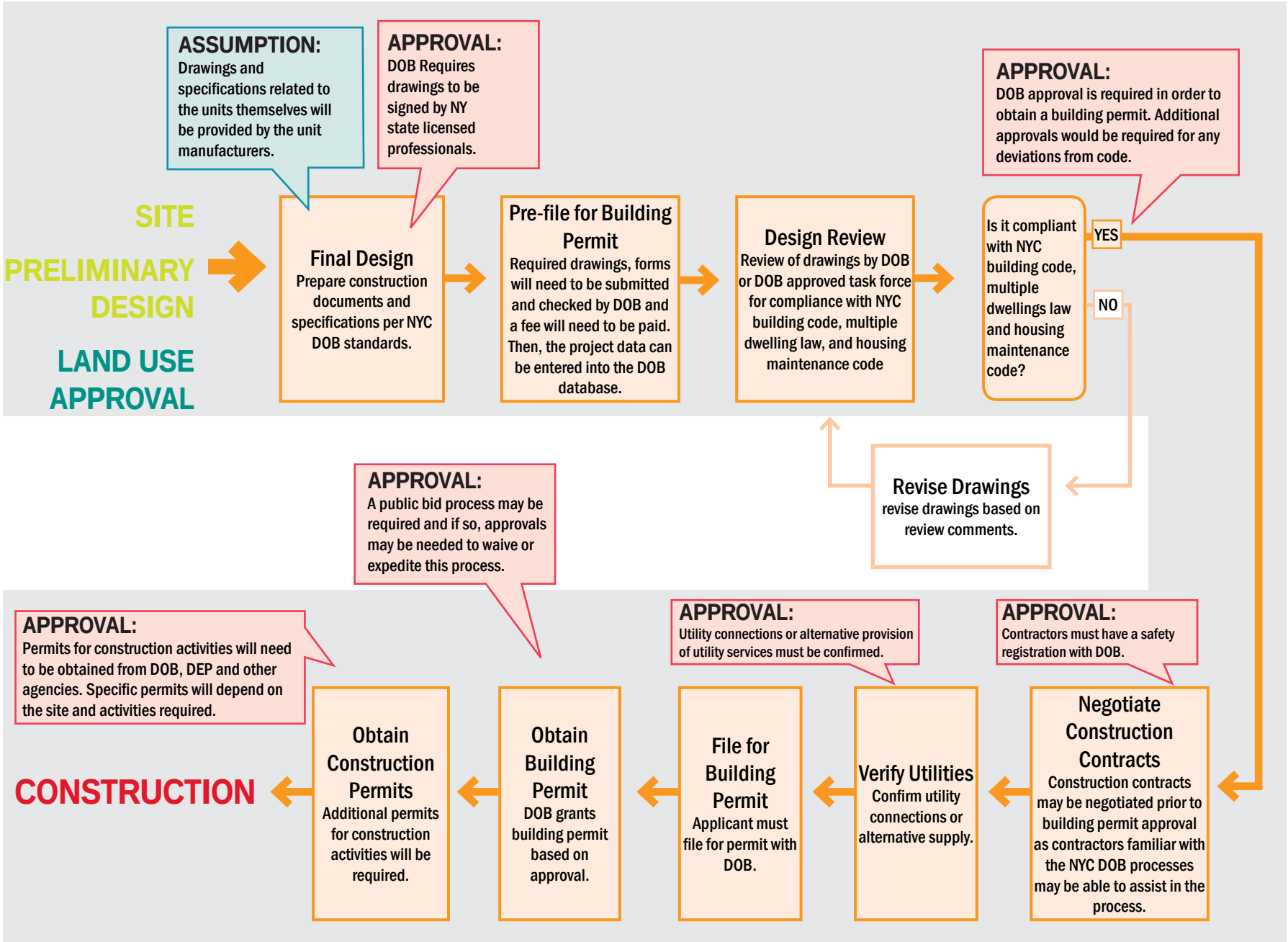
	Final Design	Design Review	Utilities Verification	Negotiate Construction Contracts	Obtain Permits
Activities	Drawings and specifications meeting NYC DOB standards will need to be prepared, including, but not limited to: • Architecture, Builders Pavement, Landscape, Structural, MEP, HVAC, ... Forms including PW1 and applicable addenda will need to be prepared. The DOB should be consulted for the full list of requirements. The city requires drawings to be signed by New York State Licensed architects and engineers.	Drawings and specifications must be reviewed for compliance with: • Zoning (Zoning Code) - should have been vetted already in land use review • Egress (Building Code) • Multiple Dwelling Law • Housing Maintenance Code This review should be completed by the DOB, or a taskforce approved by the DOB. Drawings may need to be revised based on review. DOB may be able to pre-approve components of the design relating only to the modular units. A review group for such pre-approvals would need to be established at DOB and the review undertaken prior to a disaster event.	Utility connections and capacities required for the project would need to be verified with the relevant utility providers	In New York City, contractors have a safety registration with DOB. Depending on lead agency, there may be requirements for a public bid process.	In addition to a Building Permit, permits will be required for many construction activities including, but not limited to: • Erosion control • Use of a crane • Access or street closures • Debris / construction trash removal
Entities Involved	**DOB**, Designers, Engineers, DCP	**DOB**, Designer, FDNY, HPD, DEP, DSNY	DEP, ConEd, Keyspan, HPD, DSNY	OEM, FEMA, USACE, DDC	DOB, DEP, DEC, DOT, Contractor

0 Pre-Disaster Planning & Policy	1 Site Selection and Preliminary Design	2 Environmental, Land Use, and Public Review	3 Final Design and Permitting	4 Construction

3 - 6 weeks

Interim Housing Development Phase 3: Final Design and Permitting

Considerations and Approvals



Interim Housing Development Phase 4: Construction

Components and Coordination

Begin Construction

Deliver Units to Site

Certificate of Occupancy or Temp. Certification of Occupancy Move In

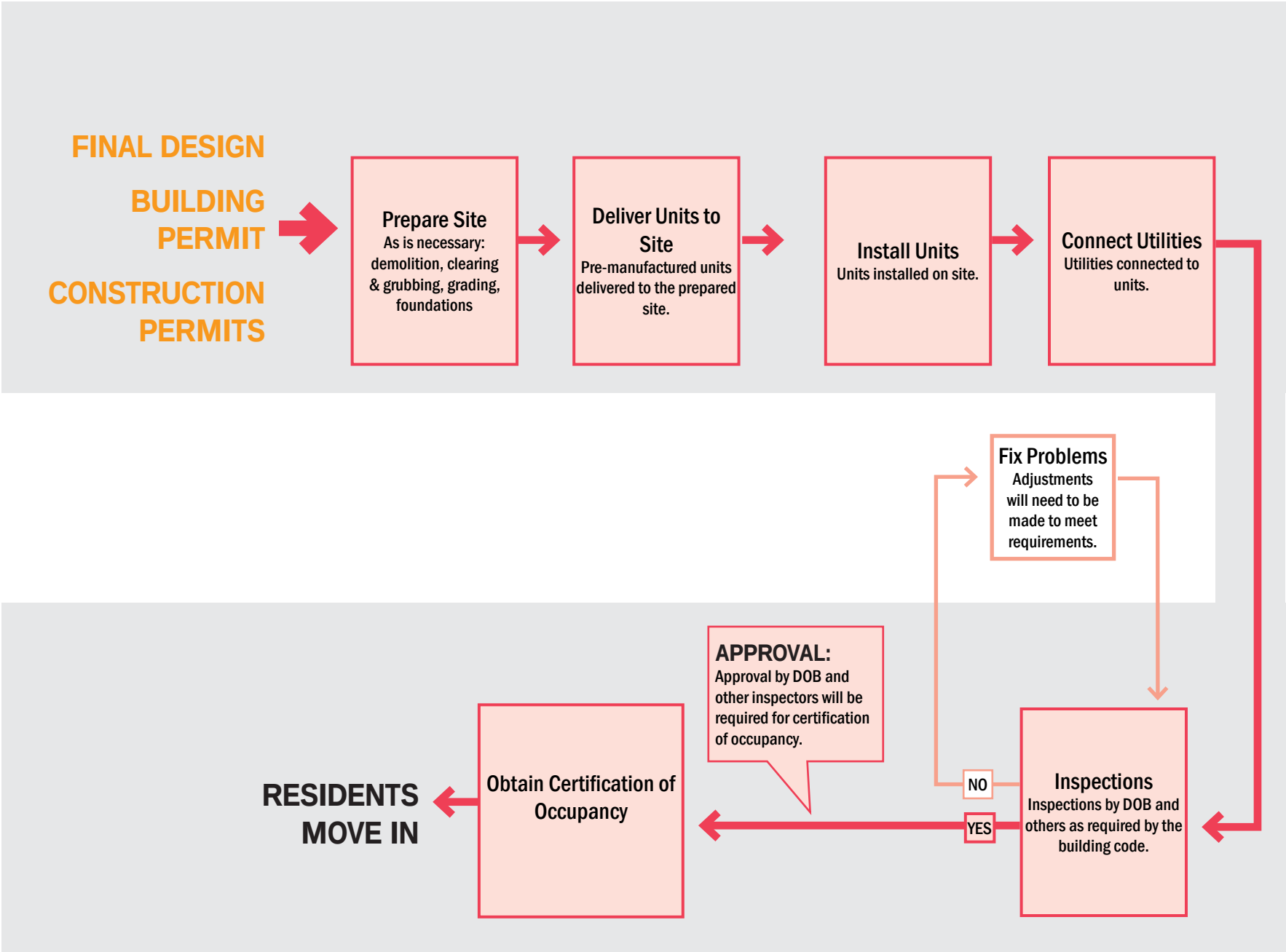
	Site Preparation	Unit Delivery & Installation	Utility Connections	Inspections
Activities	Site preparation including (as required by the site and the design): • demolition, clearing, and grubbing or site as required. • grading if required • foundations	Units delivered to site from manufacturer, stacked, and installed.	Connect to all utilities not provided on-site.	Inspections required for: • plumbing • foundations • structures • materials • mechanicals • fire
Entities Involved	Contractor, DOT, FDNY, DEP, DDC	Contractor, Fabricator, DOT, DDC	Contractor, ConEd, DEP, Fabricator, DDC	DOB, FDNY, HPD, DEP, DSNY, Fabricator

0 Pre-Disaster Planning & Policy	1 Site Selection and Preliminary Design	2 Environmental, Land Use, and Public Review	3 Final Design and Permitting	4 Construction

4 - 8 weeks

Interim Housing Development Phase 4: Construction

Considerations and Approvals



Where will interim housing go in the city?

Site Selection

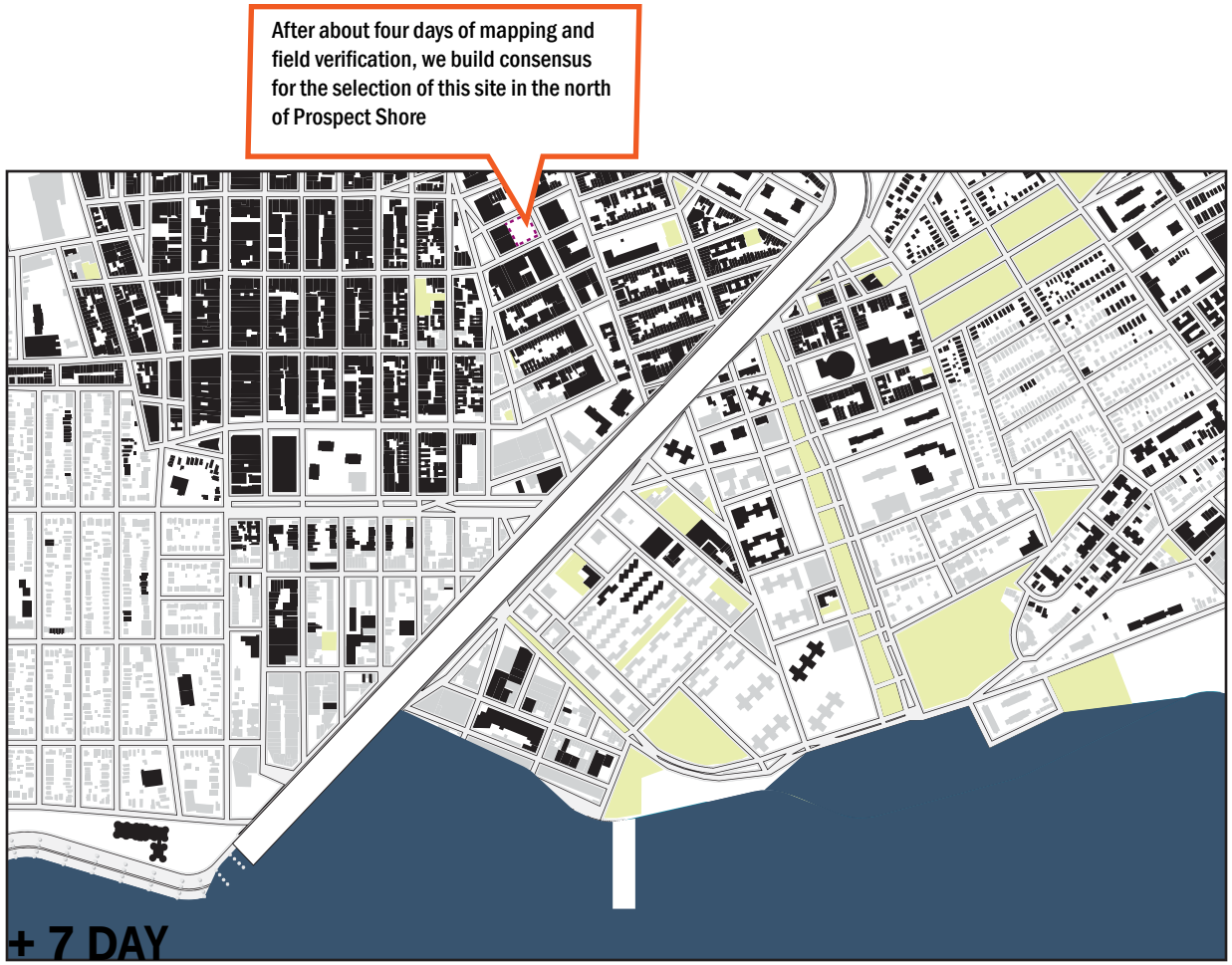
A week after the storm, many residents of Prospect Shore and other impacted parts of the City are doubling up, staying in congregant shelters, or staying out of town. The housing stock here has been badly damaged. Existing housing resources are clearly insufficient to accommodate the displaced population. The Interim Housing plan is implemented. The process begins with site selection.

We begin by mapping what we know about Prospect Shore. We use satellite imagery, property and street maps, topography, and data on ownership, zoning, transit, and amenities.

We also map real time data sets gathered in the field by emergency operatives. This data includes utility recovery, damage assessment, debris removal, sheltering, other staging and logistics operations. We'll also be checking in with larger city and regional efforts for long term planning and large-scale environmental remediation.

With this compiled data in hand we begin to narrow our field of options. We first consider what sites are physically feasible. From that initial set we begin to prioritize which sites are best suited for Interim Housing at the moment. Site selection will be an ongoing and iterative process. A site that is a best option on Day 7 maybe not be the best option on Day 100.

There are many regulatory and constructability issues that weigh the selection of an appropriate site. This case study follows a path of least resistance.



Constructability Considerations

Is it accessible by roads cleared of debris?

Key considerations:

- Site assessment and survey teams need to be able to get to the site.
- Trucks, cranes and other equipment necessary to deliver and construct the units need to be able to reach the site.

Immediately after the storm, Prospect Shore is blanketed with a thick layer of debris from buildings, vehicles, trees and everything else swept up in the storm surge. Search and rescue teams arrive first. They are followed by other operations including debris clearance, damage assessment, utility restoration, emergency medical care, and food and water distribution. We incorporate information from these groups with our site selection process.

We focus first on those areas that would become accessible within the first week after the storm. Such areas include sites adjacent to cleared roads, on this side of the police perimeter erected around damaged areas within which search and rescue operations continue.

There are many variables involved in the debris clearance and immediate life safety operations, so we concentrate on the sites we can identify as clear at the moment of mapping.

Constructability Considerations

Is it available?

Key considerations:

- Is the site unoccupied by buildings under repair or being rebuilt?
- Are there plans to permanently rebuild or redevelop the site within two years, or the anticipated span of interim housing?
- Is the site currently being used for other recovery efforts?

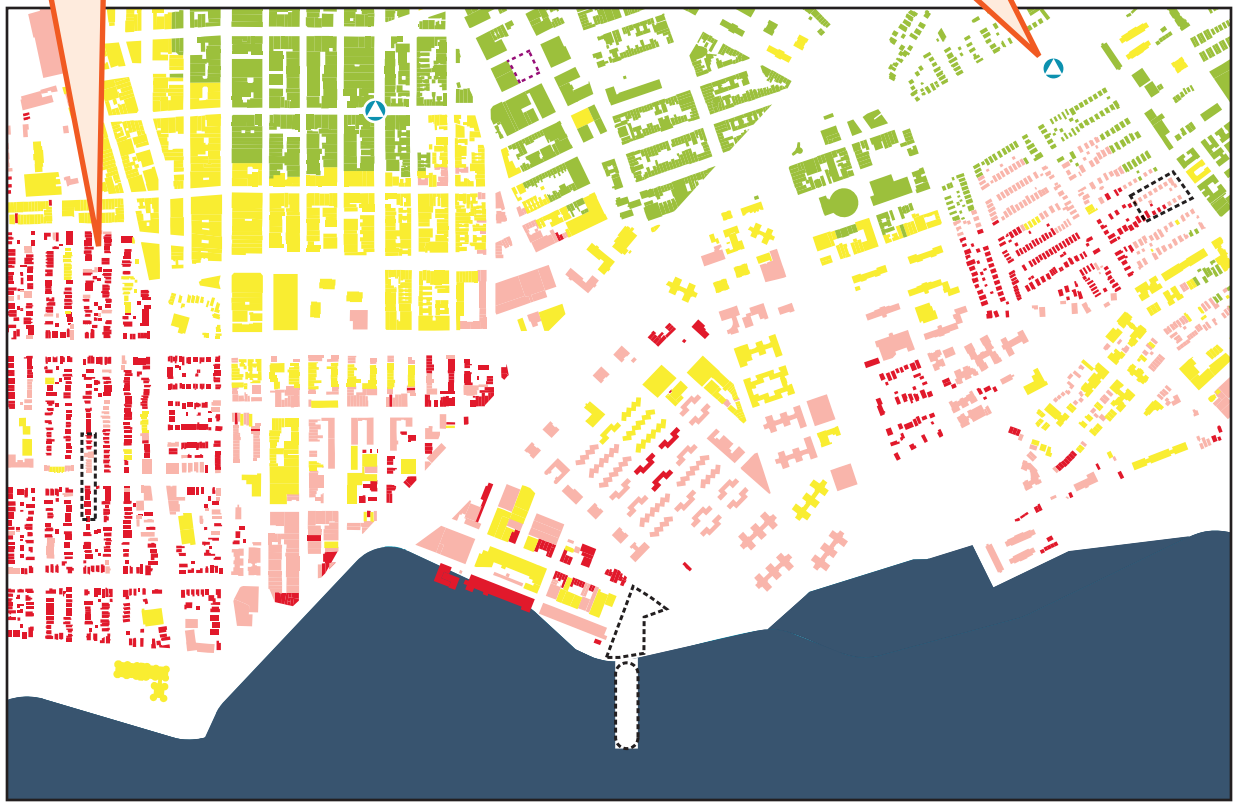
Interim Housing happens simultaneously with permanent reconstruction, and sometimes in close proximity. The use of land for interim housing is weighed against other post-disaster needs and long-term recovery plans. Some sites may be unavailable in the short-term because they are occupied by immediate recovery uses. Other sites are part of long-term recovery and reconstruction efforts and interim housing should not interfere with these plans.

We immediately exclude intact and under repair buildings as potential sites. While we retain sites with destroyed buildings and buildings slated for demolition (cleared sites) in our list of potential sites, we recognize that these would require more investigation, as long-term recovery and construction would take first priority.

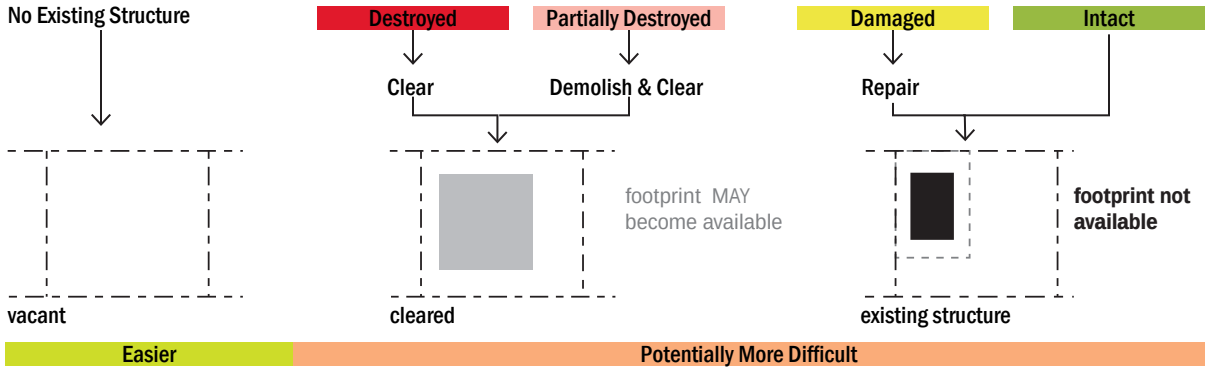
COORDINATION:
Information from **OEM's** damage assessment teams help identify areas where cleared land may become available in the future.

ASSUMPTION:
Permanent repair and recovery takes precedence over interim housing. Sites with owners who are planning to rebuild immediately are eliminated from consideration.

COORDINATION:
Gathering information from **all post-disaster taskforces** is critical to ensure that interim housing does not conflict with other recovery efforts.



Site Development Conditions:



Livability Considerations

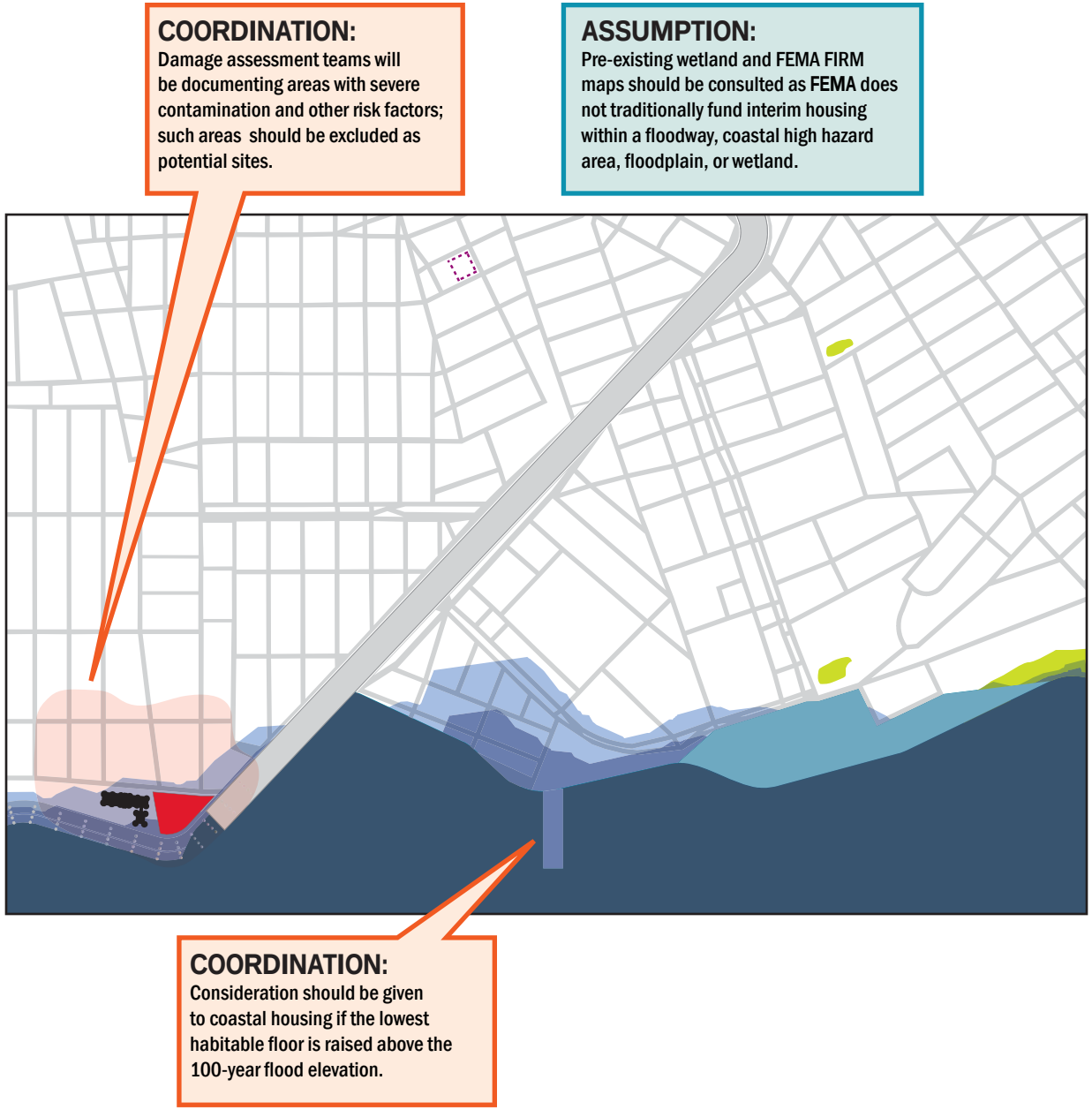
Is the site safe?

Key Considerations

- Is it outside of floodways and coastal high hazard areas?
- Is it outside the 100-year flood zone?
- Is it free of designated brownfields?
- Is the site free of evident contamination hazardous to basic human health?

Many people of Prospect Shore have just undergone a traumatic event that has displaced them from their homes. Their interim housing should not expose them to further harm, whether it is flooding from another storm, or other natural or human-caused risk factors.

In identifying sites we consider key environmental risk factors that would likely result in unsafe living conditions for interim housing residents including clear contamination issues and flood hazard issues.



Constructability Considerations

Is it big enough?

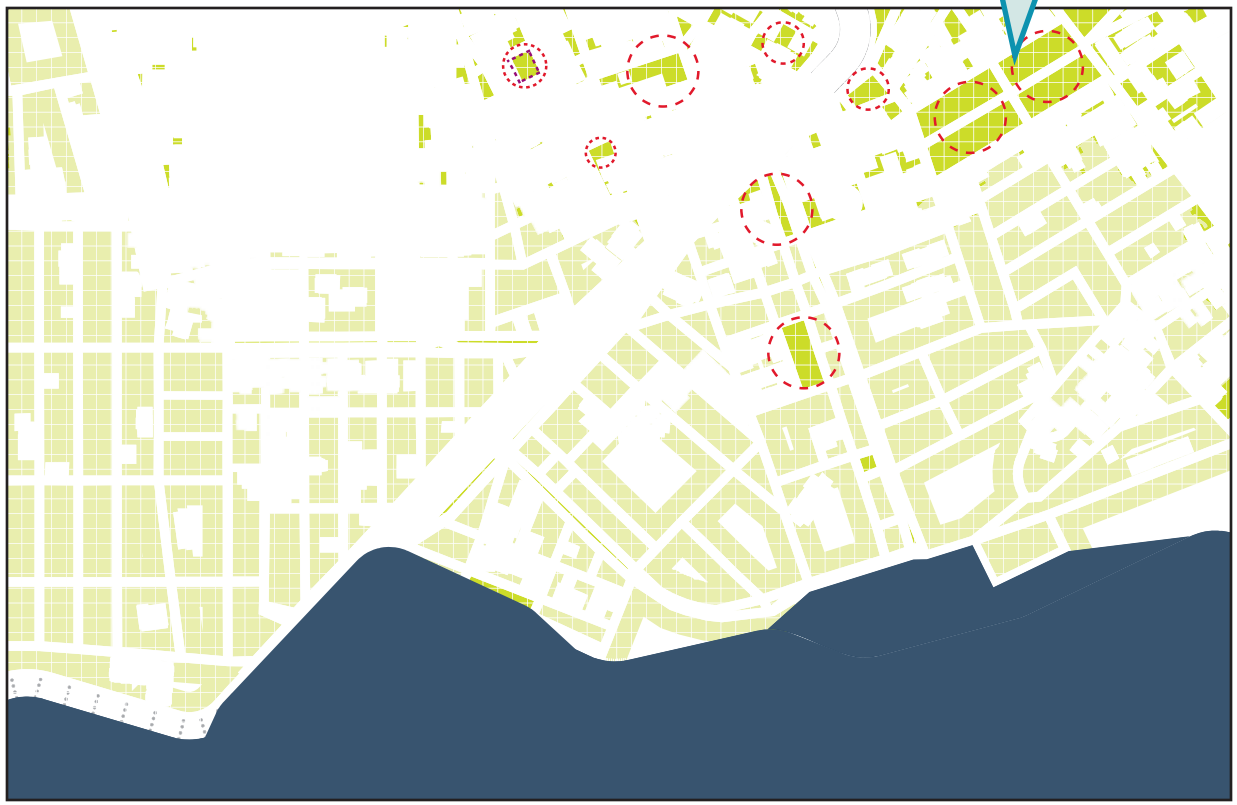
Key Considerations:

- Can the site accommodate the minimum footprint, with the necessary setbacks from roads and intact or under repair buildings?

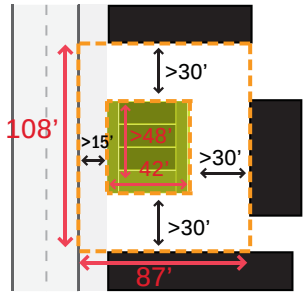
Prospect Shore is densely developed and finding sites that are large enough to support interim housing is a challenge. We assume look first for sites larger than a half acre. Sites this large meet our basic requirements for providing density with appropriate set backs.

We look first in the areas that are accessible at the moment. We leave consideration of land that is now being cleared of storm debris and destroyed buildings to a later date when more is known about those conditions. This narrows are field of options very quickly.

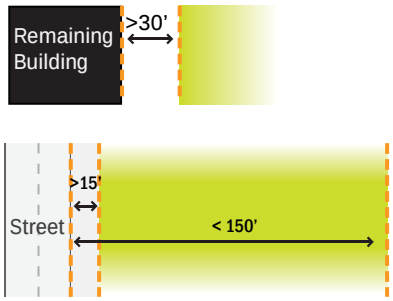
ASSUMPTION:
Larger sites are preferable to smaller sites for multi-family housing.



Most Constrained Site:



Adjacency Constraints:



* Sites must be adjacent to streets

ASSUMPTION:
The basic housing module we use is 12'x30' per the IHPS. The basic module cluster assumed here contains four floors of three pre-manufactured modules plus circulation (per building and fire code access and egress requirements).

Constructability Considerations

Will soil conditions and slope allow interim housing?

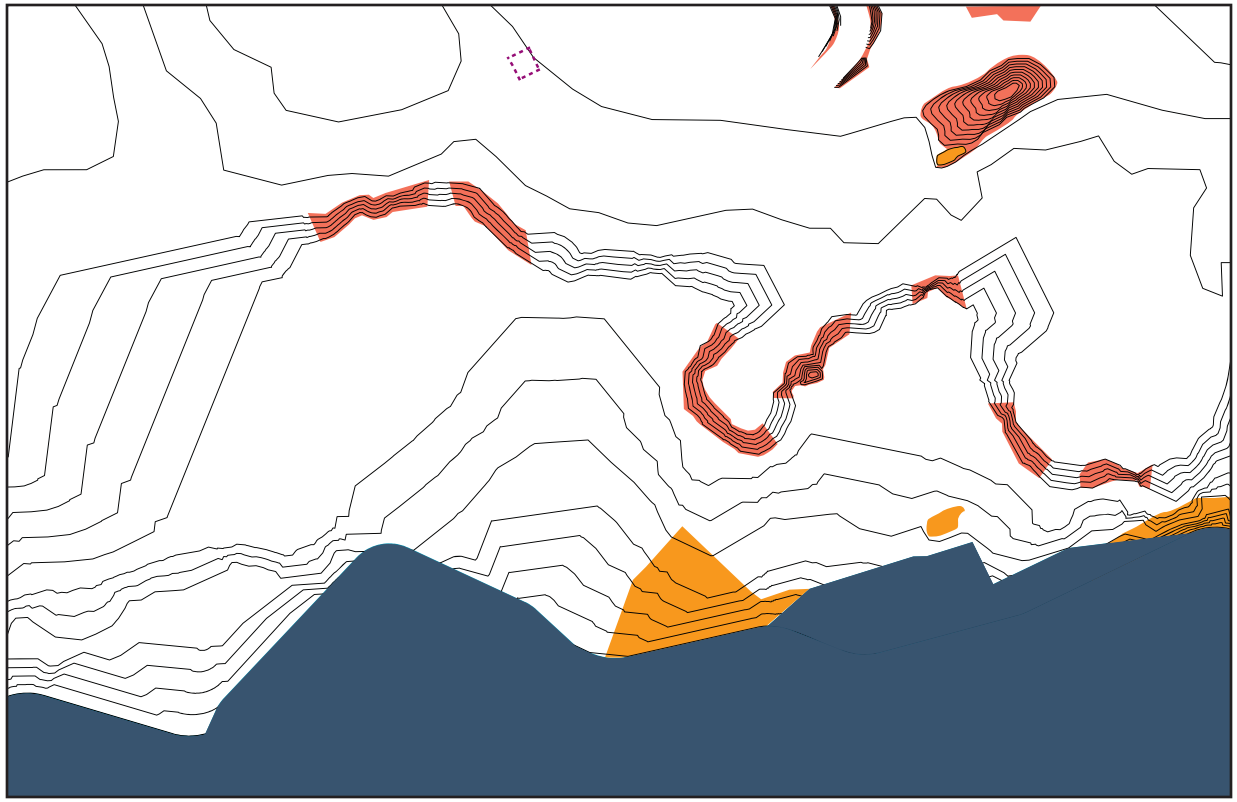
Key considerations:

- Will the soils support structures?
- Is it sloped less than 12%?

The best sites for interim housing need minimal site preparation. Steep slopes and unstable soils require complicated foundations and sometimes lots of ramping and for accessibility.

We generate a slope map of Prospect from existing topographical information. We compile soil profiles which show the soil density and bearing capacity from individual owners.

We also determine the frost line, which helps to determine how deep any temporary foundation will need to be placed.



Slope Constraints:

< 2%	Ok, but grading may be needed to ensure drainage.
2 - 5%	Best, drains and easy to meet ADA requirements.
5 - 8%	Good, some adjustments may need to be made for accessibility.
> 12%	Bad, too steep to easily construct interim housing and access.

Constructability Considerations

Will the owner let us use it?

Key considerations:

- Can you determine the owner?
- Can you contact the owner?
- Is the owner willing to have the site used for Interim housing?

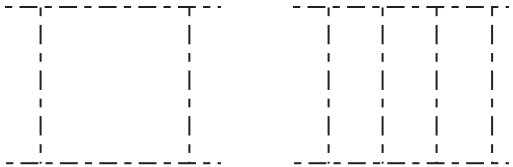
We cannot begin design without the permission of the site's owner. It may be difficult to locate landowners; some of them are likely displaced by the storm. For this reason, we take a strong preference for publicly owned property.

Once a site is identified and owner located, survey and assessment teams request access in order to investigate it. If access is granted and the site is deemed appropriate, permission to use the site is requested.

Types of Owners:

Public	Private
• City	• Individual
• State	• Developer
• Federal	• Institution
• Multi-State Authority	• Not-for-profit
Preferred	Potentially More Difficult

Number of Owners:



1 lot → 1 owner

multiple lots → possibly multiple owners

Preferred | Potentially More Difficult

ASSUMPTION:
Interim housing sites will not be purchased.

ASSUMPTION:
Public ownership is preferred in order to expedite the lease process, but many public sites, especially parks and parking lots, will be occupied in the short-term by other recovery operations.

Constructability Considerations

Will zoning allow interim housing?

Key Considerations:

- Is interim housing compliant with the site's zoning?

To determine compliance with zoning we need to have preliminary site plan which includes the height, bulk , and number of units. There are many other zoning requirements that must be considered including floor area ratios, open space ratios, residential density, and parking ratios. The Department of City Planning is consulted on questions relating to zoning.

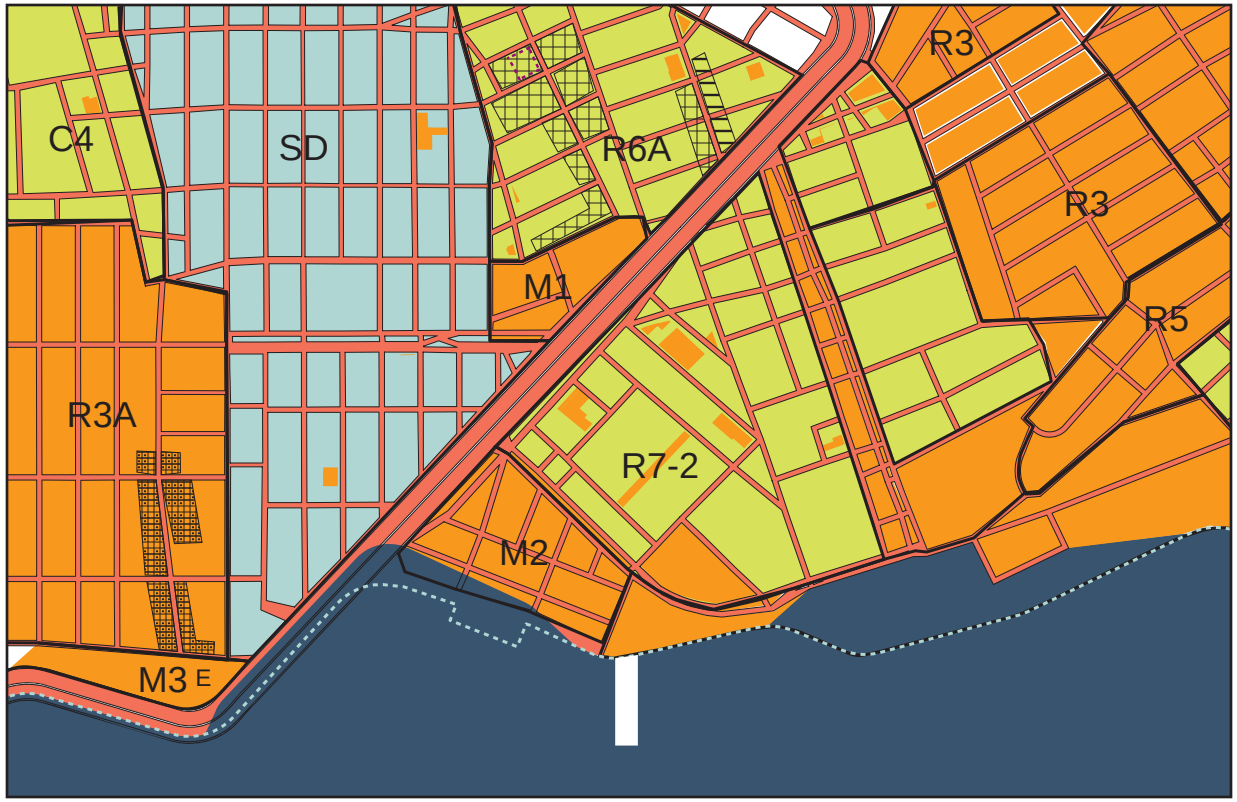
Prospect Shore has several areas with zoning that allow 3 and 4-story multifamily residential with commercial uses on the ground floor. In this case study, we focus on an area zoned medium density residential (R6a with a commercial overlay)

Because interim housing is temporary, any negative long-term impacts of the project on the permanent character of the neighborhood should be minimal. On the contrary, we try to design interim housing in such a way to protect and heal the character of the neighborhood.

ASSUMPTION:
Interim housing as presented in the playbook will be considered "multi-family housing".

COORDINATION:
DCP should be consulted on all zoning and land use questions. Further consideration will need to be given to the legal and zoning definition of interim housing.

COORDINATION:
A pre-established zoning designation for interim housing could help to ensure that the intent of zoning is protected while the process could proceed "as-of-right."



	May Be Compliant May be possible to construct multifamily interim housing without violating the zoning resolution.	Not Compliant Multi-family Interim Housing as described in this case study would not be compliant with existing zoning.
Residential Districts:	R6, R7, R8, R9, R10	R1, R2, R3, R4, R5
Commercial Districts:	C1, C2, C4, C5, C6	C3, C7, C8
Manufacturing Districts:		M1, M2, M3
Special Districts:	Varies (If a site is within a special district, the specific requirements of that district must be studied)	
Other:		Mapped Parks, Mapped Streets

Livability Considerations

Is it close to home?

Key Considerations

- Is the site in a neighborhood where residents have been displaced?

The people in Prospect Shore want to stay close to home. They want to be with their friends and family, continue with their jobs, school, church and book clubs. Most of all, they want to take part in the reconstruction effort. That's why we are looking for an interim housing site in Prospect Shore.

We have honed in on a location that looks like it might work. We map out how close it is to the population that we believe is displaced. It seems that if we try to stay close to the higher density area, we can place housing closer to home for more people.

Livability Considerations

Is it near transit and other neighborhood services?

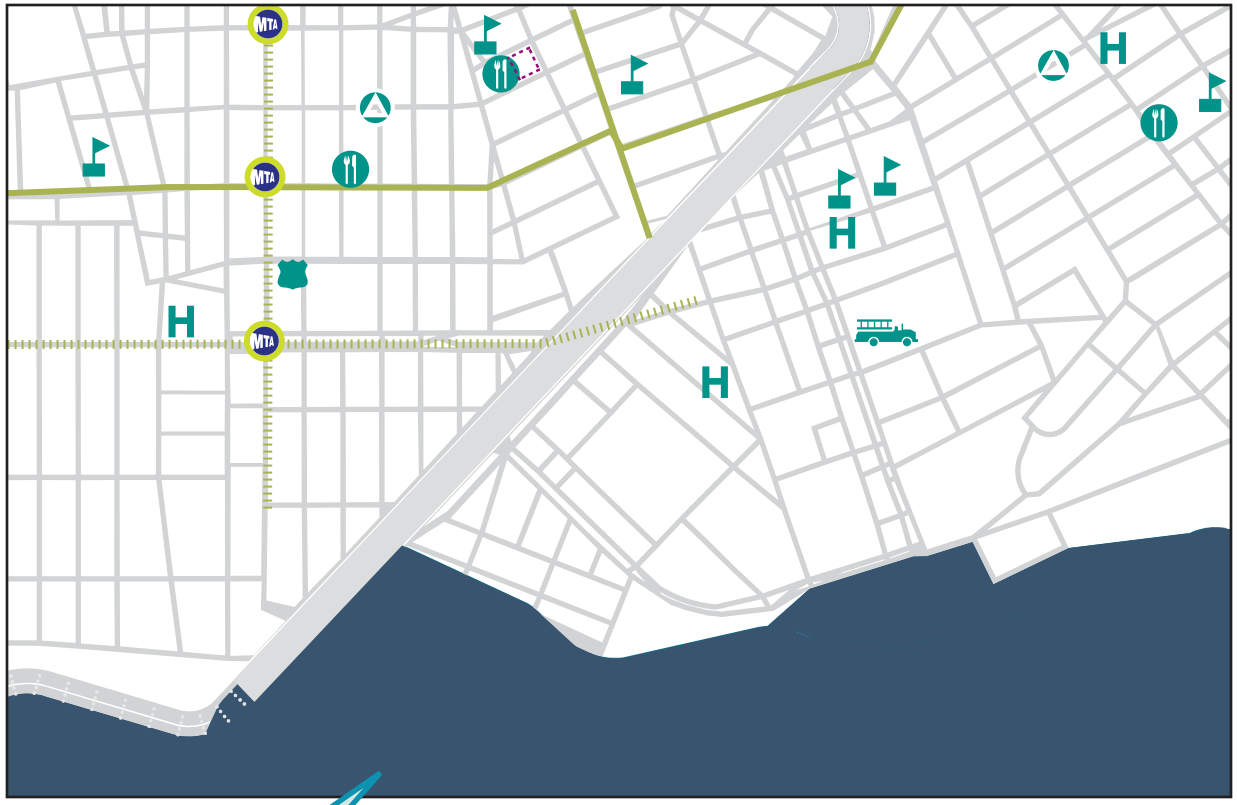
Key Considerations:

- Is the site within a comfortable walk of working public transit?
- Is the site within a reasonable walk or transit ride of critical neighborhood services including a hospital or clinic; schools and childcare; and a grocery, market or food distribution center?

Prospect Shore has great transit access and the people depend on it. Also, many people who do have cars have had them badly damaged in the storms.

Siting housing near working transit connections is critical in order to keep residents well connected to work, services, family, and other needs.

We also try to keep residents near services they need to rebuild. We map out the proximity of the likely site to critical services such as health care, childcare, education, groceries, and other fundamental services.



ASSUMPTION:
Successful interim neighborhoods will depend on more than just housing.

Livability Considerations

Are there working utilities?

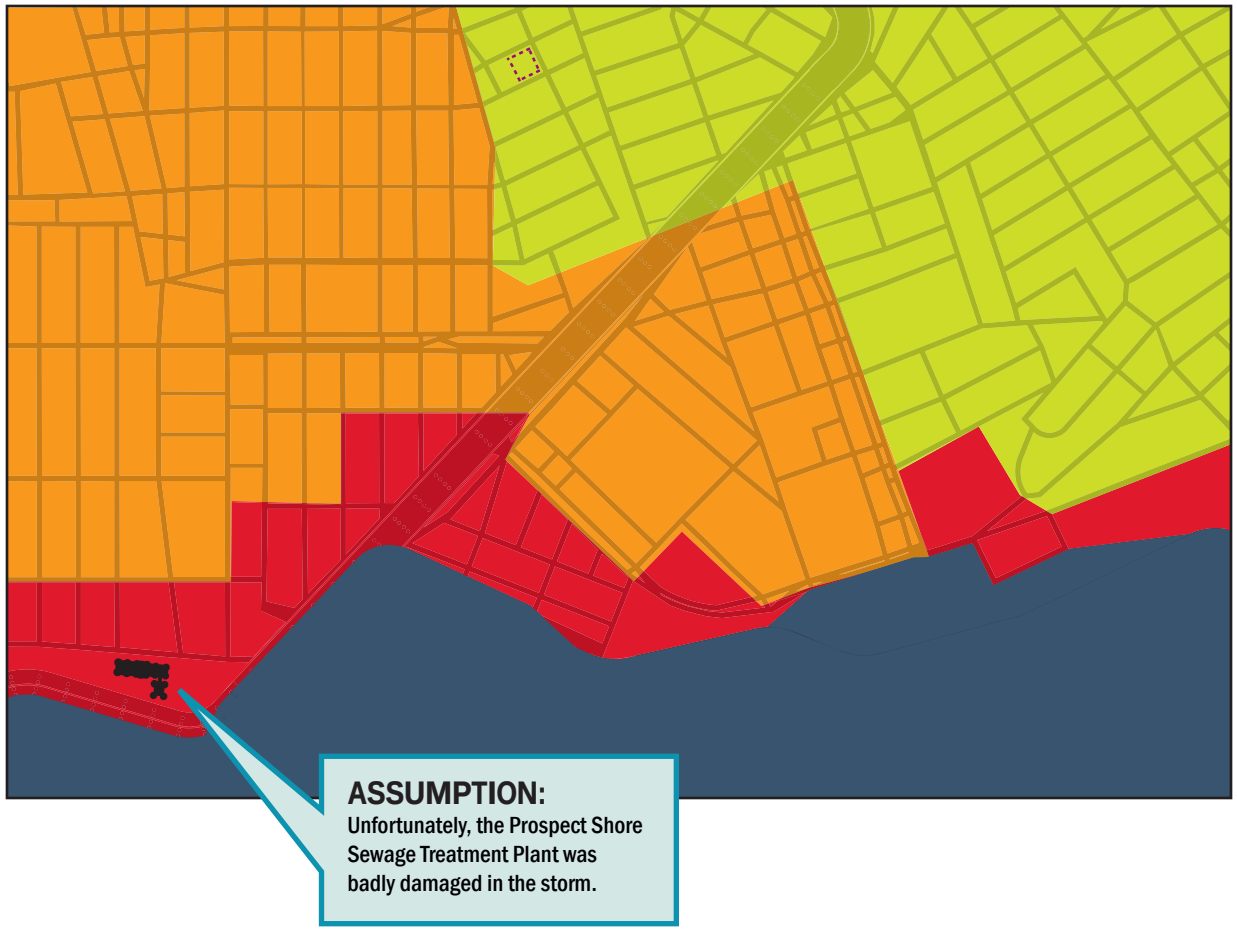
Key Considerations

- Does the site have a connection to operating power, water, sewer and telecommunications?
- If not, when are these services likely to come back on line?

Using available utility connections is preferable when possible to ensure ease and rapidity of construction. It also will provide residents with a close to normal experience.

Although it is preferable to stay “on the grid” when possible; we investigate various conventional and alternative technology options for electricity, sewerage, water, and storm water that would create on-site provision of all or part of necessary utilities. This is documented in the appendix of the case study.

We intend the interim housing to site lightly on the ground. We try to make an effort to minimize the reliance of these units on existing utilities.



Field Verify Sites

The “windshield” survey

We gathered most of this information remotely from GIS and other records, so we thought it best to check it out first hand at this point.

We asked some members of a damage assessment team to verify this site in the field. Their observation confirms our information.

COORDINATION:
There will be many ongoing recovery and reconstruction efforts after the storm, other field teams may be able perform preliminary site assessments in conjunction with other activities.

Iterim Housing Preliminary Site Assesment Evaluation

pre-entered information to be verified in the field

Access to Transportation and Neighborhood Services	note or confirm the distances to the following services from the site as measured from the boundary of the site. Note changes on map to left or attached neighborhood map.
distance to major road	adjacent
distance to public transit (subway and bus)	subway stop: .66 miles, Bus stop: 500 ft
distance to POD/congregant shelter	POD: 1/4 mile shelter: < 1/4 mile
distance to school & childcare	Public elementary school across street
distance to hospital	1/2 mile
other?	grocery adjacent

Utilities / Infrastructure	confirm these connections in the field to the degree possible. Note where further information is needed. Note changes on map to left or attached site map.
water (note potablility)	available, line in Ave B
electricity	covered (sporadic) line in Ave B
sewer	covered (stressed plant) line in Ave B
gas	—
telecomm (hardline)	line in Ave B, working?
telecomm (cellular, note provider(s))	covered, verizon, AT&T

Location & Size	provide basic information on the sites location, this information should be checked in the field.
longitude / longitude	
borough / block / lot(s)	Hudson : 501 : 1
primary street / cross street(s)	Ave B / btw Dervall & VanCortlandt
Size in acres	.65 (28,500 sf)
Dimensions	180' x 160'

Additional Field Observations

Site Conditions	record field observations on the following questions
Is the site currently being used? If so, what for?	Vacant
Is there debris on site?	Some, nothing larger than a TV
Are there signs of contamination on site?	No
Is there standing water on site?	No

Owner Information	
Owner name	Jay Thrasher
Owner phone	212 617 5729
Owner email	?
Owner Address	27 Prospect Ave
Owner Interest?	Willing to lease /permit

Additional Comments
Stray cats on Site.

Site Typology

What are the most likely?

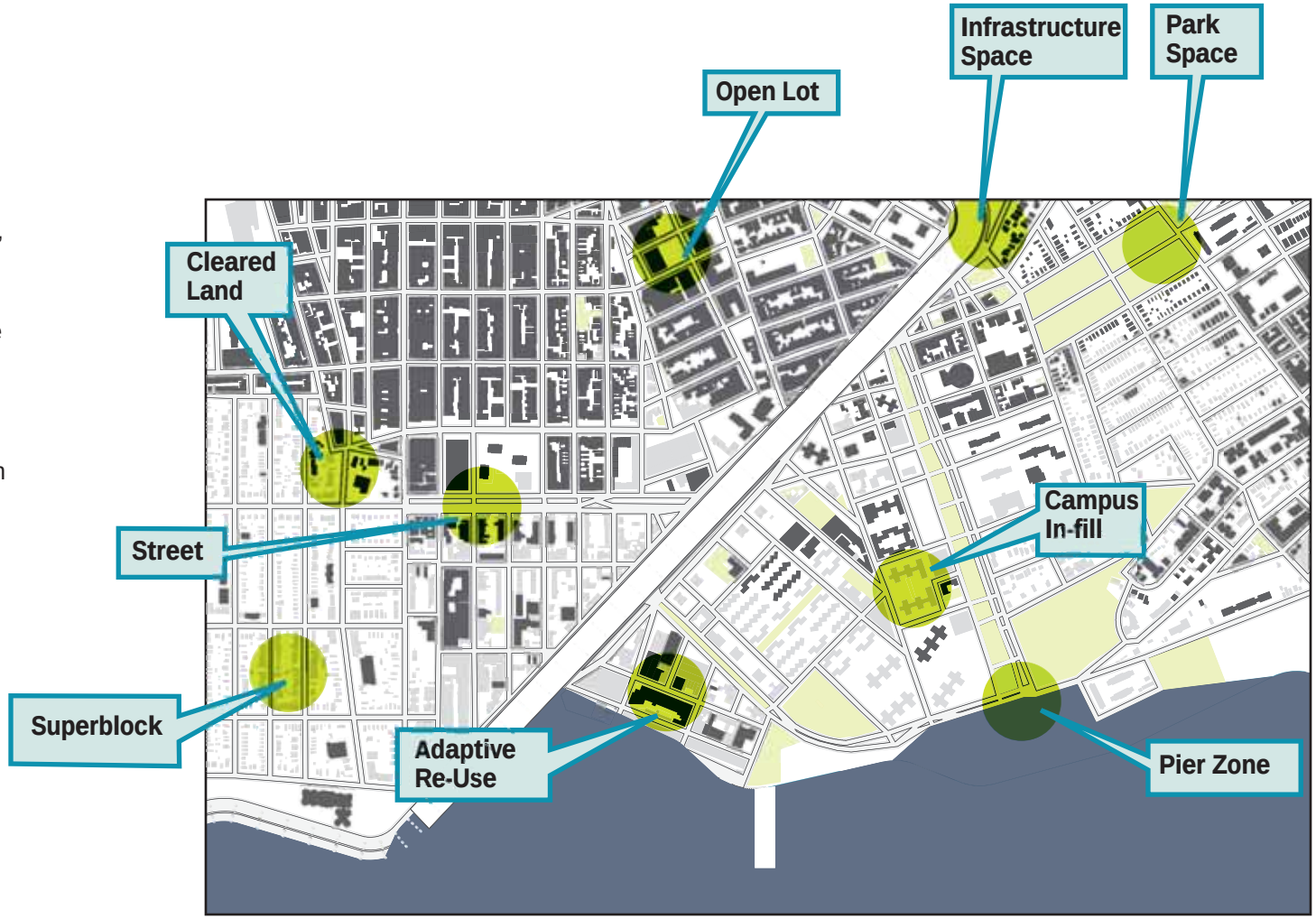
In the process of selecting a site, we discover that there are a variety of “types” of sites that may be available. Every site has its particular characteristics that offer constraints and opportunities for the development of Interim Housing.

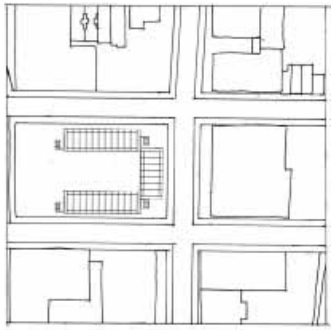
We looked at ten different sites in Prospect Shore which represent ten different sites that are likely to be found in New York City.

We choose the site that has the least amount of physical, political and regulatory hurdles.

However, it is not a given that there will always be a clear “path of least resistance” in choosing a site.

The following page gives an overview of some of the particular challenges in each of the sites we examined.



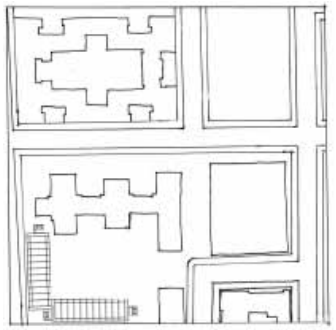


PAVED LOTS:
Lots that are vacant prior to the event including parking lots or undeveloped sites.

Key regulatory hurdles:
Zoning
Environmental review

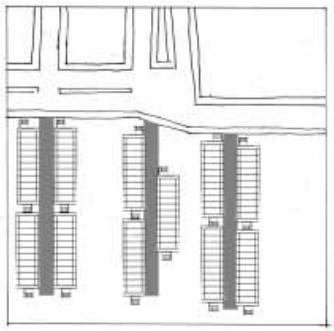
CLEARED LAND:
Land that was developed prior to the storm but has been cleared due to storm damage.

Key regulatory hurdles:
Acquisition/Owner consent
Insurance requirements
Zoning
Environmental review



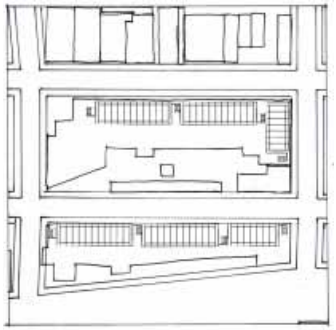
CAMPUS IN-FILL:
Land surrounding existing buildings such as public housing and campus dorms.

Key regulatory hurdles:
Owners' by-laws
(e.g. NYCHA Section 18)
Zoning
Environmental review



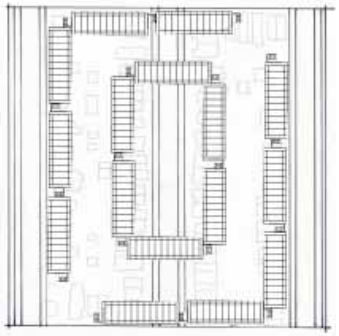
PIER ZONE:
Water-borne housing in the area between the edge of the water and the pier line

Key regulatory hurdles:
NYS DEC
USACE
USCG
PANYNJ
Environmental review



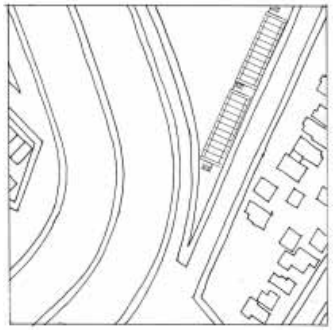
ADAPTIVE RE-USE:
Large buildings that can easily accommodate re-use as housing

Key regulatory hurdles:
Owner consent
Zoning
Codes *(Multiple Dwelling Law)*
Environmental review



SUPER BLOCK
Land spanning temporarily closed streets

Key regulatory hurdles:
FDNY
Zoning
DOT *(revocable consent)*
Utility easements

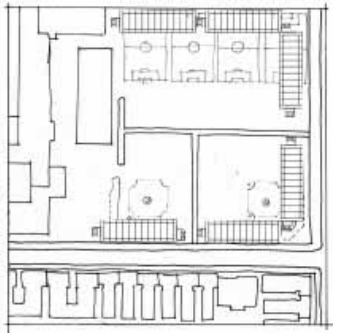


INFRASTRUCTURE SPACE:
Residual space around major infrastructure such as under highways.

Key regulatory hurdles:
Zoning
Environmental Review
Dept. of Health *(Air Quality)*
NYS DOT

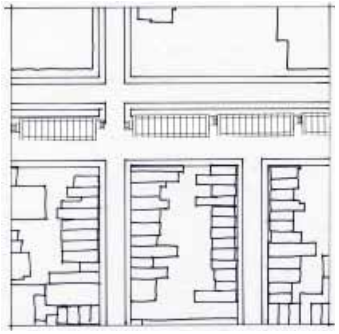
ADJACENT TO PARKS:
Widened sidewalks and areas adjacent to the perimeter of park space.

Key regulatory hurdles:
Zoning
Dept. of Parks
NYS DOT



PARKS:
Open space within public parks and on playing fields.

Key regulatory hurdles:
Zoning
Environmental Review
Recreational
Dept. of Parks



STREETS:
drive-lanes, parking, medians, and sidewalks

Key regulatory hurdles:
FDNY
Zoning
DOT (revocable consent)
Utility easements

What will Interim Housing look like?

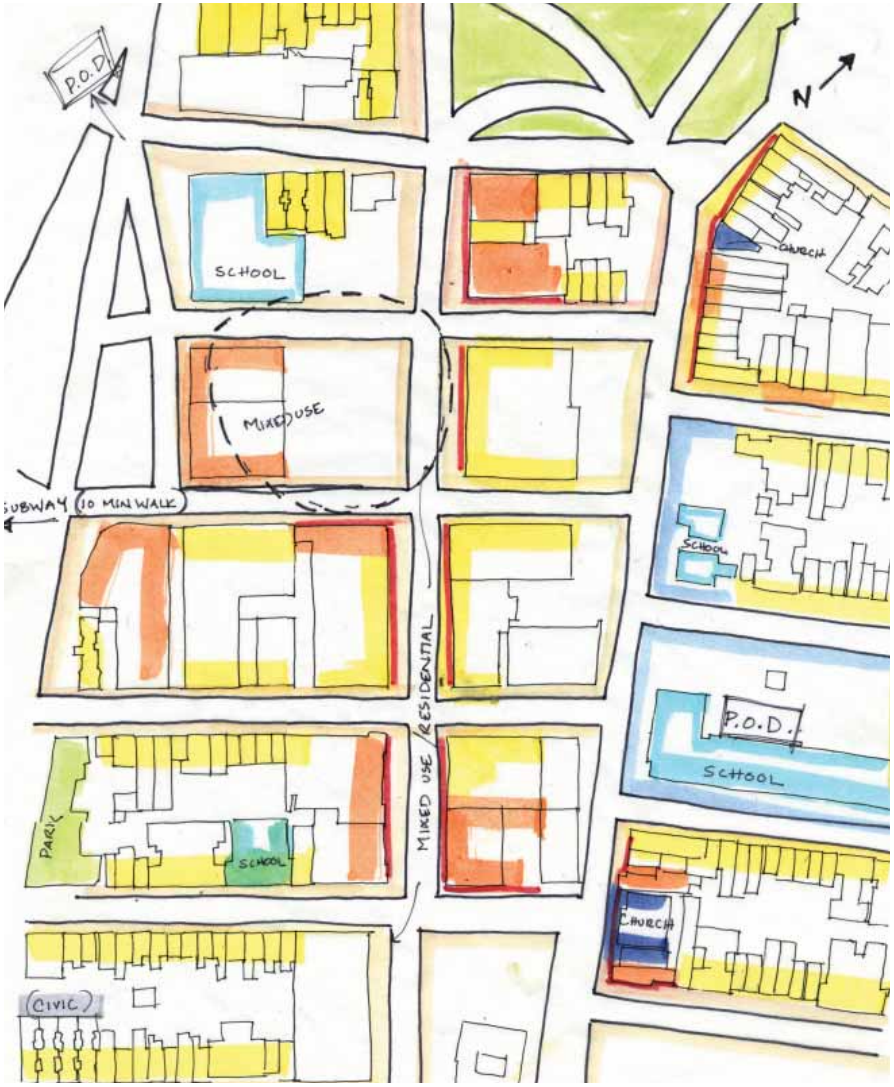
Design process

Survey: Urban Design Analysis

What is the character of the neighborhood?

Good urban design starts with the street and sidewalk, the predominant public space in the city. We begin the site analysis by mapping the streets and sidewalks. We move on to map the boundaries of the site, its adjacencies, and other significant locations in the immediate area. Some of the areas the urban design analysis focuses on include:

- Pedestrian pathways
- Street activity, business restoration and provision of basic household goods.
- Building heights, street walls, setbacks and general massing
- Open space
- Street trees and other landscape or streetscape features
- Other significant locations including laundry, grocery, schools, police station, fire stations, libraries , etc.
- Distance to mass transit
- Distance to important locations for relief and recovery efforts including PODs (points of distribution for food and medicine)

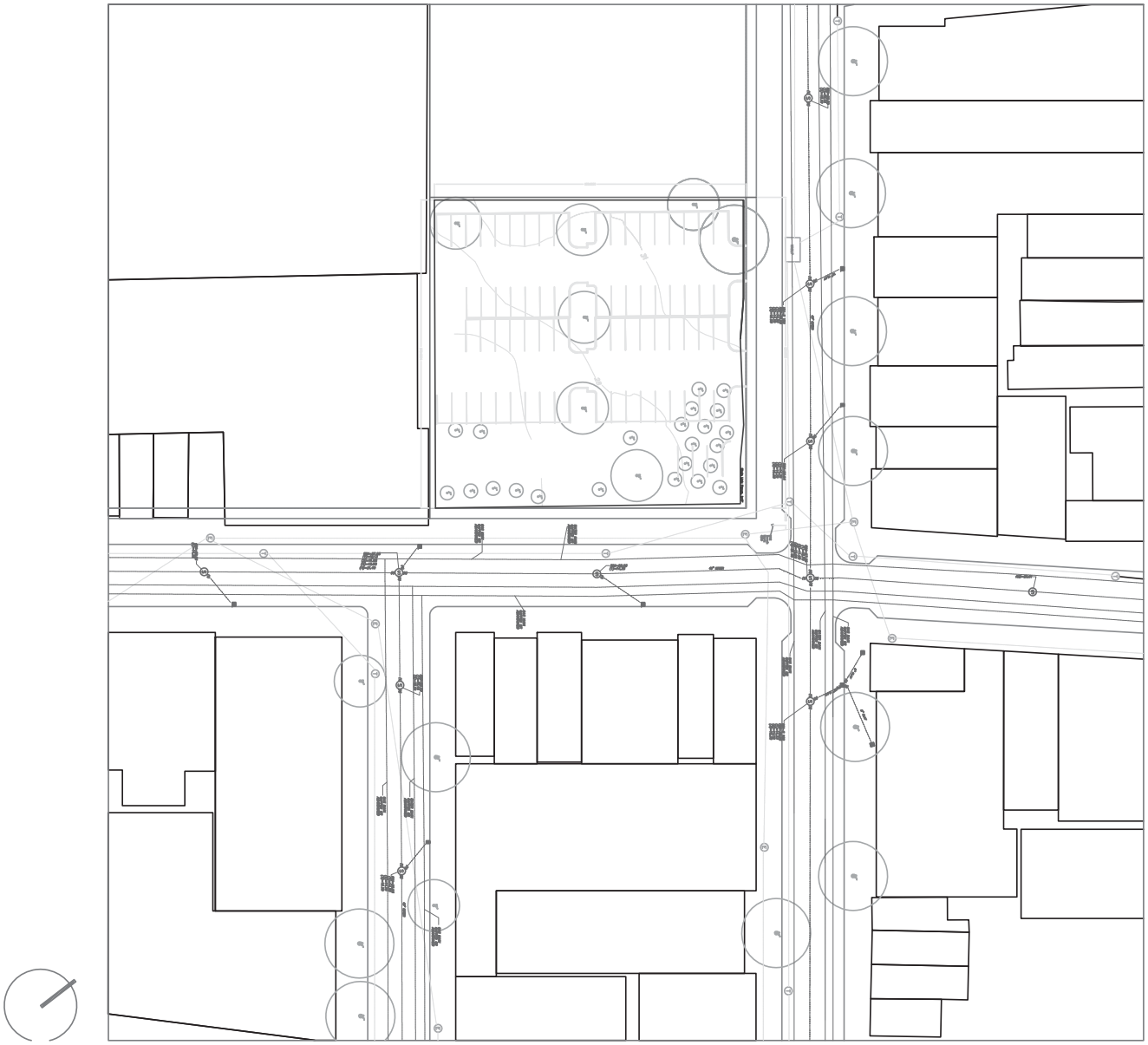


Survey: detailed description of site

What are we working with?

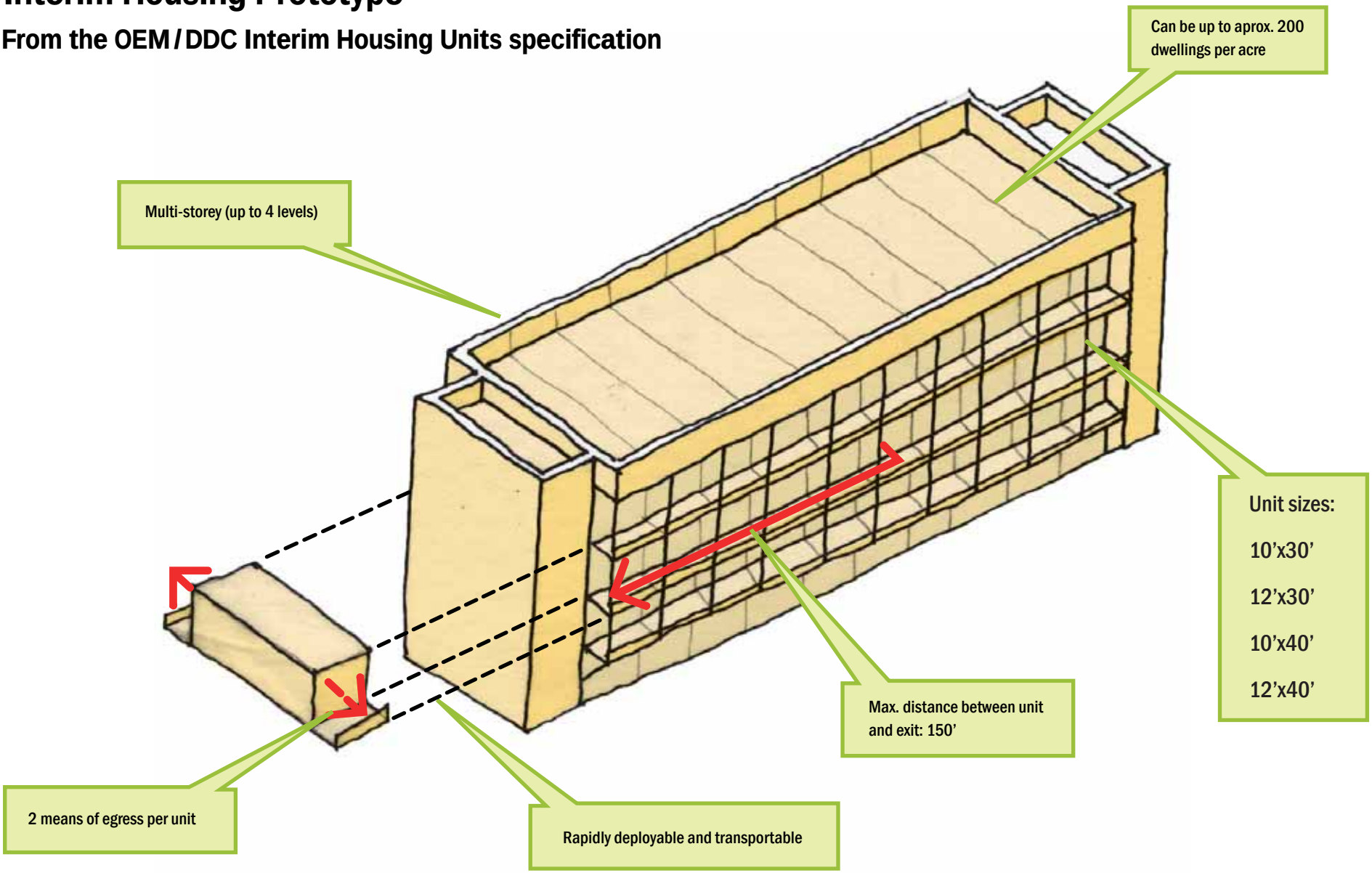
Appropriately accredited engineers will conduct a survey of the site. They will follow a standard procedure and try to complete a full survey as rapidly as possible.

- Metes and bounds
- Topography
- Utilities location and condition (above and below ground)
- Drainage
- Soil samples and geotechnical report to determine bearing capcity
- Coverage (soil, mixed flora, pavement, debris, infill, etc.),
- Trees and other planting
- Depth of water table and frost line
- Shade coverage and shadows (for future solar units)
- Noticeable air or noise pollution

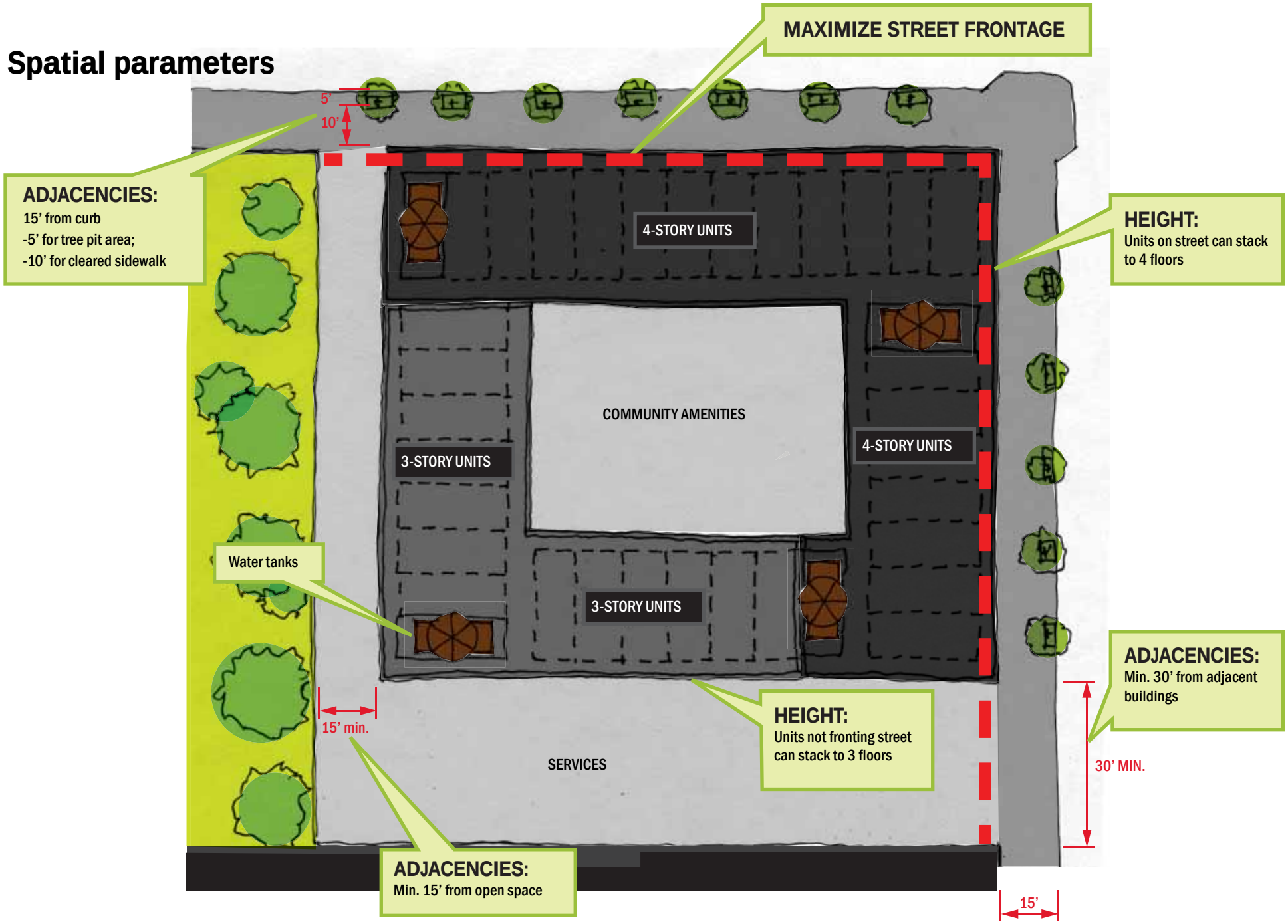


Interim Housing Prototype

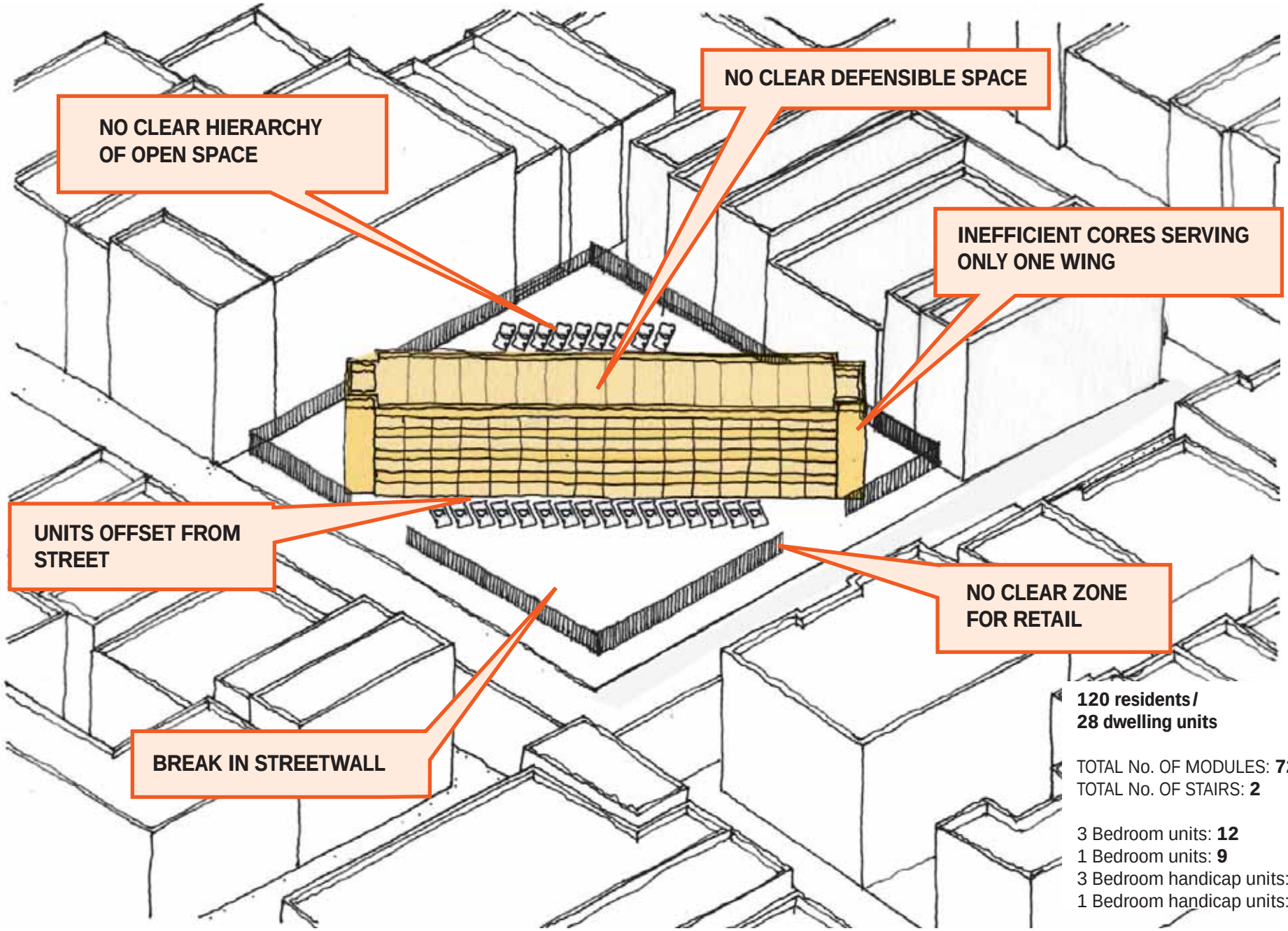
From the OEM / DDC Interim Housing Units specification



Spatial parameters



“Barracks-Style” Arrangement

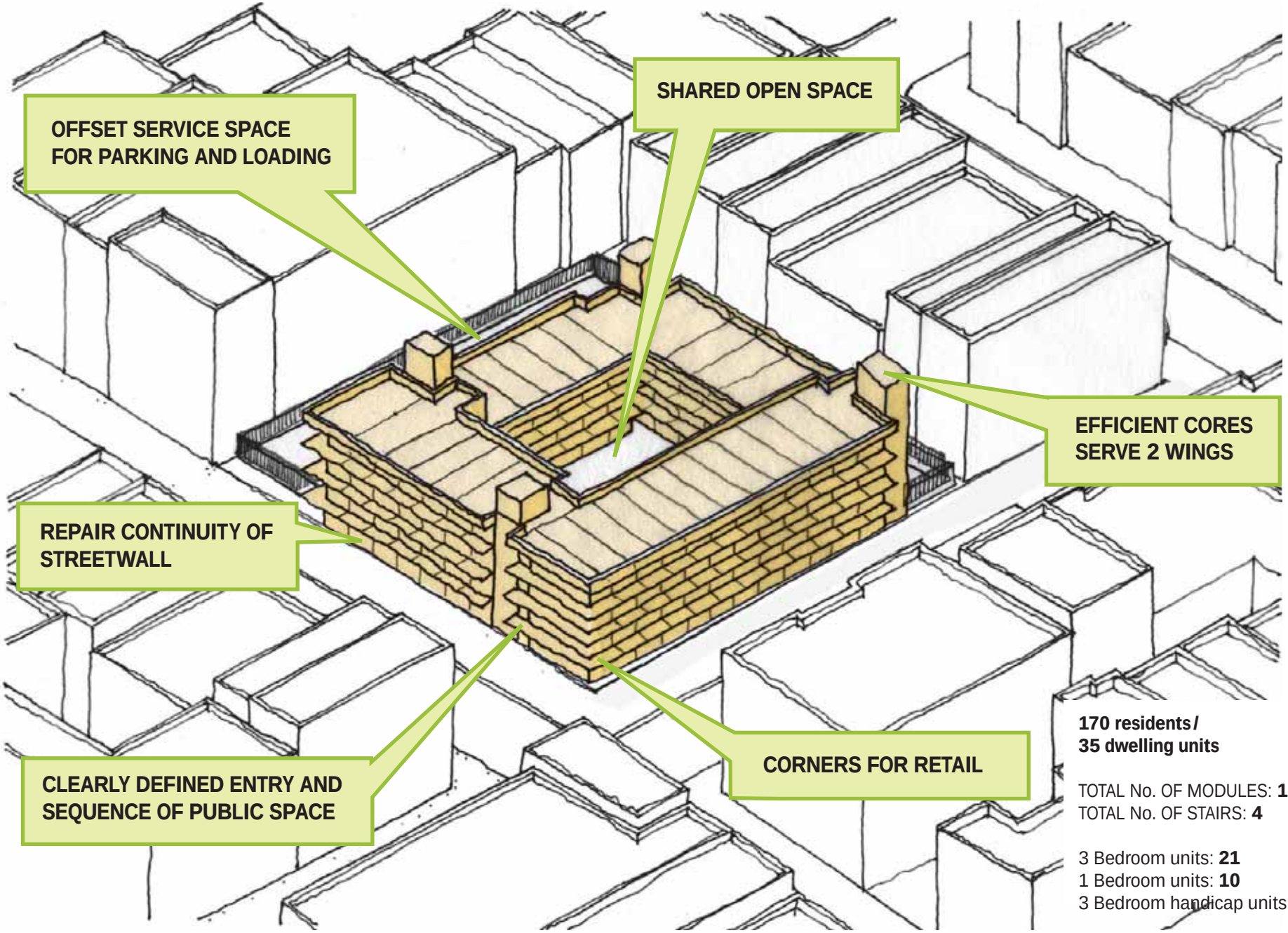


120 residents /
28 dwelling units

TOTAL No. OF MODULES: **72**
TOTAL No. OF STAIRS: **2**

3 Bedroom units: **12**
1 Bedroom units: **9**
3 Bedroom handicap units: **4**
1 Bedroom handicap units: **3**

“Neighborhood-Sensitive” Arrangement

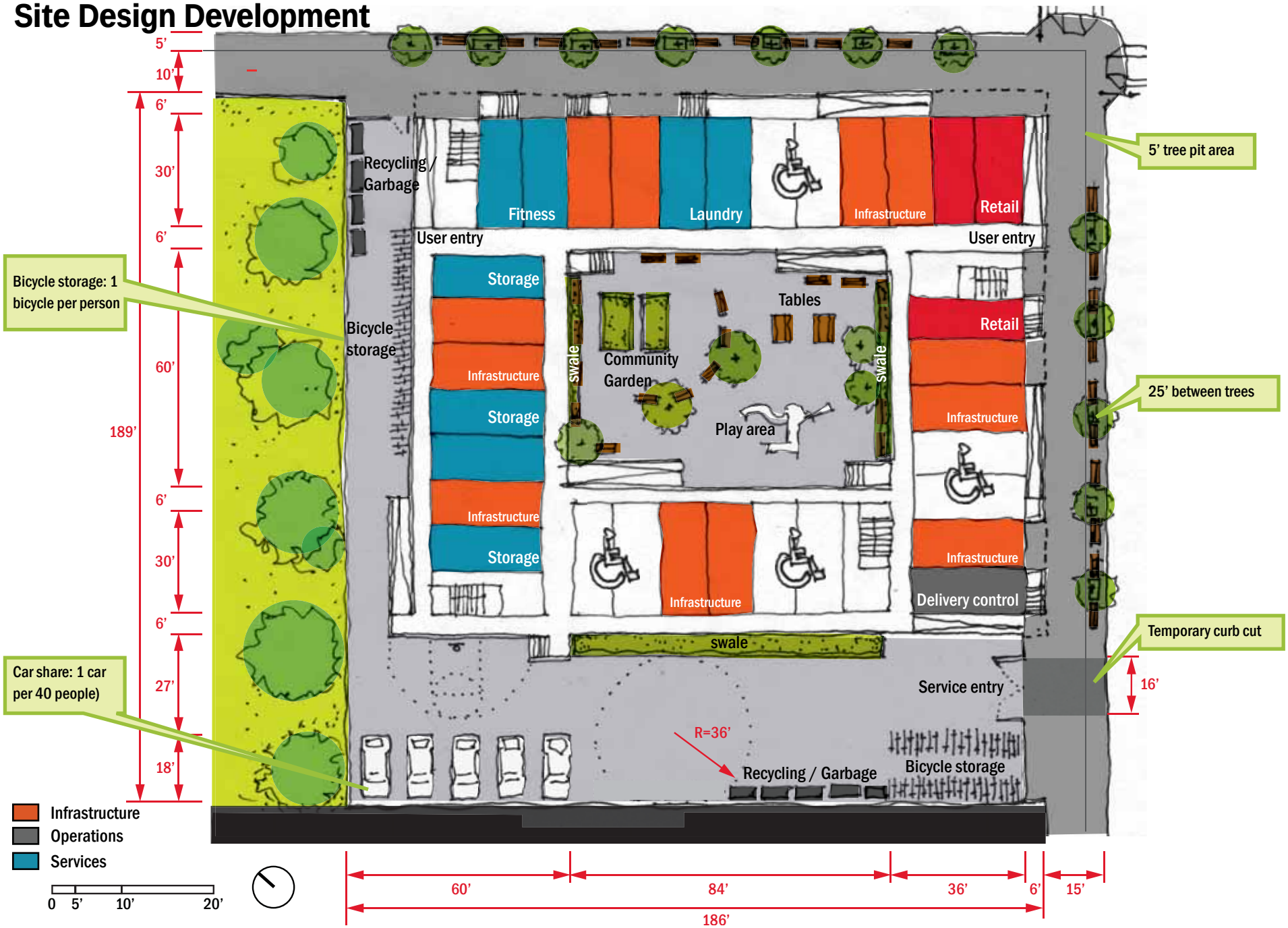


170 residents /
35 dwelling units

TOTAL No. OF MODULES: **115**
TOTAL No. OF STAIRS: **4**

3 Bedroom units: **21**
1 Bedroom units: **10**
3 Bedroom handicap units: **4**

Site Design Development



View from the street

Eyes on the street

Information wall

Fresh food available

Clear main entrance

Terrace / outside seating

Porch area in ground level residential units

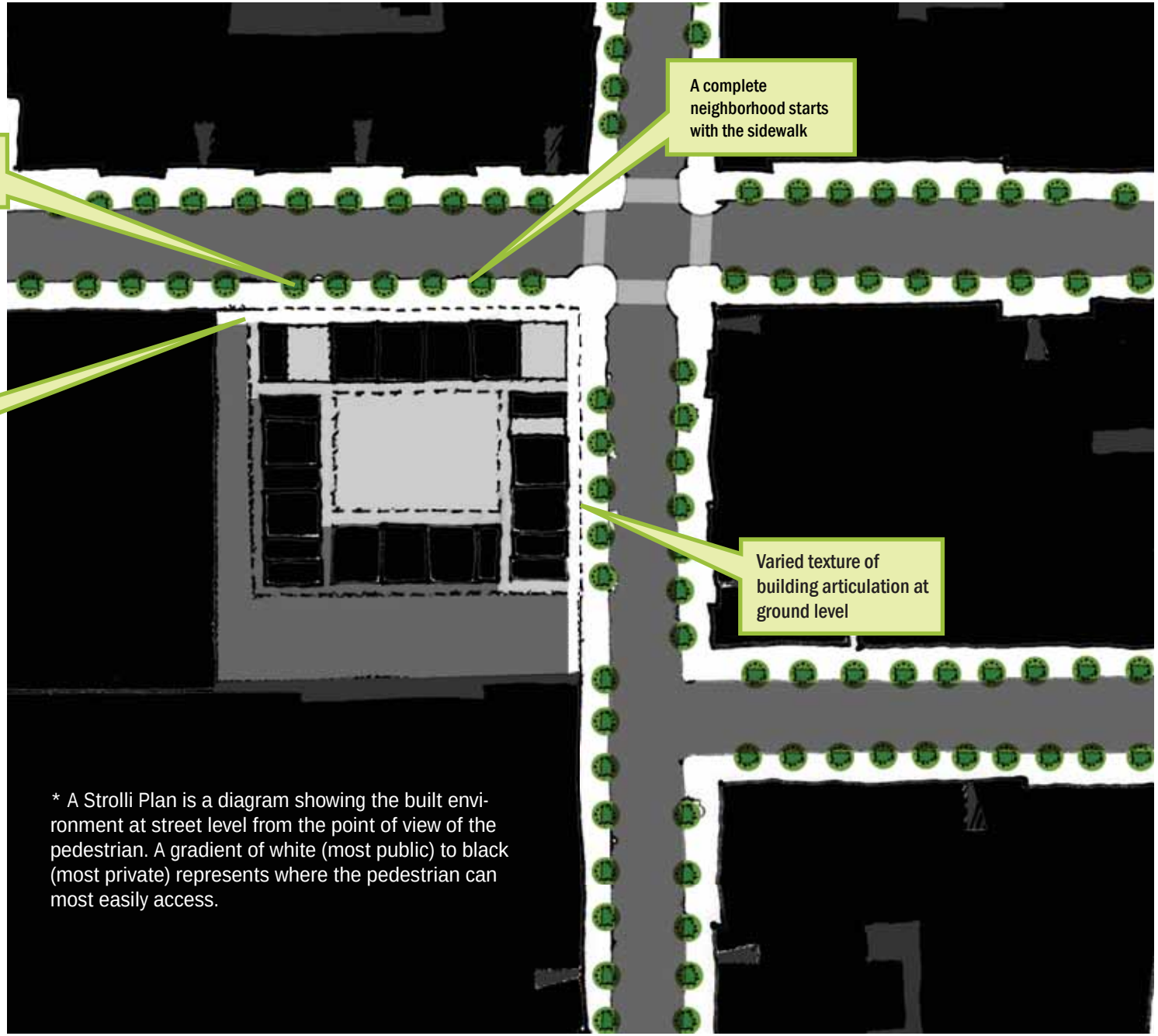
Uninterrupted rhythm of street trees

Service entrance

Informal seating area

Strolli plan*

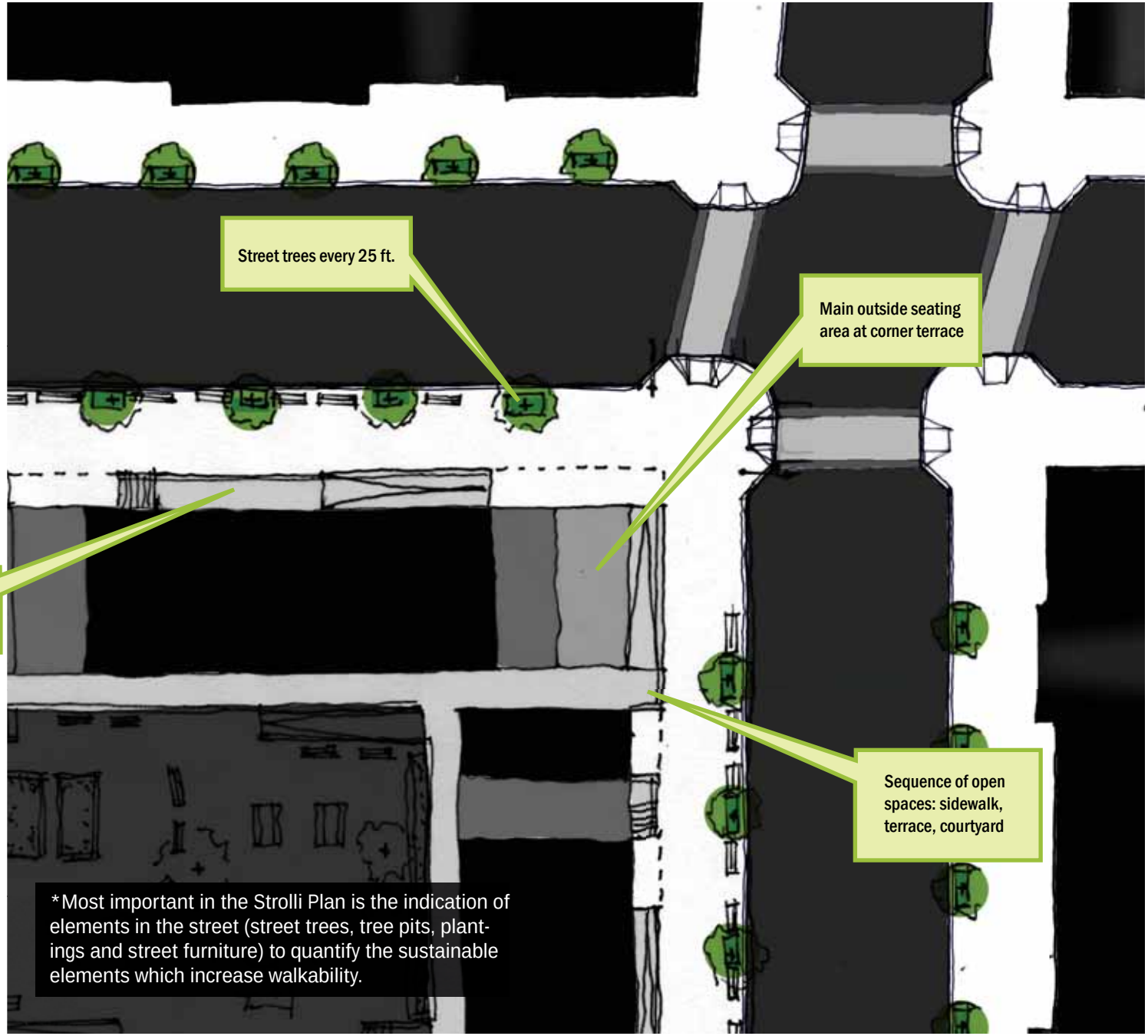
Neighborhood **scale**



* A Strolli Plan is a diagram showing the built environment at street level from the point of view of the pedestrian. A gradient of white (most public) to black (most private) represents where the pedestrian can most easily access.

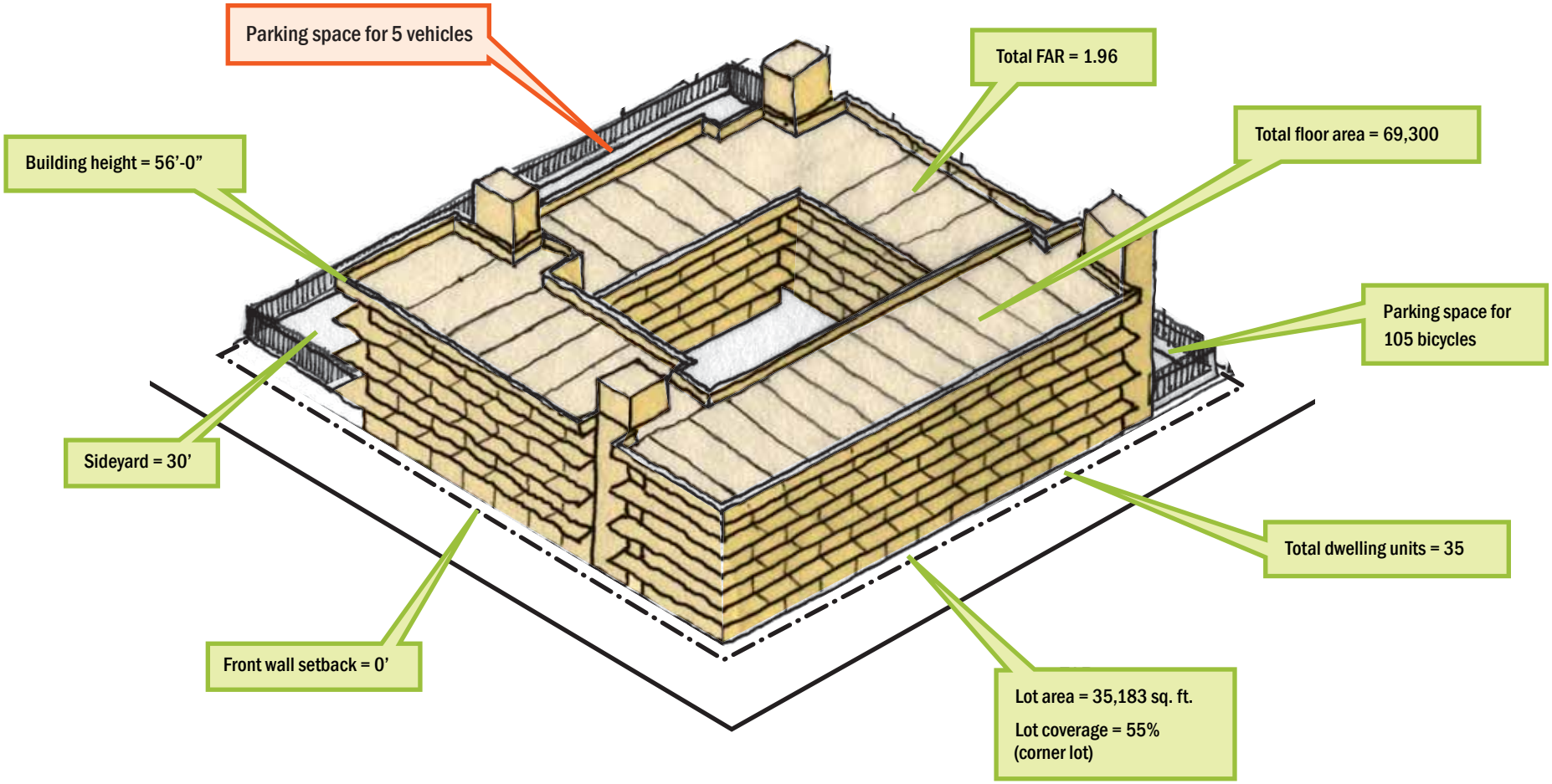
Strolli plan*

Corner **scale**



*Most important in the Strolli Plan is the indication of elements in the street (street trees, tree pits, plantings and street furniture) to quantify the sustainable elements which increase walkability.

Zoning Compliance



Requirements	Permitted in R6A	Proposed
Max. FAR	3.0	1.96
Max. Floor Area	105,300 sq. ft.	69,300 sq. ft.
Max. Building Height	70 ft	56 ft
Max. Lot Coverage (corner lot)	80%	55%
Min. Required Side Yard	30 ft.	30 ft.
Max. front wall setback for narrow street*	15 ft.	0 ft.
Permitted number of dwelling units	155	35
Parking Ratio**(50%)	18	5***
Bike Parking (1 per 2 units)	18	105

* cannot be less than any other building within 150 ft.
** cannot be between building and the street
*** car share offered in lieu of parking requirement

Section view

What are the next steps?

Appendix

1. OVERVIEW OF PERMITS AND APPROVALS 2-5
2. SITE SELECTION DATA CATEGORIES 6-9
3. PERMITTING AND APPROVALS AGENCIES 10
4. INFRASTRUCTURE OVERVIEW 11-12
   - Disaster Housing is GREEN!
   - Damage Assessment and Strategies
5. MODULE ORGANIZATION 13-14
   - Module Units
   - Clustering Around Units
6. SYSTEMS GUIDELINES 15-17
   - Energy
   - HVAC and Water Heating
   - Water Use
   - Sewage
7. INFRASTRUCTURE MENU 18-20
8. SITE DESIGN TECHNIQUES 21-25
   - Foundation Investigation
   - Roof Investigation
   - Designing for Slopes
   - Site Steps / Ramps
   - Circulation and Drainiage

Overview of Permits and Approvals

The table on this and the following pages present an overview of the various review processes, approvals, and permits that may be required to construct Interim Housing in compliance with New York City rules and regulations. This list should be viewed as a work in progress and will be reviewed and updated as the Interim Housing process is developed.

Type	Permit / Approval / Review / Action	Related Documents)	Agencies Involved	City process time frame (if available)		Notes / Comments
				Required min. time (days)	Median time (days)	
Environmental approvals (required)	Determination		OEC, DEP, SHPO, Landmarks, additional depending on applicable environmental law: NEPA (federal), SEQRA (state), CEQR (city). Lead agency for project		22 - 46*	Under CEQR: Type I actions and undefined actions are subject to environmental review and an EAS is required; Type II actions are categorical exclusions and do not require environmental review. Consult the CEQR technical manual for list and descriptions of Type I and II actions. City Environmental Review should be coordinated with the OEC; Federal and State review should be coordinated with the applicable agencies. Environmental review will include consideration of historic properties and landmarks as well. *median time for City Environmental Quality Review process for projects in FY09 & FY08. Note that if an Environmental Assessment Statement or an Environmental Impact Statement is required, mandatory time frames exist. For complex projects the CEQR process can take YEARS ... but in FY08&09, 71% of Environmental Review Applications were completed within 6 months. source: Mayor's Office of operations performance report on DCP.
Environmental approvals- (may be required)	Environmental Assessment (EA) (may or may not be required; this would need to be determined by the lead agency)	Environmental Assessment Statement or Report (EAS or EAR)	Lead agency with ... Depends on applicable law (NEPA, SEQRA, CEQR) NEPA: EPA, FEMA or USACE; City would likely request review of document by DEP SEQRA: DEC, Agency in charge of project; City would likely request review of document by DEP CEQR: OEC, DEP, Agency in charge of project All: SHPO, Landmarks			City environmental review is mandated for actions directly undertaken by the city or for which a city provides financial assistance. City environmental review is not mandated for as of right construction. FEMA may require an EA under NEPA for actions they undertake or fund. Action

Type	Permit / Approval / Review / Action	Related Documents)	Agencies Involved	City process time frame (if available)		Notes / Comments
				Required min. time (days)	Median time (days)	
Environmental approvals- (may be required)	Statement of Findings	Negative NEPA: Finding of No Significant Impact (FONSI) CEQR: Negative Declaration		30		No EIS required. CEQR requires the lead agency give public notice of a negative declaration and provide a 30-day public comment period.
		Negative with conditions: NEPA: FONSI with Mitigation CEQR: Conditional Negative Declaration		30		No EIS required as long as conditions are met. CEQR requires the lead agency give public notice of a conditional negative declaration and provide a 30-day public comment period.
		Positive	ibid			Environmental Impact Statement is required
	Environmental Impact Statement (EIS) (only required if there are positive findings from the EA)	Scope of Work	ibid	40		Minimum 30 days, maximum 45 between statement of findings and public scoping meeting. 10 days after meeting to receive comments. Maximum 30 days after public scoping meeting to publish scope of work
		Draft Environmental Impact Statement (DEIS)	ibid			
		Public Review Period	ibid	30		*Depends on applicable law / procedure, but there are mandatory public review periods. Public review under CEQR can happen concurrently with land use review.
		Final Environmental Impact Statement (FEIS)	ibid			
		Findings	ibid	10		must be minimum of 10 days between issueing of FEIS and written findings
Land Use Approvals (required)	Zoning compliance review	ZD1 Zoning Diagram and Form^	DOB, DCP		33 - 48*	^This is the building permit form (see building permit section). Review for compliance with zoning code typically happens as part of the building permit process, but we would want to initiate process as soon as possible once a site has been identified.
Land Use Approvals (may be required)	ULURP (only required if not compliant or certain other cases, see DCP)	Application and Pre-Certification	DCP			Other actions besides violation of the zoning resolution may trigger ULURP; for a list of actions triggering ULURP, consult DCP (list also available at: http://www.nyc.gov/html/dcp/html/luproc/ulpro.shtml) Other Land Use actions may be required besides ULURP ; other forms of land use review have different requirements than ULURP. While frequently shorter periods than ULURP, most have mandatory public review periods. DCP should be consulted on all zoning compliance and land use questions. For a complete description of the ULURP Procedure, see http://www.nyc.gov/html/dcp/html/luproc/ulpro.shtml * (median time FY09 & FY08) in FY09 79% of LU applications were referred within 6 months, 74% in FY08. (source: Mayor's Office of operations performance report on DCP). This would be for the entire land use review process.
		Community Board Review	Community board	60		
		Borough President Review	Borough President (and sometimes borough board)	30		
		City Planning Commission Review	City Planning Commission	60		
		City Council review	City Council	50		
		Mayoral review	Mayor's Office	5		
		City Council review	City Council	10		

Type	Permit / Approval / Review / Action	Related Documents)	Agencies Involved	City process time frame (if available)		Notes / Comments
				Required min. time (days)	Median time (days)	
Building, Construction, and Inspections	The following series of permits, approvals and reviews all relate to the DOB permitting and approval process. The application process at this point is tracked through the Building Information System (BIS) at DOB. There are an extremely large number of potentially required items, not all of which will be applicable in every case. The PC1 Required Items Checklist privides a list of potentially required items, and can be found online, along with other DOB forms and permits, at: http://www.nyc.gov/html/dob/html/forms/forms_permits.shtml#pw1. A list and description of specific required items and when they are applicable can be found in the DOB's "Required Items Reference Guide," Available online at: http://www.nyc.gov/html/dob/html/guides/required_items_reference_guide.shtml. Note for both permits and inspections, some of the required inspections may be dealt with through the process being developed for the design and approval of prefabricated modular units, and addressed prior to the disaster event, while others will not be addressed until site design and construction. DOB will need to be consulted in order to determine which items are which and establish an approval process specific for Interim Housing.					
Building & Construction Permit Approvals	Pre-file application for Building Permit	complete drawing set	DOB		110 (city-wide average or median (confirm with DOB) for buildings with more than 3 dwelling units for period jan 2008 -may 2010) info from Joshua Florsheim at DOB	An overview of the entire building permit application process can be found on the DOB website: A New York State licensed Professional Engineer (PE) or Registered Architect (RA) must submit construction plans to obtain a permit. Refer to the DOB for list of required drawings and specifications. Forms and instructions are available on the DOB website: http://www.nyc.gov/html/dob/html/forms/forms_permits.shtml#pw1
		PW1 Plan / Work Approval Application Form	DOB			
		PD1 Plot Diagram Form	DOB			
		ZD1 Zoning Diagram Form	DOB			
		Additional PW1 Addendums	DOB			
	Pay Fee		DOB			
	Application Entered into BIS		DOB			
	DOB Reviews application		DOB DOB will consult with DCP, HPD, FDNY, and other agencies as needed.			Drawings and specifications are reviewed for compliance with: Zoning (Zoning Resolution), Egress and LL58/87 (disability), Egress (Building Code), Multiple Dwelling Law, Housing Maintenance Code. Required items needed for construction work are determined by the plan examiner at this time.
	Additional Signoffs and Permits					Some permits and approvals may be required prior to DOB approval. These are determined during the review process. A list of these potential items can be found in the PC1: required Items Checklist, and furhter information can be obtained in the DOB's "Required Items Reference Guide."
	DOB Approves Application		DOB			DOB approval is required for a building permit to be issued.
	Construction Permits	Multiple, refer to DOB for required items based on project	DOB, DEP, FDNY, and others depending on project			Permis relating to site preparation / demolition and construction of the building that have been identified during the DOB review will need to be filed. Specific permits required will be identified during the review process, but a list of potential permits and approvals can be found in the DOB's Required Items Reference Guide."
	Additional Permits	Multiple, refer to DOB for required items based on project	DOB and others			In addition to construction-specific permits, other permits may be required. In general, such permits fall into the following categories: Boiler, Electrical, Elevator, Limited Alteration Applications, Place of Assembly, Plumbing. Specific permits required will be identified during the review process, but a list of potential permits and approvals can be found in the DOB's Required Items Reference Guide."
	File & Obtain Building Permit	Approved documents from review	DOB			
		PW-2 Permit Application Form	DOB			Requires contractor information, thus a contractor must be retained prior to this submission. Form can be found at: http://www.nyc.gov/html/dob/html/forms/forms_permits.shtml#pw1
		PW-3 Cost Affidavit Form	DOB			
		Fee Payment	DOB			

Type	Permit / Approval / Review / Action	Related Documents)	Agencies Involved	City process time frame (if available)		Notes / Comments
				Required min. time (days)	Median time (days)	
Inspections	inspections	OP-98 Notice results form	DOB, Special Inspectors, FDNY, DEP, ConEd, DOHMH, HPD, additional agencies may be involved depending on project details and location			This form is used for self-certification of plumbing, sprinkler and standpipe inspection(s) and/or test(s) of work filed on either the Schedule B (PW-1B) form or the Alteration Repair Application (ARA-1) form and covers many required inspections.
	additional inspections	additional Inspections				There may be other inspection items required. Again, a list of potential inspection items can be found in the The PC1 Required Items Checklist provides and a list and description of these items can be found in the DOB's "Required Items Reference Guide."
Certification of Occupancy	application for certificate of occupancy	PW6 Certificate of Occupancy Application	DOB			The PW 6 form is filed in order to initiate inspections required prior to issuance of a Certificate of Occupancy. The applicant (Professional Engineer, Registered Architect or Superintendent of Construction) shall complete the Statement of Compliance in accordance with section 27-221 of the Building Code of the City of New York. Filed before inspections in.
	Certificate of Occupancy	PW7 Certificate of Occupancy / Letter of Completion Folder Review Request	DOB			A final Certificate of Occupancy will be issued when the completed work complies with the submitted plans and applicable laws, all paperwork is completed, all necessary approvals have been obtained from other appropriate City agencies, all fees owed to the Department are paid, and all relevant violations are resolved.
	Temporary Certificate of Occupancy	PW7 Certificate of Occupancy / Letter of Completion Folder Review Request	DOB			A TCO has an expiration date, usually 90 days after its date of issuance. This means that while the Buildings Department has determined that the house or apartment building is safe to occupy, the approval is only temporary and is subject to expiration.

Site Selection Data

Site selection will be aided by being able to rapidly gather and map both pre and post storm information about the city and its neighborhoods as well as the storm's impact. The table below lists data categories that will likely be critical to identifying and evaluating potential sites for post-disaster interim housing. The corresponding City Environmental Quality Review (CEQR) technical category is also listed, which will aid in coordinating information if environmental assessment is required.

Site Selection & Assessment Categories	Related Environmental Assessment - CEQR Technical Analysis - category	Data Required	Probable Data Source
Data that will need to be gathered or updated post-disaster			
Aerial / satellite Imaging	none	Post storm aerial or satellite images	USACE, google
Post Disaster Damage Assessment & Recovery Activities	none	Building damage assessment - structures remaining, structures destroyed, and status of repair or clearance	OEM
		Debris clearance - areas covered and areas cleared	OEM
		Sheltering - location of shelters, and number and info of individuals and families being housed	OEM
		Distribution and logistics center locations	OEM
Transportation & Access	Transportation (13)	Cleared Roads - primary routes, secondary roads & streets	OEM, USACE
		Roads and Streets - ROW and carriageway widths	DOT
		Traffic capacities - check with CEQR	DOT, MTA
		Public Transit - working subway stations, operating & predicted to be operational bus routes	MTA
	none	Evacuation routes	OEM

Site Selection & Assessment Categories	Related Environmental Assessment - CEQR Technical Analysis - category	Data Required	Probable Data Source
Utilities (power, water, sewerage, stormwater, and telecom)	Water and Sewer Infrastructure (10)	Sewerage System - working lines, working treatment locations, and capacity by treatment plant or coverage area	DSNY, OEM, USACE
		Water Supply - working lines and potability	DEP, ?, OEM, USACE
		Water Supply - alternative water sources	OEM, USACE
		Water - working fire hydrants	
		Storm sewer systems - drainage, capacity, and level of function	DEP, ?, OEM, USACE
	Energy (12)	Electricity - working lines and capacity by section	ConEd, OEM, USACE
		Electricity - sites with or with potential for alternative energy generation	
	none	Telecom - working hardlines	Verizon, ?
		Telecom - cellular / wifi coverage	Cellular Providers
Community Facilities & Services	Community Facilities & Services (3)	Healthcare - working hospitals and clinics	DHMH, universities, private sector
		Education - open and predicted to reopen public schools	DOE
		Childcare - open and predicted to reopen child care centers	
		Libraries - open and predicted to reopen libraries	NYCPL
	none	Food - working groceries, farmers markets, and food distribution sites	
		Culture - community centers and churches	
	Open space (4)	Open space & recreation - open public parks and recreational facilities	DPR
Security & Emergency Services	Community Facilities & Services (3)	Emergency services - working fire stations	FDNY
		Security - working police stations	PDNY
Environmental Quality	Hazardous Materials (9)	Visible contamination / hazardous materials on-site	DEP, OEM, USACE

Site Selection & Assessment Categories	Related Environmental Assessment - CEQR Technical Analysis - category	Data Required	Probable Data Source
Existing, Pre-Disaster Data			
Critical FEMA Information		FEMA flood zones	FEMA (pre storm)
		Floodways	FEMA (pre storm)
		Coastal high hazard areas	
	Natural Resources (8)	Wetlands	FEMA (pre storm)
Physical Conditions	none	Topography / Slope	
		Soil Stability	
Ownership	none	Ownership (public: city, state, regional, or federal agency; Private)	DCP
	none	Ownership - owner contacts, including if in New York post-storm	
Land Use, Zoning & Public Policy	none	Location of relief & recovery effort land uses, including: debris storage locations, point of distribution centers	OEM, FEMA, USACE
	Land Use, Zoning & Public Policy (1)	Current land use (post storm)	OEM, USACE
		Pre-storm landuse	OEM, USACE
		Zoning	DCP
		NYC Waterfront	DCP
Community Context	none	Pre-storm location of displaced persons - housing destroyed or evacuated and unable to return due to the storm	
	Socioeconomic conditions (2)	Inhabited / working residential, commercial, or industrial activities	OEM, USACE, DCP, DOB
	Neighborhood character (18)	Surrounding building types & heights, land use, demographics	DCP
Historic, Cultural, Design, Visual, and Natural Resources	Shadows (5)		
	Historic and Cultural Resources (6)	Historically or culturally significant NYC properties - New York City Landmarks, Interior or Scenic Landmarks, New York State and National Register or Historic Places	Landmarks, SHPO
	Urban Design and Visual Resources (7)		DCP
	Natural Resources (8)	Natural resources - check with CEQR	

Site Selection & Assessment Categories	Related Environmental Assessment - CEQR Technical Analysis - category	Data Required	Probable Data Source
Environmental Quality	Hazardous Materials (9)	Designated brownfields	DEP, OEC
		Prior land uses involving use of hazardous materials - ie cleaners, heavy industrial, etc	DCP
		Sites with institutional controls - ie. Restrictive declarations	DCP
		Presence of underground storage tanks	DEP
		Environmental justice communities	
	Air Quality (14)	check with CEQR	DEP
	Greenhouse Gas Emissions (15)	check with CEQR	DEP
	Noise (16)	check with CEQR	
	Public Health (17)	check with CEQR	
	Construction Impacts (19)		

List of Agencies and Acronyms

Government Level	Agency	Acronym
City / Local	Office of Emergency Management	OEM
	NYC Department of City Planning	DCP
	NYC Department of Buildings	DOB
	NYC Department of Design and Construction	DDC
	Fire Department of NYC	FDNY
	Police Department of NYC	NYPD
	NYC Housing Authority	NYCHA
	NYC Housing Preservation and Development	HPD
	NYC Mayors Office of Environmental Coordination	OEC
	NYC Department of Environmental Protection	DEP
	NYC Department of Transportation	DOT
	NYC Department of Sanitation	DSNY
	NYC Landmarks Preservation Commission	LPC
	NYC Department of Parks and Recreation	DPR
	NYC Department of Health and Mental Hygiene	DOHMH
	NYC Department of Education	DOE
	NYC Board of Standards and Appeals	BSA
	NYC Economic Development Corporation	EDC
Regional / Metro	Port Authority of New York and New Jersey (PANYNJ)	PANNYNJ
	Metropolitain Transportation Authority (MTA)	MTA
State	New York State Emergency Management Office	SEMO
	New York State Department of Environmental Conservation	DEC
	New York State Department of Transportation	NYS DOT
	State Historic Preservation Office	SHPO
Federal	Federal Emergency Management Agency (FEMA)	FEMA
	United States Army Corps of Engineers (USACE)	USACE
	Department of Environmental Protection	EPA
	Department of Housing and Urban Development	HUD
	White House Council on Environmental Quality (CEQ)	
	National Weather Service	NWS
	Coast Guard	USCG
	National Guard	USNG

Infrastructure Overview

Disaster Housing is GREEN!

A disaster event, although devastating to a community, will provide opportunities for implementing more efficient and sustainable technologies than are usually attempted during typical planning and reconstruction.

Renovating and rebuilding necessary services and infrastructure with these technologies can substantially change the direct and indirect impacts we have on our natural systems. Interim Housing Units should not only be equipped to function during a post disaster situation where infrastructure is limited or not available, but should be designed to 'sit lightly' for the entire life of their use.

	Interim Housing Unit	Average NYC Apartment
Bedrooms	2	2
Number of Inhabitants	4	4
Square Footage	720 ft^2	1,500 ft^2
Energy Consumption	10 kW/day - 9 kW 1 kW/ day	10 kW/day
Water Demand	180 gal/day -22% washing machines -18% conventional toilets -2.7% baths -1.5 dishwashers 102 gal/day	180 gal/day
Garbage Removal	64.4 lbs/ week -39% organics -36% recyclable 16 lbs/week	64.4 lbs/ week
Human Waste Removal	22.4 gal/week of human waste -69% composted 7 gal/week of non-toxic filtered liquid	22.4 gal/week of human waste + 226.8 gal/week of flush water 249.2 gal/ week of sludge

Available Solar Energy

Communal washing machines run off of rainwater catchment system.
Foam flush toilets use 95% less water than conventional toilets.
Baths and dishwashers not provided in units.

Organics can be disposed of in composting toilet system.
Recycling system available on site.

Infrastructure Overview

Damage Assessment & Strategies

ELECTRICITY

100% — 100% function of all pre-existing utilities
- No need for power generating systems.

>80% — Stable with sudden but infrequent blackouts
- Grid connection available. On-site generators where necessary.

>50% — Frequent, short-term blackouts—entire community is affected
- Grid connection available. On-site generators where necessary.

>40% — Cannot reach demand; begin dividing electric supply by alternating hourly schedule to all communities
- Solar introduced to help relieve energy demands from grid. Generators brought on site for back-up.

>20% — Not all neighborhoods are reached with available electric supply; some receive short intervals of service only
- Solar providing basic energy needs to nearly all locations. Generators start taking heavier loads (pumping water, etc.)

0% — 0% function of pre-existing utilities
- Solar power and bio-diesel generators working to full capacity.

WATER

100% — 100% function of all pre-existing utilities
- Access to city water is fully established. No need for additonal systems.

>80% — Access to city water for majority of the population. Some experiencing temporary short-term (12-24 hrs) loss
- Access to city water. Truck water delivery to scheduled PODs.

>50% — Entire population experiencing temporary short-term (12-24 hrs) loss
- Increased truck deliveries.

>40% — Alternating daily access to water; occasional 2-3 day dry spells
- Water catchment systems introduced on an as-needed basis. In-home filtration and purification.

>20% — Very infrequent access to city water; dry spells up ot 1.5 weeks long may be experienced
- Water catchment systems installed at all locations. Beginning the process of on-site filtration and purification.

0% — 0% function of pre-existing utilities
- Water catchment systems connected to on-site filtration and chlorinzation/ ozonation. Pumped to central tank for unit distribution.

SEWER

100% — 100% function of all pre-existing utilities
- Sewer available for connection.

>80% — Sewer functioning to full capacity—excepting certain low-lying flood zone neighborhoods
- Sewer available for connection.

>50% — Operating but with proposal to flush conservatively. Occasional street sewage overflows, but quick to repair
- Sewer available for connection on conservative flush policy.

>40% — Sudden and increasing frequency sewer overflows.
- Introduce composting units to areas where sewer is in disrepair. Liquid by-product line connected directly to sewer.

>20% — Sewage operating at over capacity due to disrepair. Some streets experiencing regularly occurring street sewage overflows.
- Composting units installed on all sites. Liquid by-product lines connected to sewer where available.

0% — 0% function of pre-existing utilities
- Composting toilets, with scheduled liquid by-product removal.

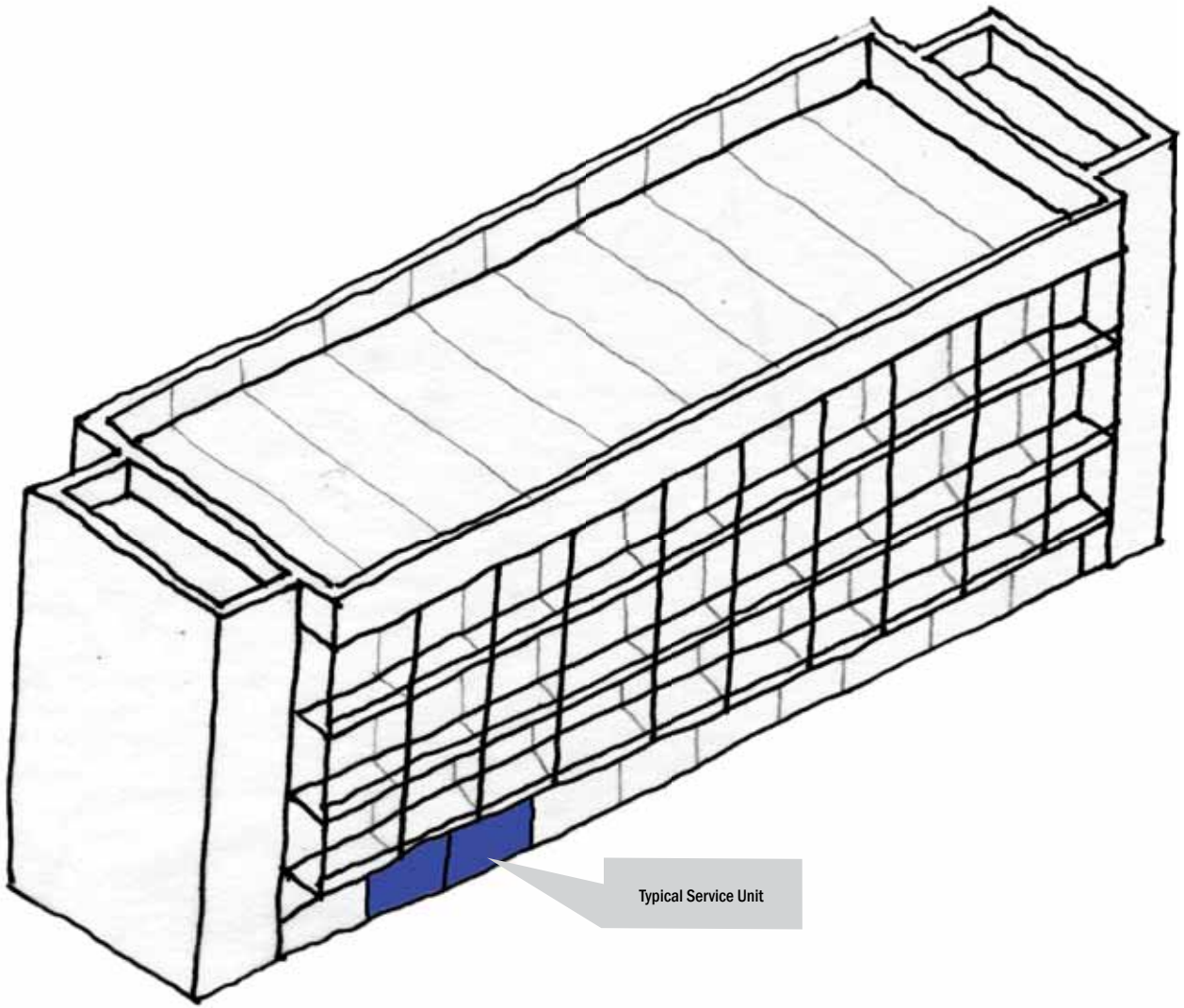
Module Organization

Service Units

To support living needs in an efficient manner, service units can be strategically located under unit clusters to serve the most residents possible.

Message boards placed on facades of the service units can improve wayfinding and orientation for residents.

Keeping the infrastructure components like fuel storage, generators, composters, water tanks, and other storage and services together in a specifically zoned area can provide efficiency in delivery, maintenance, and fume and noise mitigation.



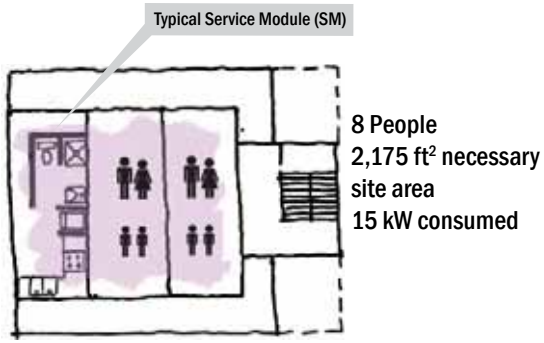
Module Organization

Clustering Around Units

An efficient cluster of modules will have the maximum number of people served by one service unit.

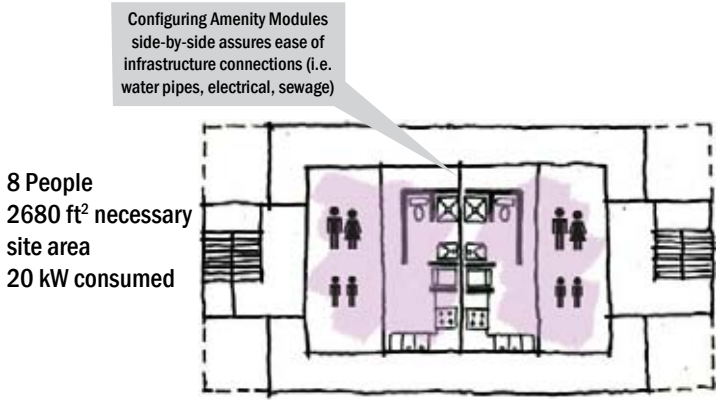
As seen in the Module Density table (below), a 3 module cluster is much more efficient than a 4 module cluster as necessary site areas and energy consumption per person decreases.

In order to maximize the density of people on site, it is preferable to house larger families. Although, with a given number of family sizes the site most likely will have to accommodate for larger and smaller families.

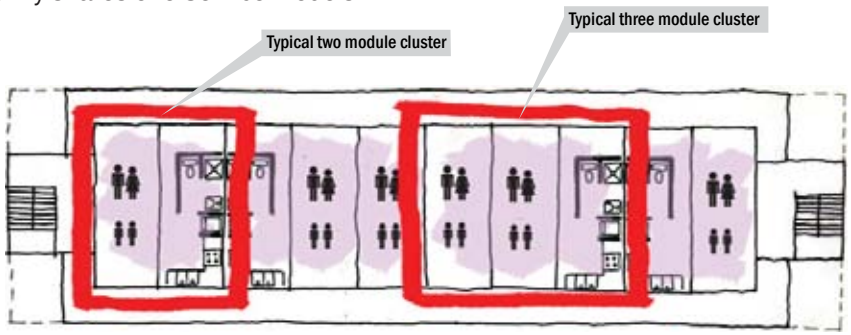


A three module configuration for a larger family shares one Service Models.

VS



While a four module configuration for two smaller families each have their own Service Modules that consequently requires more energy and a larger site.



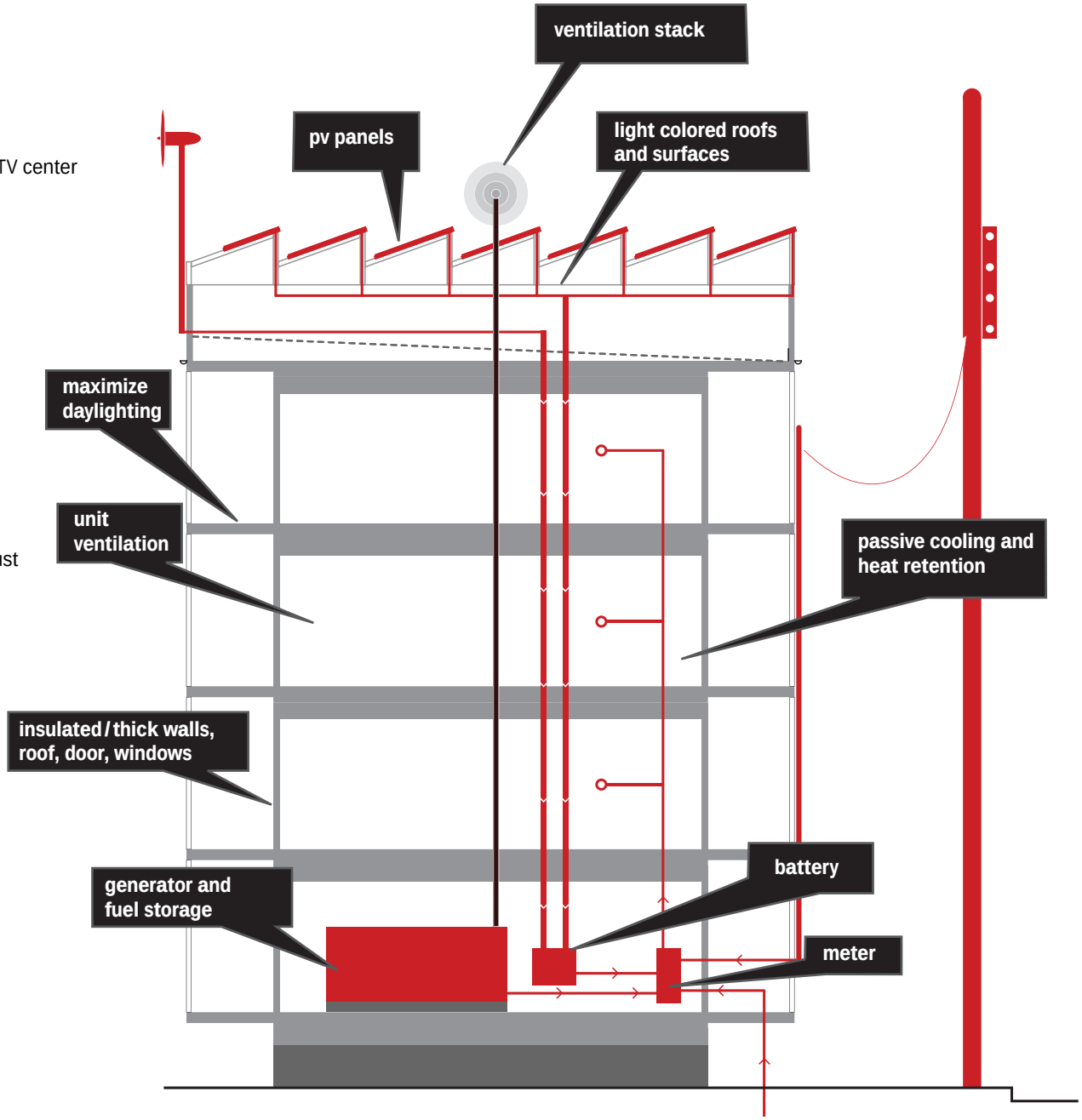
A ten module configuration, suitable for two larger families and two smaller families

Module Density	2	3	4	5	6	7	8	9	8	9	10
# of Service Modules, SM	1	1	2	2	2	3	3	3	4	4	4
Necessary Site Area[1] (ft²)	1,670	2,175	2,680	3,845	4,350	4,850	5,355	5,860	5,355	5,860	6,365
People (max.)	4	8	8	12	16	16	20	24	16	20	24
Energy Consumption (kW/day)	10	15	20	25	30	35	40	45	40	45	50
Water Demand[2] (gal/day)	68	136	136	204	272	272	340	408	272	340	408
Produced Garbage (lbs/day)	9	18	18	28	37	37	46	55	37	46	55
Produced Human Waste (gal/day)	3	6	6	10	13	13	16	19	13	16	19
Produced Grey Water (gal/day)	62	125	125	187	249	249	312	374	249	312	374
Available Solar Energy[3] (kW)	9	13	17	23	26	30	34	38	34	38	42
Available Rain Collection (gal/year)	31,380	43,935	56,490	75,320	87,870	100,425	112,980	125,530	112,980	125,530	138,085

Systems Guidelines

Energy recommendations

- Connect to grid as soon as possible
- Reduce consumption
  - Cap supply per unit
  - Limit high load appliances
  - (i.e. Limit accessible wattage per unit)
  - Provide on-site cooling center, laundry service, cable TV center
- Use low demand, energy efficient technologies
  - Lighting (LED, CFL, etc.)
  - HVAC
  - Water heating
  - Appliances with energy star rating
- Implement community education on energy conservation
  - Shut off and unplug
  - "How to" decrease daily use
- Deploy targeted renewable energy supply systems
- Provide generators/fuel tanks as last resort
- Define maximum electrical demand
  - Per unit
  - Per site
- Define maximum
  - Fuel demand, storage and delivery protocol (gal/day)
- Consider location on site, structural shelter, and noise/exhaust mitigation
- Install cogeneration capabilities



HVAC & Water Heating Guidelines

- Define BTU and hot water demand
  - per unit
  - per site
- Choose appropriate system
  - modular
  - centralized

Systems Guidelines

Water Use Recommendations

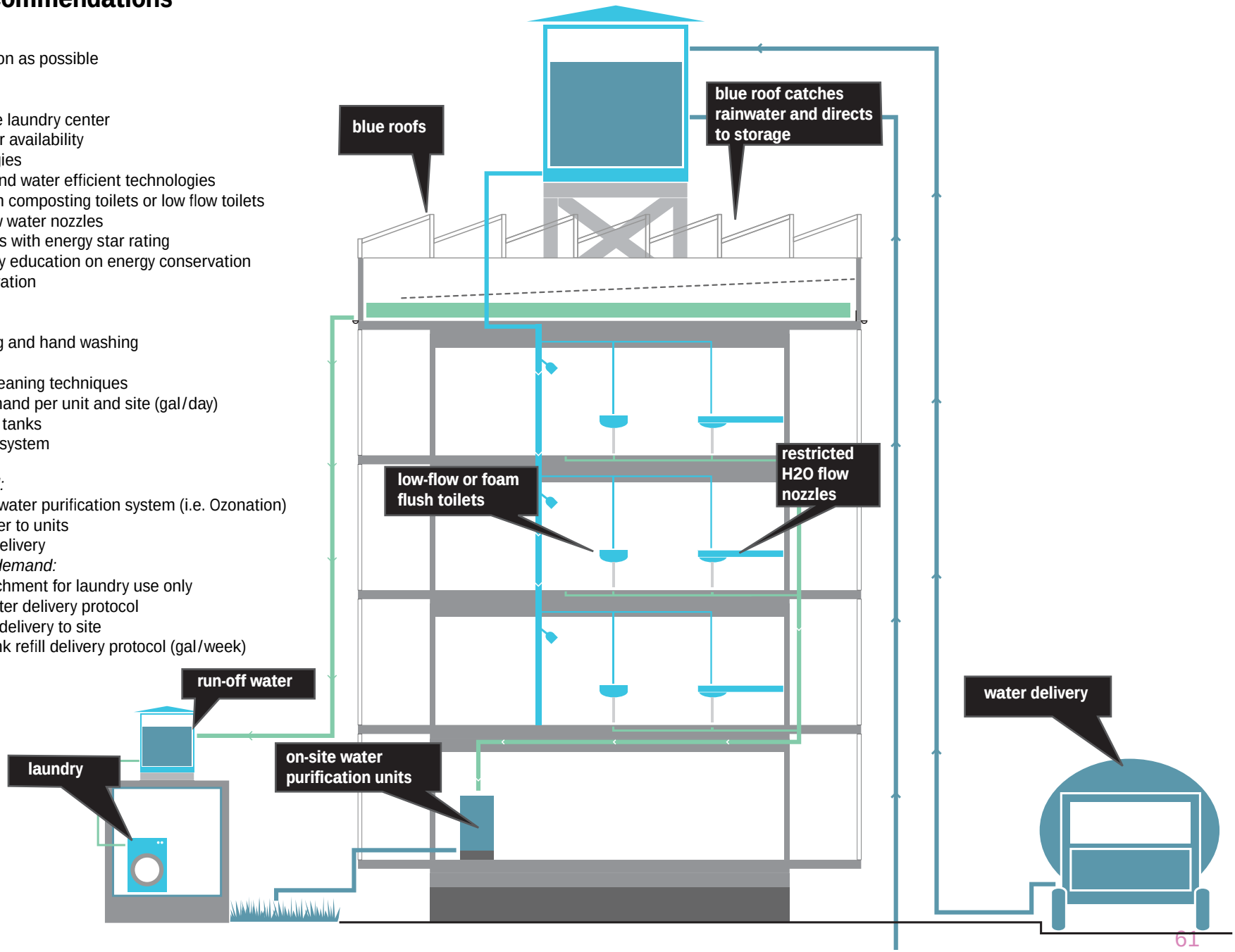
- Connect to grid as soon as possible
- Reduce consumption
- Cap supply per unit
    - Provide on-site laundry center
    - Regulate water availability
    - Design strategies
    - Use low demand water efficient technologies
    - Use foam flush composting toilets or low flow toilets
    - Restricted flow water nozzles
    - Use appliances with energy star rating
- Implement community education on energy conservation
    - Water conservation
    - Dish washing
    - Showering
    - Teeth brushing and hand washing
    - Toilet flushing
    - Appropriate cleaning techniques
- Define maximum demand per unit and site (gal/day)
- Size and install water tanks
- Construct catchment system

If supply fulfills demand:

- Install on site water purification system (i.e. Ozonation)
- Distribute water to units
- Cease water delivery

If supply cannot reach demand:

- Store rain catchment for laundry use only
- Proceed to water delivery protocol
- Provide water delivery to site
- Implement tank refill delivery protocol (gal/week)



Systems Guidelines

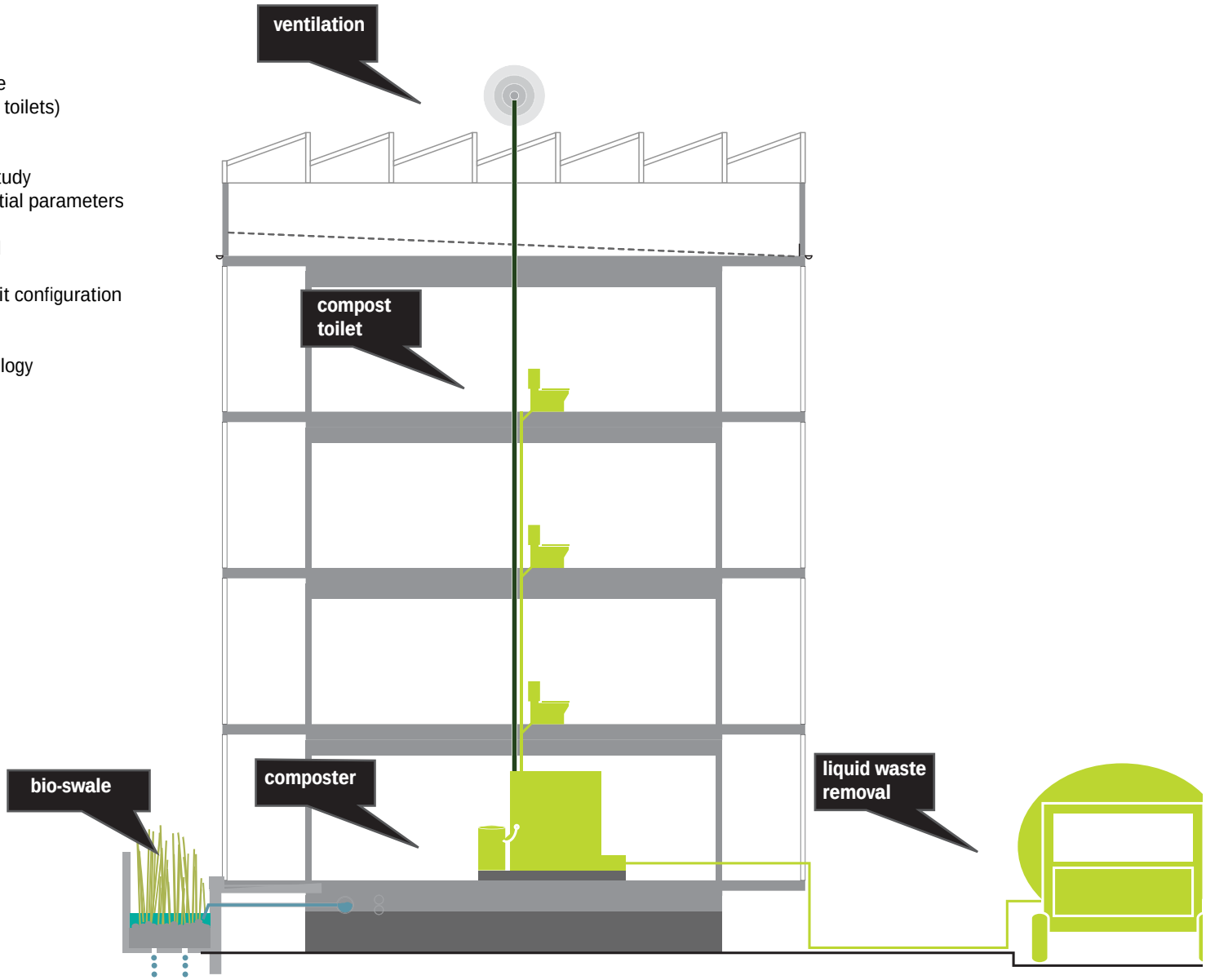
Sewerage Recommendations

If sewage connection available:

- Conduct sewer connection feasibility study
- Install above ground sewer lines
  - Gravity flow
  - Sub pumps/energy necessary
- Excavate for connection to existing sewer line
- Water availability (water demand for flushing toilets)

If sewage connection not available:

- Conduct sewage retention basin feasibility study
  - Above ground basin location and spatial parameters
  - Necessary pumping/energy
  - Daily-hourly waste extraction protocol
- Conduct compost feasibility study
  - Location and spatial parameter in unit configuration
  - Minimum temp. Requirements
  - Monthly maintenance
  - Community education on new technology
  - Biannual liquid extraction protocol



Infrastructure Menu

The following table represents a matrix of available energy systems for the Interim Housing Unit. Different configurations of systems can be paired together to achieve the most integrated and efficient scheme.

		Generator	Microturbine Generator	PV Electric	Residential Wind Turbine	Hydrogen Fuel Cell
Description		Electric energy produced from fuel combustion	Electrical energy produced by small combustion turbines	Electricity produced from sunlight through photovoltaic cell systems	Electricity produced from the collected kinetic energy of wind	Energy conversion device that can capture and use the power of hydrogen
Fuel Type		gasoline, diesel, biodiesel, nat. gas	gasoline, diesel, biodiesel, nat. gas	none	none	Hydrogen
Time	lead time for installation	Excellent	Excellent	Poor	Poor	Excellent
Cost	to implement	Excellent	Excellent	Medium	Poor	Poor
	to operate	Poor	Poor	Excellent	Excellent	Excellent
Availability		Excellent	Medium	Medium	Poor	Poor
Safety Concerns		Medium (fuel spills possible)	Medium (fuel spills possible)	Excellent	Excellent	Excellent
Noise		Poor	Poor	Excellent	Medium	Excellent
Fumes		Poor	Poor	Excellent	Excellent	Excellent
Operating Maintenance		Poor	Medium (less moving parts than std. generator)	Excellent	Excellent	Excellent
Capacity Available		up to 2000 kW	up to 2000 kW	0.01 kW / ft^2	1.5 - 3 kW ea.	up to 150 kW

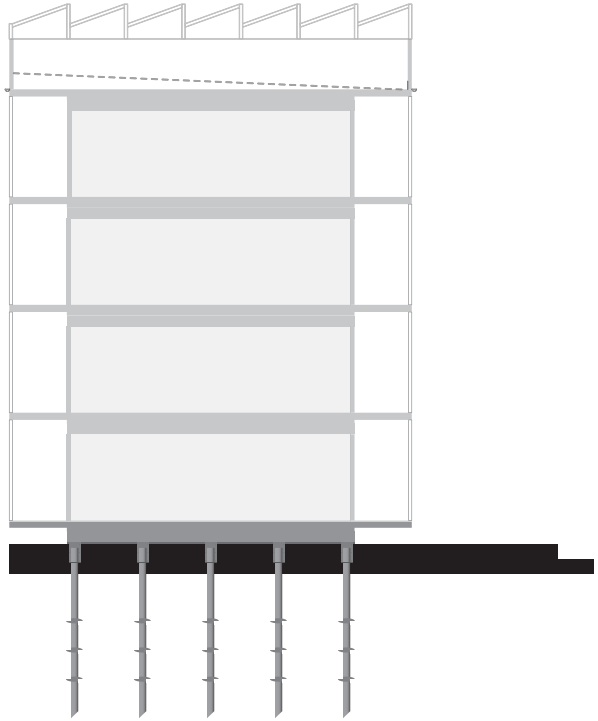
		Heat			Ventilation	Air Condition (AC)			
		Centralized	Decentralized (living unit)			Centralized		Decentralized (living unit)	
					It is assumed that ventilation will be properly designed for in all kitchens and bathrooms by the manufacturer				
		Electric Boilers	Electric Baseboards	Mini Split System		Central Air	Passive Cooling	Room Air Conditioner	Mini Split System
Description		Creates heat through electric energy supply	Creates heat through electric energy supply	Heats through exterior heat pump		Air condensing unit cools and distributes air	Using architec-ture to inhibit air flow through building	Air condensing unit cools and distributes air	Cools through exterior heat pump
Time	lead time for installation	Medium	Excellent	Excellent		Medium	Excellent (inherent in unit design)	Excellent	Excellent
Cost	to implement	Excellent (standard technology)	Excellent	Excellent		Excellent	Excellent	Excellent	Excellent
Cost	to operate	Excellent	Medium (constant energy demand)	Medium		Medium	Excellent	Medium	Excellent (w/ high efficiency model)
Availability		Medium	Excellent	Excellent		Excellent	Excellent	Excellent	Excellent
Noise		Medium	Excellent	Medium		Medium	Excellent	Medium	Medium
Estimated Life Time		10-20 years	20 years	10 years		15-20 years	life of building	10 years	10 years

		Combined Heat & Power (CHP)	Geothermal	Domestic Hot Water (DHW)			
				Centralized		Decentralized (living unit)	
		Cogeneration	Geothermal	Electric Boiler	Solar Thermal	On Demand	Heat Pump
Description		Harnesses captured heat losses from an engine generator	Harvests thermal energy underneath earth's surface	Electric supply main-tains a constant water temp. in storage tank	Collects solar energy in the form of thermal or heat energy	Electric element heats water as needed	Extracts heat from surrounding air to heat water in storage tank
Time	lead time for installation	Medium	Poor (excavation necessary)	Excellent	Poor (design intensive)	Medium	Excellent
Cost	to implement	Medium	Poor	Excellent	Medium	Medium	Excellent
	to operate	Excellent	Excellent (naturally available source)	Excellent	Excellent	Medium	Excellent
Availability		Medium	Medium	Excellent	Medium	Medium	Excellent
Noise		Medium	Excellent	Medium	Excellent	Medium	Excellent
Estimated Life Time		20-30 years	25 years (interior components) 50 years (exterior components)	10-20 years	15-20 years	20 years	15 years

NOTE: Choosing between centralized and decentralized systems is extremely dependent on the demand. For most cases decentralized systems operate more efficiently with low demands and centralized systems with high demands.

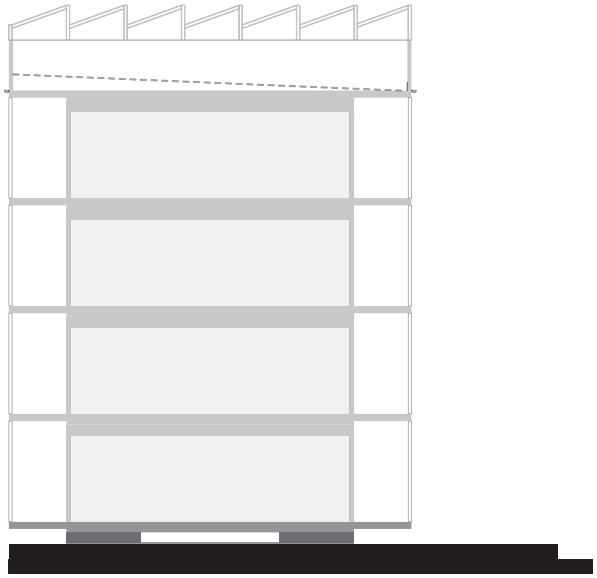
Site Design Techniques

Foundation Investigation



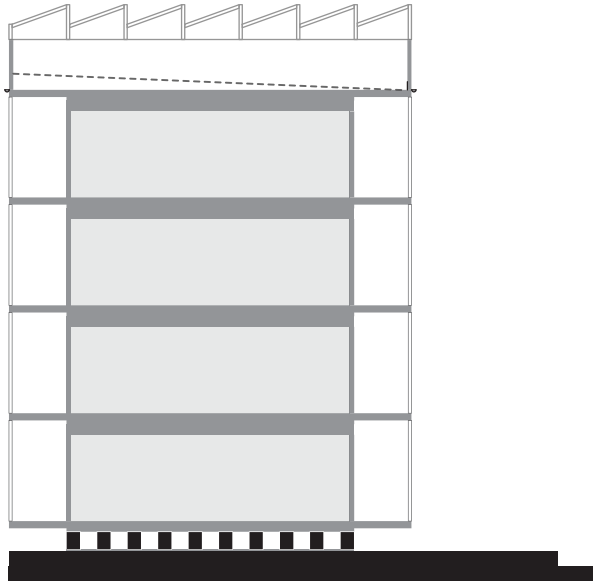
Screw piles (Helical)

- Fast installation
- All weather Installation
- Removable
- Reusable



Precast concrete plank on grade

- No soil penetration
- May require grading
- May be insufficient for load

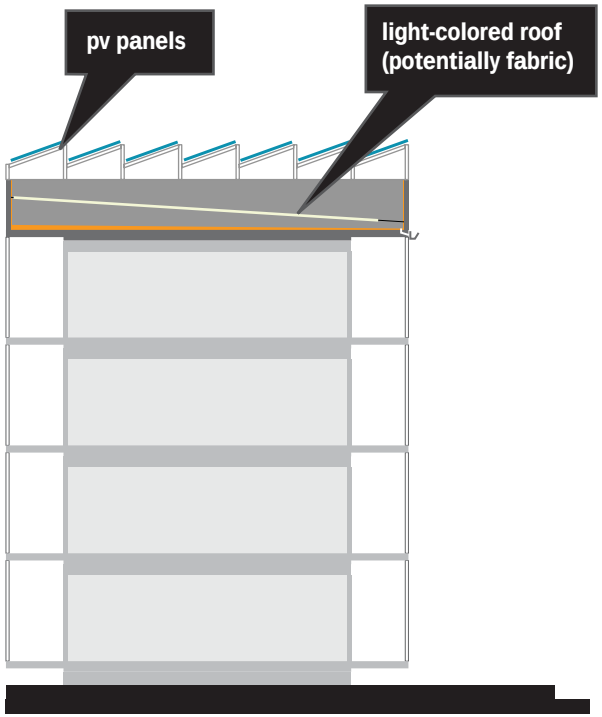


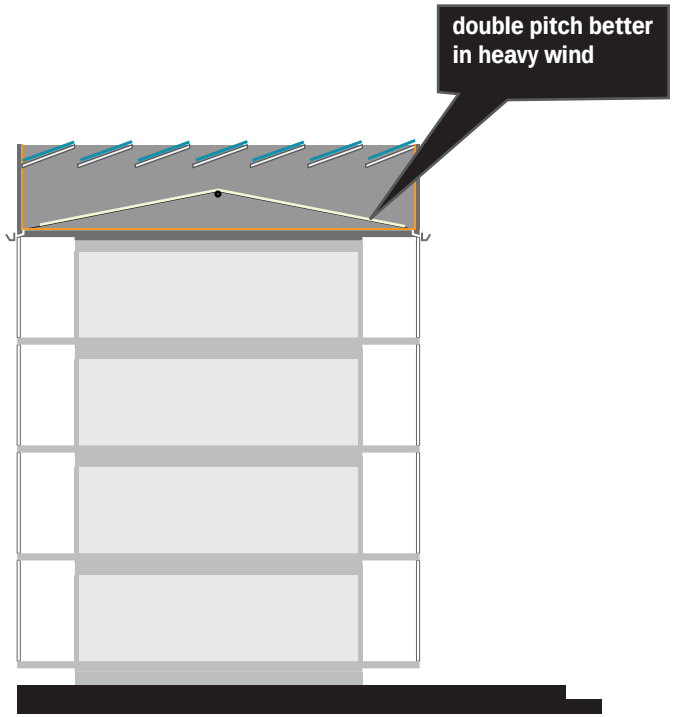
Slab on grade with base isolator

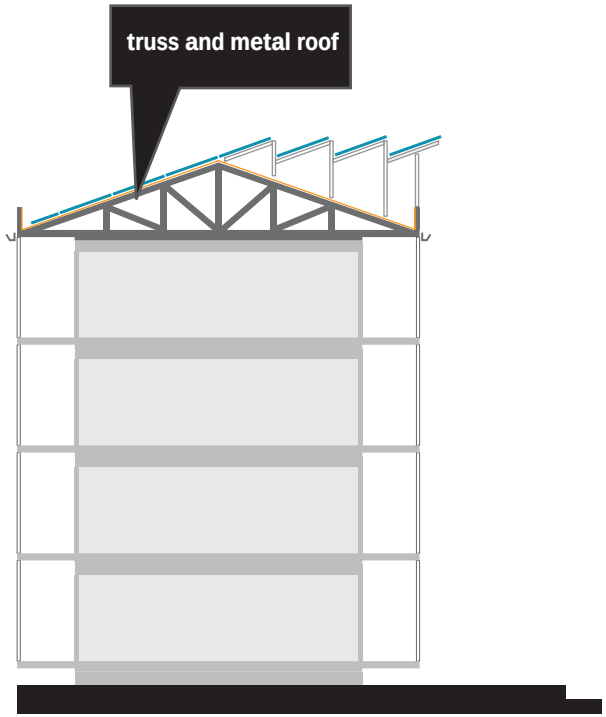
- No soil penetration
- Seismic protection
- Can negotiate variable grades

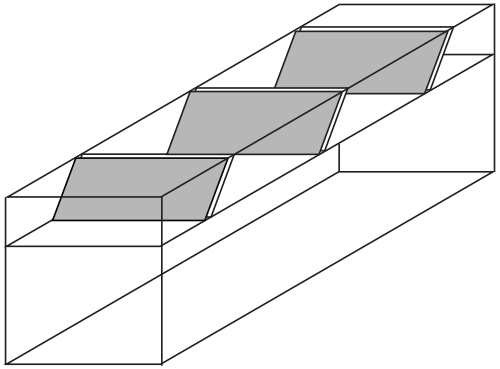
Site Design Techniques

Roof Investigation







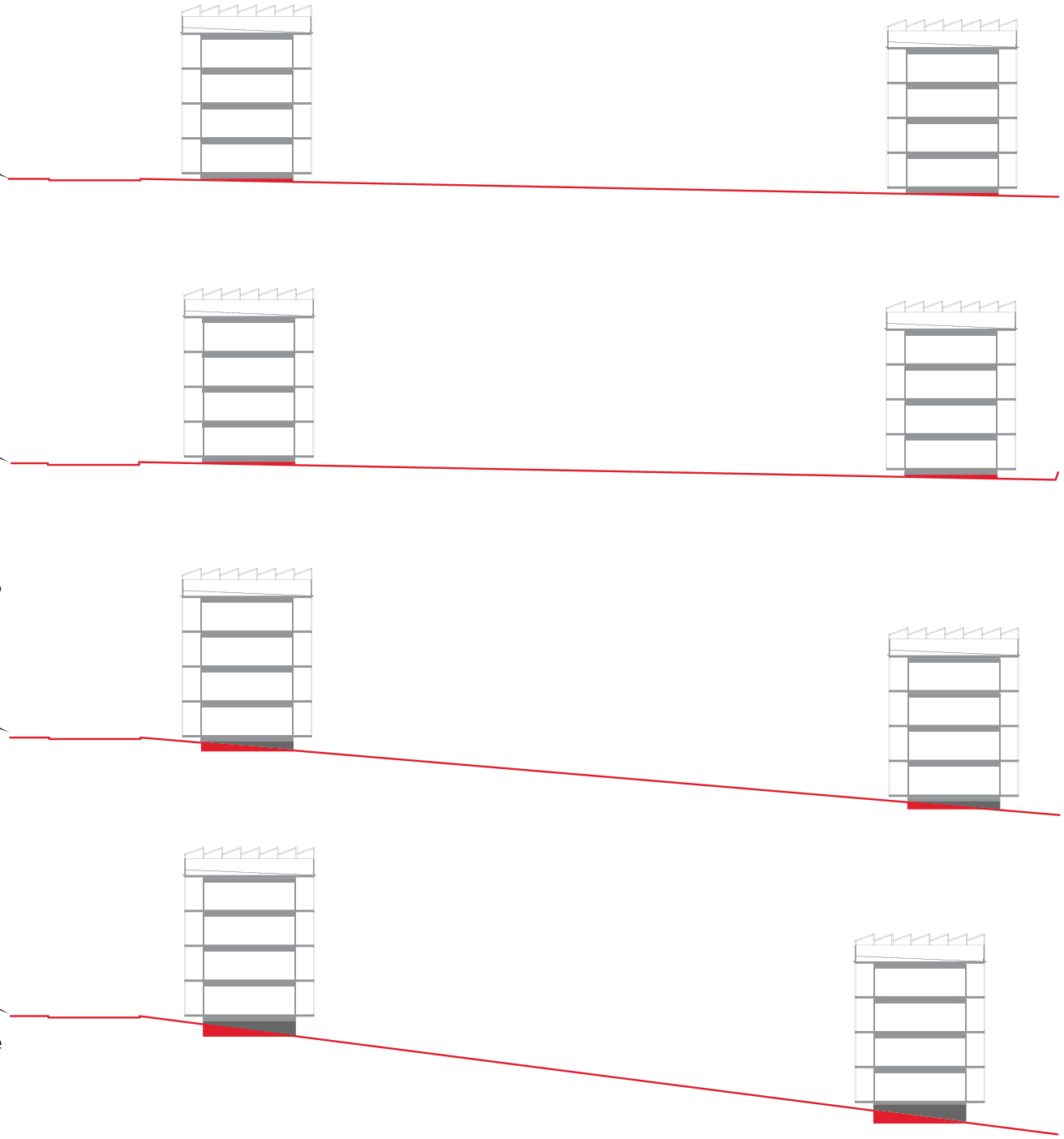


Pre-Fab Units

- Configured for roof component
- Provide joints for fastening pv panels

Site Design Techniques

Designing for Slopes



- Imperceptible from the ground. Maintain at least 2% slope over site for good drainage.

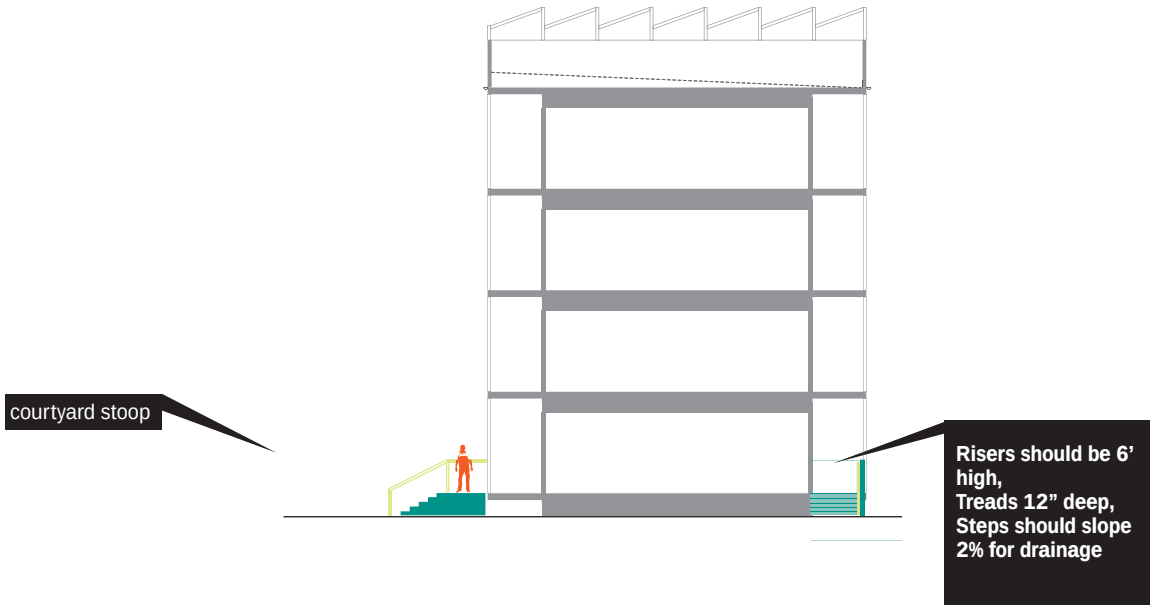
- Some grading or adjustment via foundations needed.
- Consider catching surface flow with swales, trenches, or drains.

- Requires Grading (and probable excavation/ exposire of soil).
- Negotiate slope with terraces, ramps, and steps.

- Extensive Grading necessary (and probable excavation/ exposire of soil).
- Negotiate slope with terraces, ramps, and steps.

Site Design Techniques

Steps and Ramps

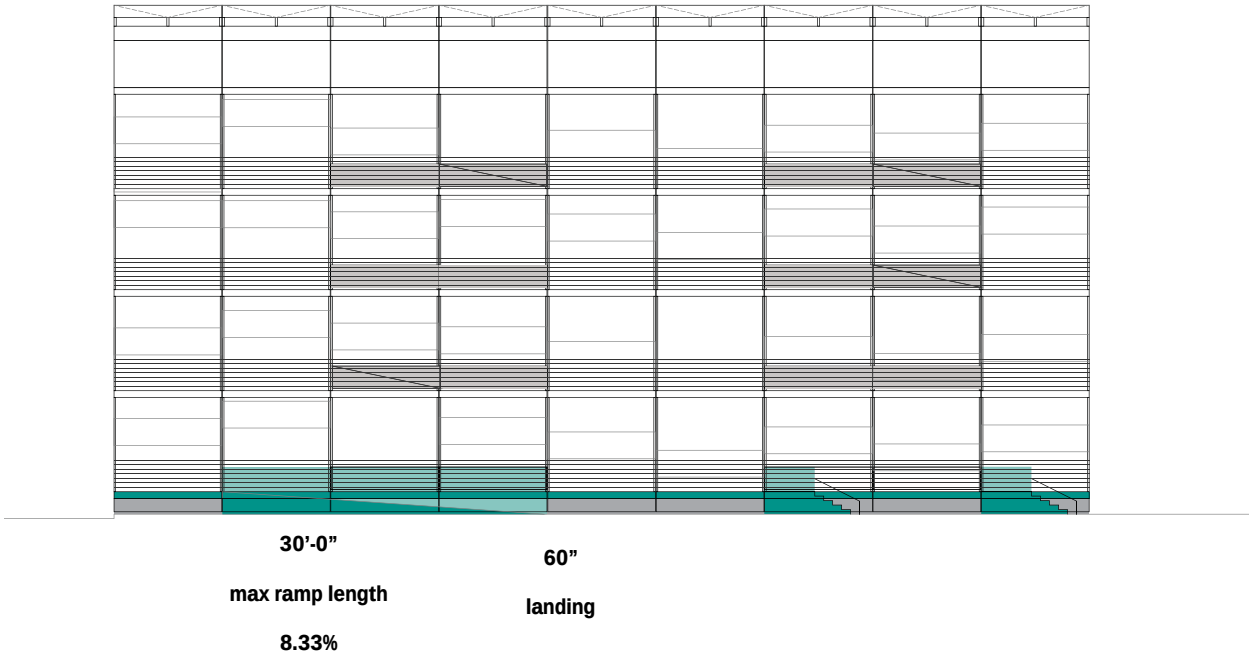


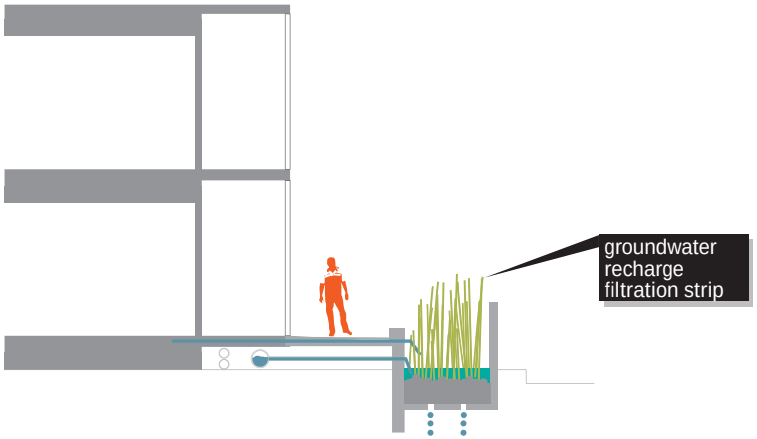
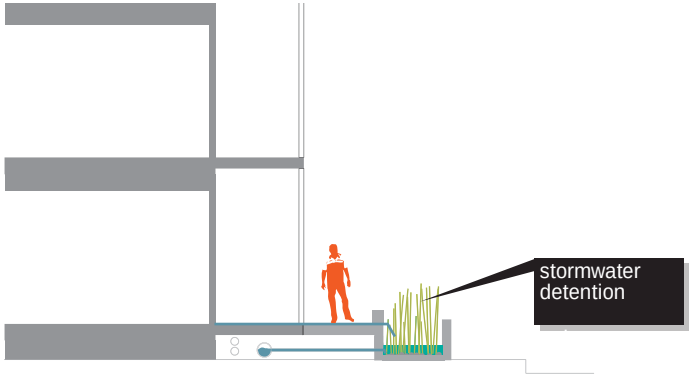
Refer to the *ADA Accessibility Guidelines for Buildings and Facilities* for complete ramp requirements.

Any part of an accessible route with a slope greater than 1:20 shall be considered a ramp The least possible slope shall be used for any ramp. The maximum slope of a ramp shall be 1:12.

The maximum rise for any run shall be 30 in (760 mm).

The minimum clear width of a ramp shall be 36 in (915 mm).



Site Design Techniques

Circulation and Drainage