

## **Upper Science Hill Development Program And Physical Sciences and Engineering Building**

*A Generational Complex to Support Initiatives in Quantum and Materials Science*

Michael Crair, Vice Provost for Research  
Karsten Heeger, Professor of Physics, Wright Lab Director  
Sohrab Ismail-Beigi, Professor of Applied Physics  
Scott Strobel, Provost

*Town Hall #3 - March 25, 2024*

# Agenda

---

- Welcome
- Recap of last Town Hall (Dec 2022)
- Progress since last Town Hall
  - Upper Science Hill Development Project
    - Phasing
  - Wright Lab – Addition (WL-A)
  - Advanced Instrumentation Development Center (AIDC)
  - Physical Science and Engineering Building (PSEB)
    - Overall building design
    - Laboratory design
    - Cores
- Q&A

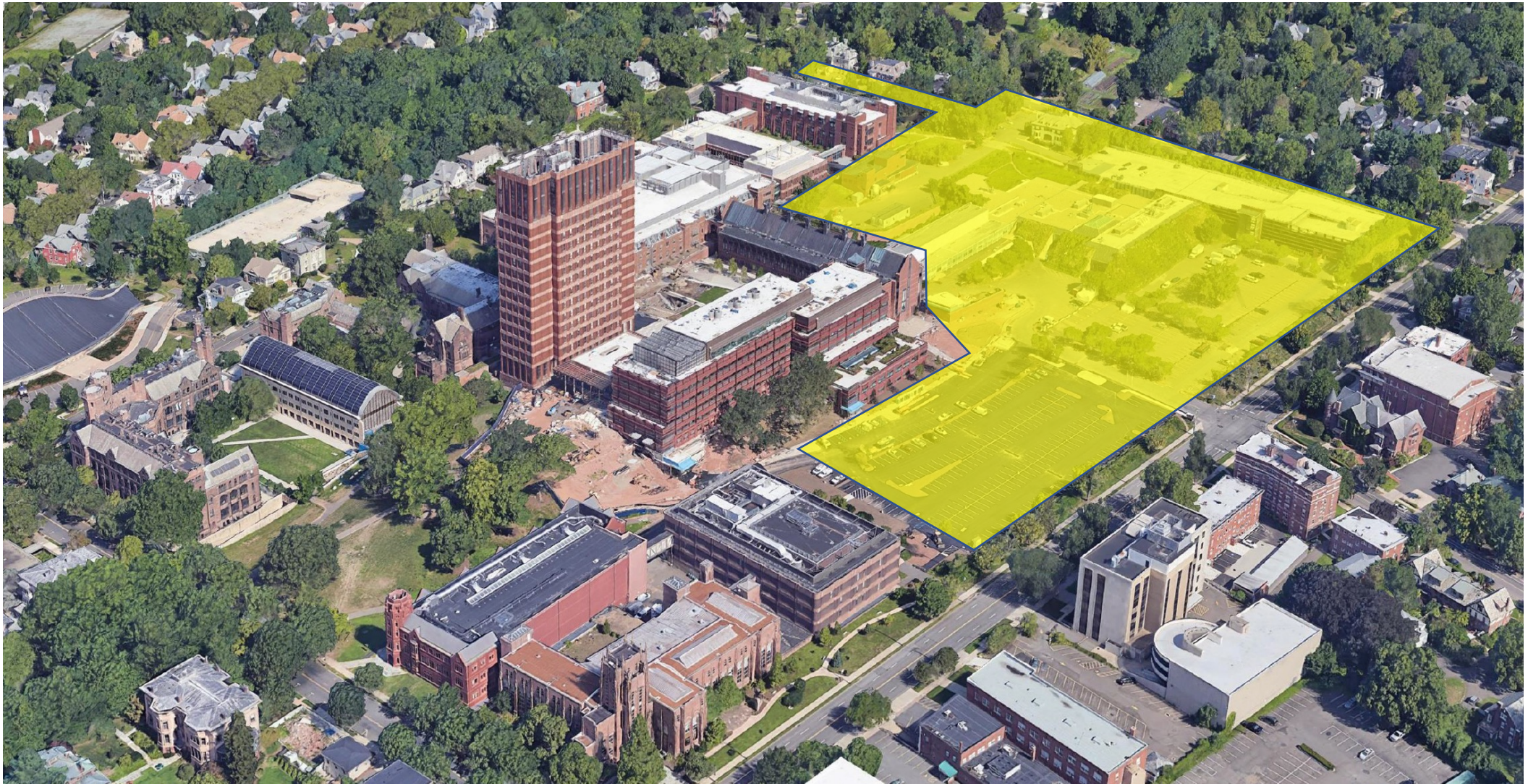
# Project Goals and Vision

---

- A generational complex to support Quantum Science, Engineering and Materials
- New laboratories for ~50 faculty from the Department of Physics, Department of Applied Physics, Materials Science, Yale Quantum Institute and other quantum-focused faculty across FAS and SEAS
- Convening space for affiliated departments, institutes, centers, and programs that will serve as a magnet for science and engineering at Yale
- A university facility to support the design and development of custom instrumentation (AIDC)
- A large and modern cleanroom and core facilities for materials characterization and imaging

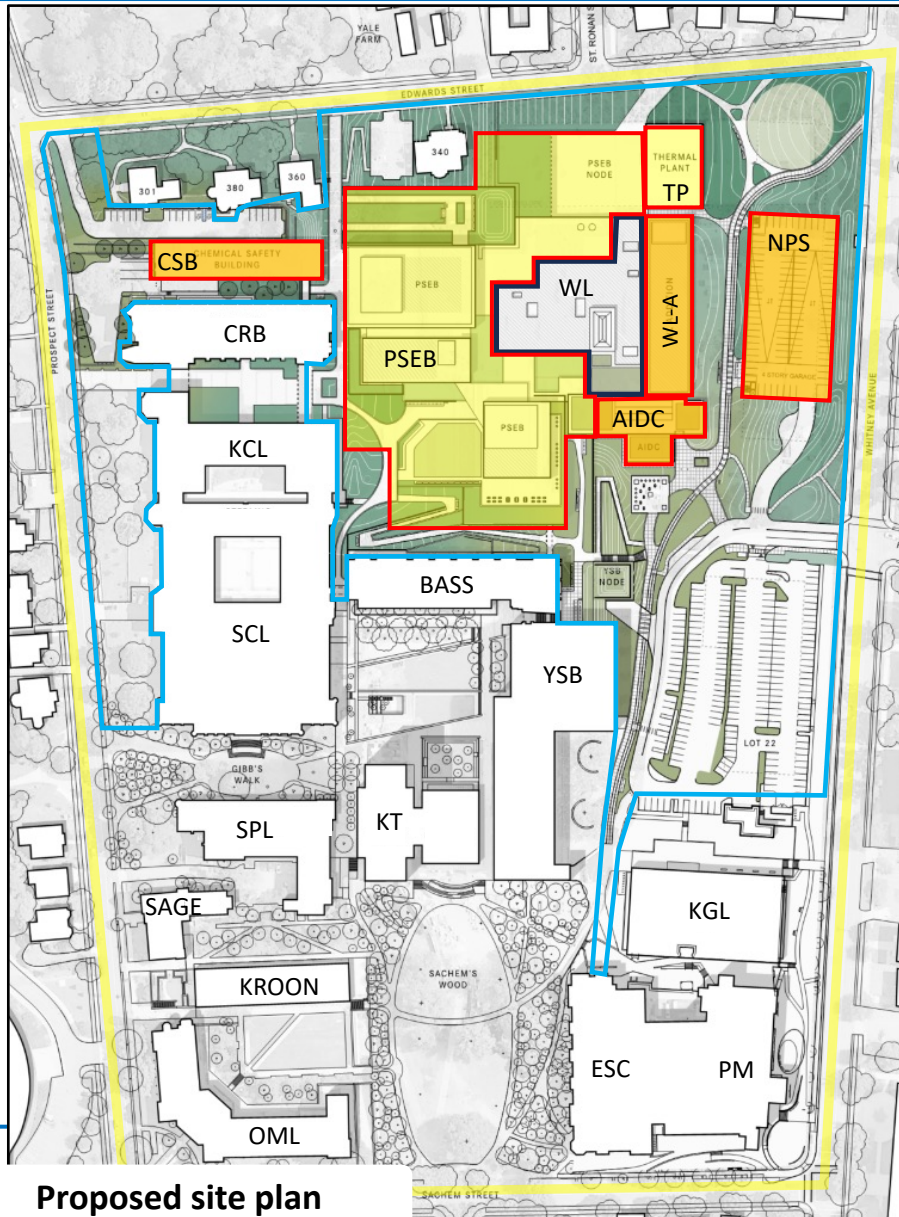


# Site Selection - 2020





# Site and Project Elements - 2022



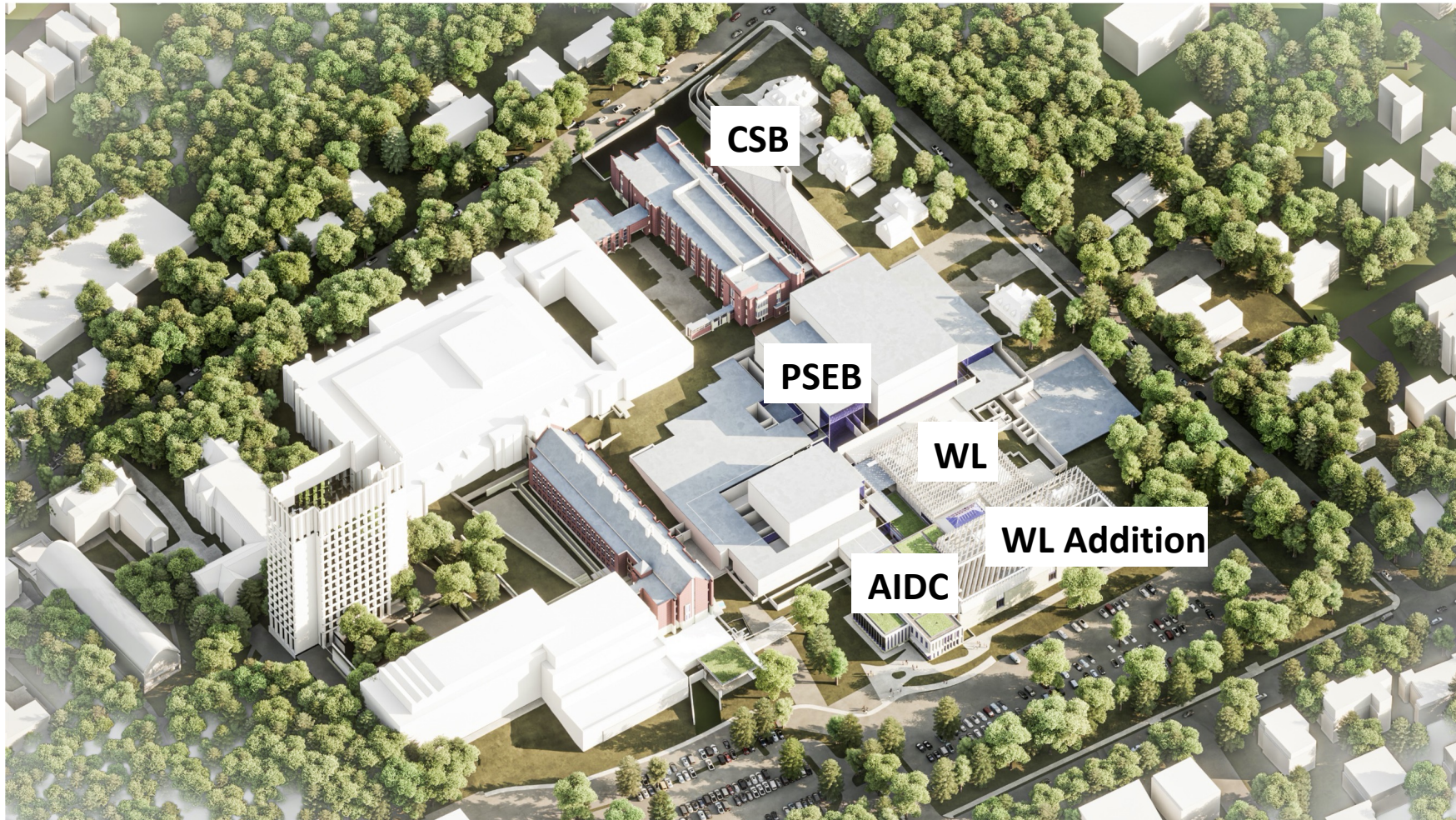
Proposed site plan

Phase 1 (enabling)	Phase 2
<p><b>New Buildings</b></p> <ul style="list-style-type: none"> <li>Advanced Instrumentation Development Center (AIDC)</li> <li>Addition to Wright Lab (WL-A)</li> <li>Chemical Safety Building (CSB)</li> </ul>	<p>Physical Sciences and Engineering Building</p>
<p><b>New Program</b></p> <ul style="list-style-type: none"> <li>Metrology</li> <li>Electronics Core</li> <li>Expanded APC</li> </ul>	<ul style="list-style-type: none"> <li>Cleanroom</li> <li>Materials Characterization Core</li> <li>Convening/Event Space</li> </ul>
<p><b>New Infrastructure</b></p> <ul style="list-style-type: none"> <li>Wright Lab Improvements</li> <li>Utilities</li> <li>Parking Improvements</li> </ul>	<ul style="list-style-type: none"> <li>Service Node</li> <li>Utilities and Thermal Plant</li> </ul>



# Upper Science Hill Development

An Integrated Complex – Expanding Science Hill





# Site Plan Bird's-Eye View

## Demo PSPG

Pierson-Sage Parking Garage

## Demo CSB

Chemical Safety Building, existing (including CRB loading dock)

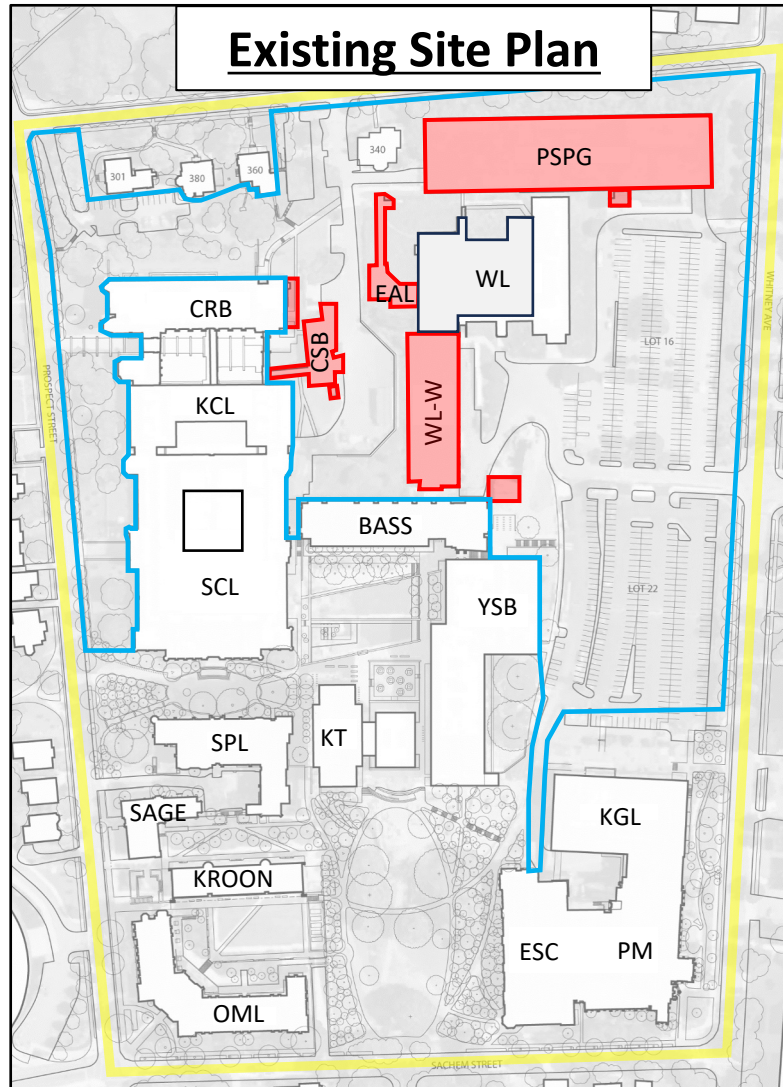
## Demo WL-W

Wright Lab-West (including Bass-YSB loading dock)

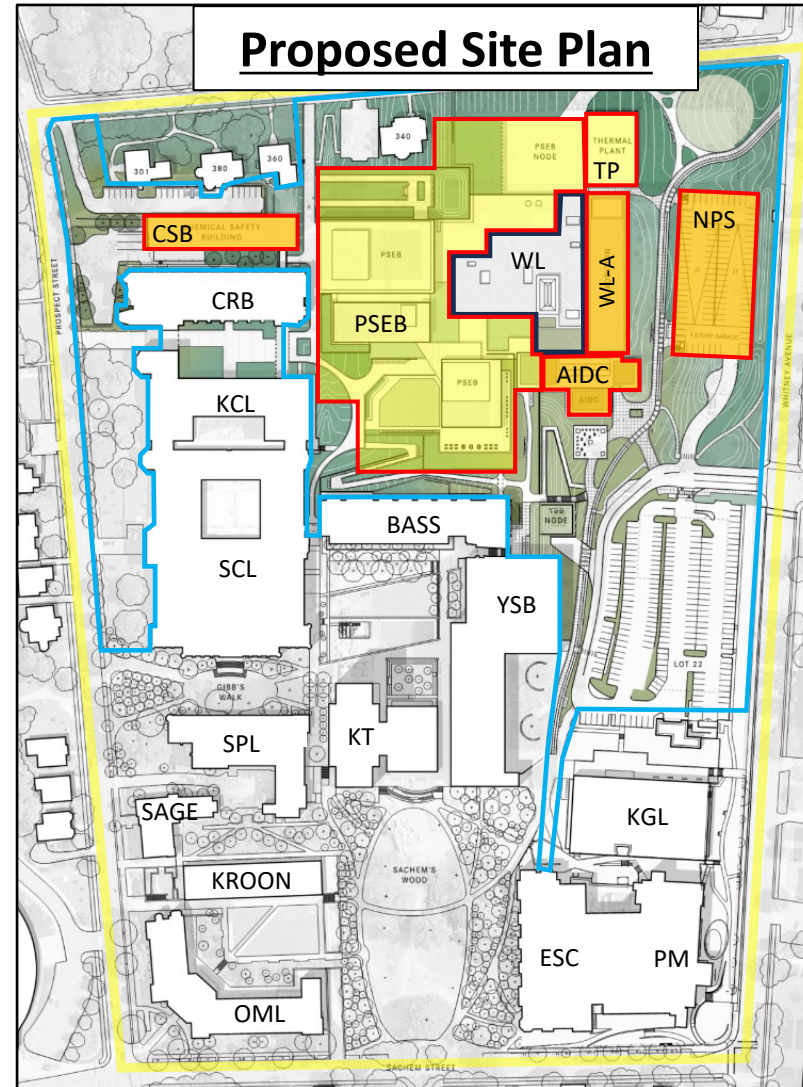
## Demo EAL

Electron Accelerator Lab

- Phase 1
- Phase 2
- Demolition



**Existing Site Plan**



**Proposed Site Plan**

## CSB

Chemical Safety Building

## WL-A

Wright Lab Addition

## AIDC

Advanced Instrumentation Development Center

## NPS

New Parking Structure

## TP

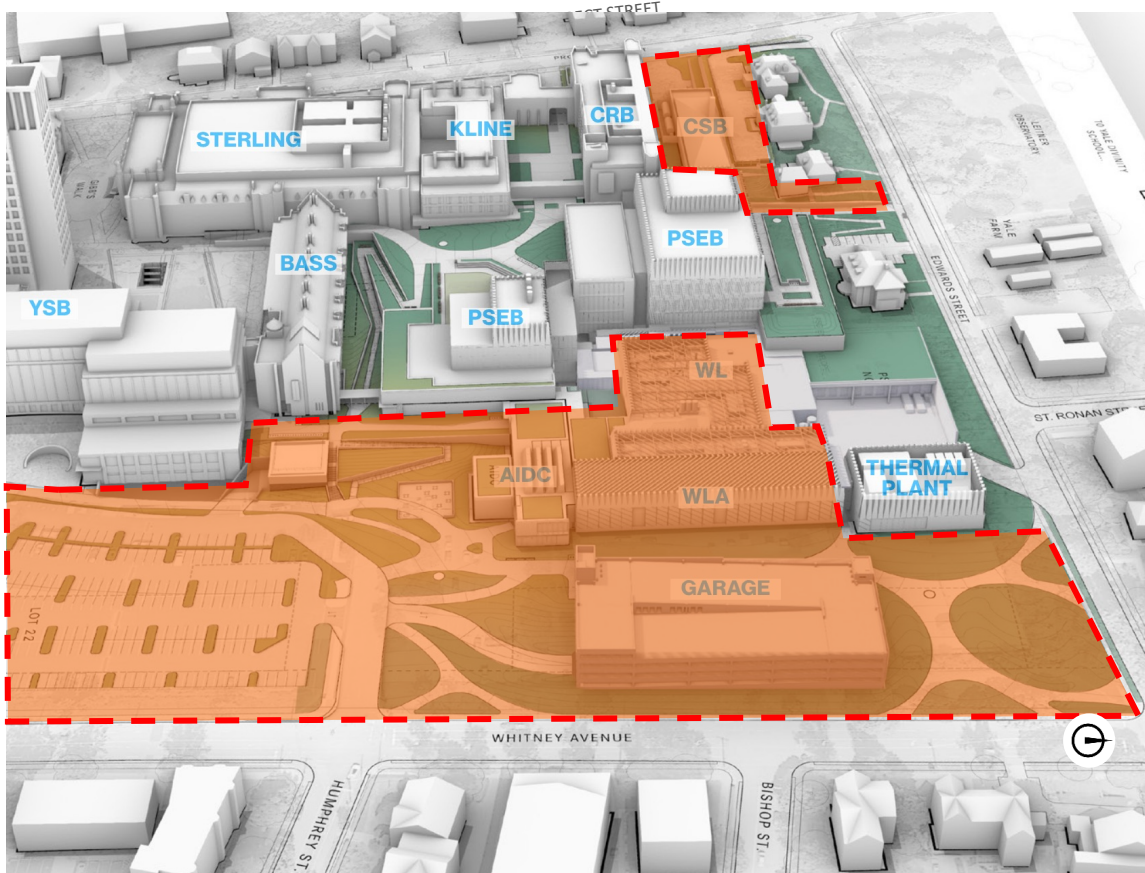
Thermal Plant

## PSEB

Physical Sciences and Engineering Building



# Upper Science Hill Development – Phase 1



## New Programs

- Advanced Instrumentation Development Center (AIDC)  
*An evolution of the existing Advanced Prototyping Center into an intellectual hub for instrumentation design and development*

## Enabling Projects

- Wright Lab Addition (WL-A)  
*Enables the demolition of Wright Lab West (WL-W)*
- Chemical Safety Building (CSB)  
*Relocates EHS and Chemistry department stockroom*
- Demolition of Pierson Sage Garage

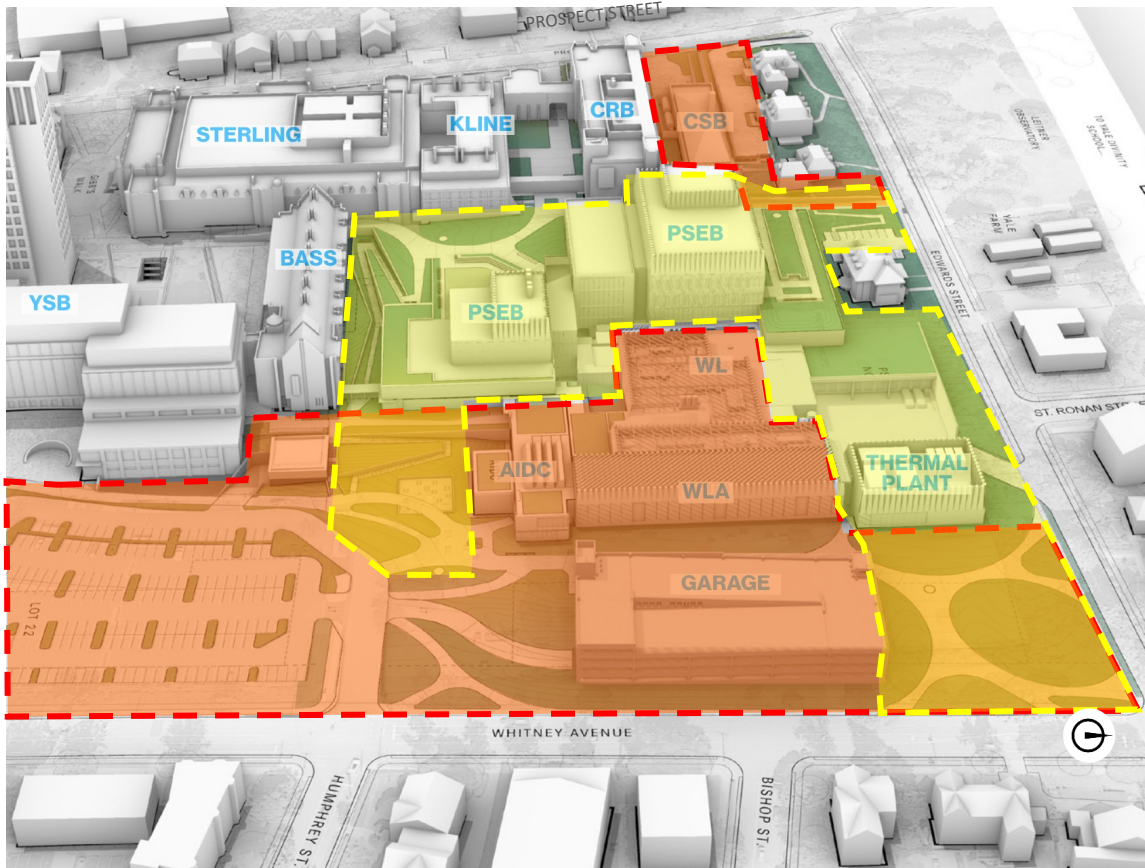
## Commitment to Sustainability

- Geothermal wells
- Photovoltaic-ready

## Operational Improvements

- New parking garage (Lot 16)
- Wright Lab high-bay floor reinforcement
- Yale Science Building – Bass Center service node

# Upper Science Hill Development – Phase 2



## New Programs

- Physical Sciences and Engineering Building  
*A Generational Complex to Support Initiatives in Quantum and Materials Science*

## Commitment to Sustainability

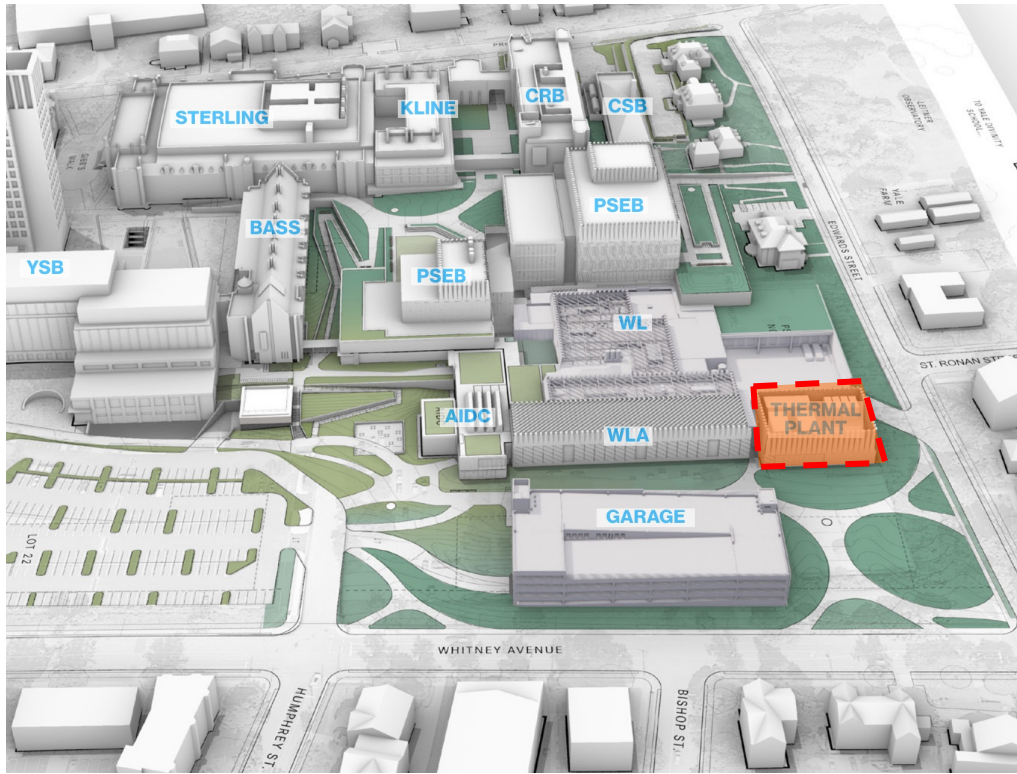
- Thermal Utilities Plant  
*Provide electrified thermal energy to Upper Science Hill  
In furtherance of Yale's Planetary Solutions*

## Operational Improvements

- New service node for Upper Science Hill
- Upper Science Hill landscaping



# Upper Science Hill Development

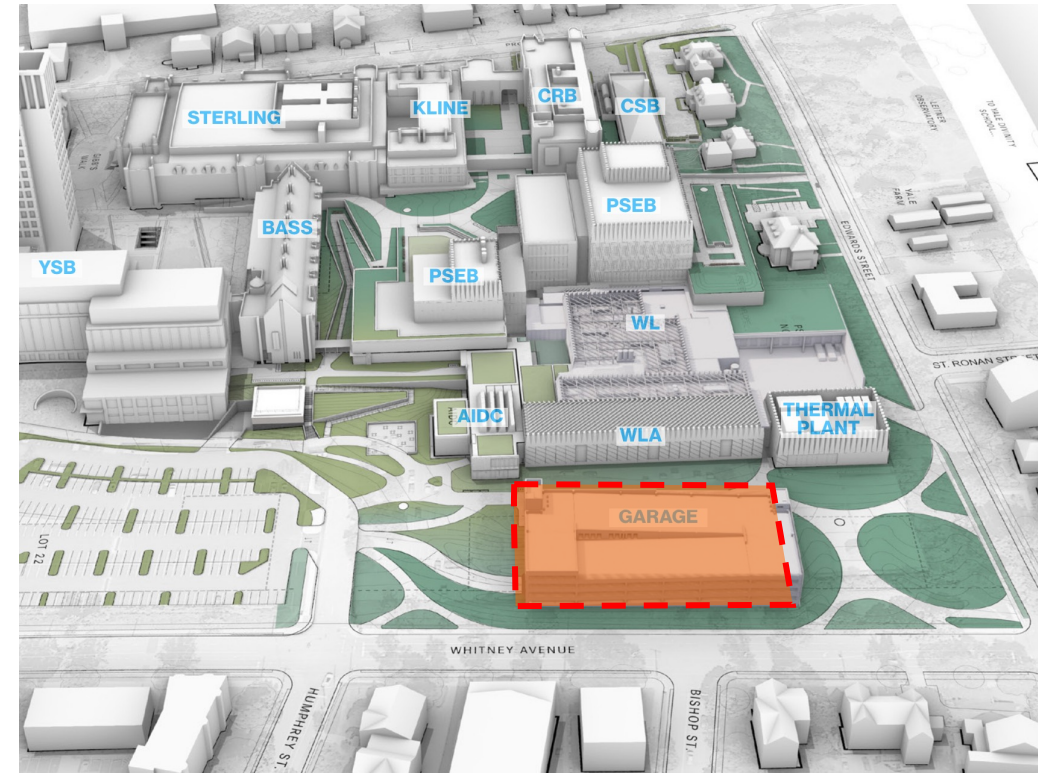


## Commitment to Sustainability

- Thermal Utilities Plant

*In furtherance of Yale's Planetary Solutions*

*Providing electrified thermal energy to Upper Science Hill*

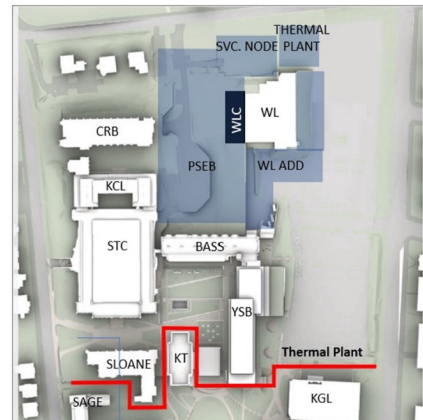
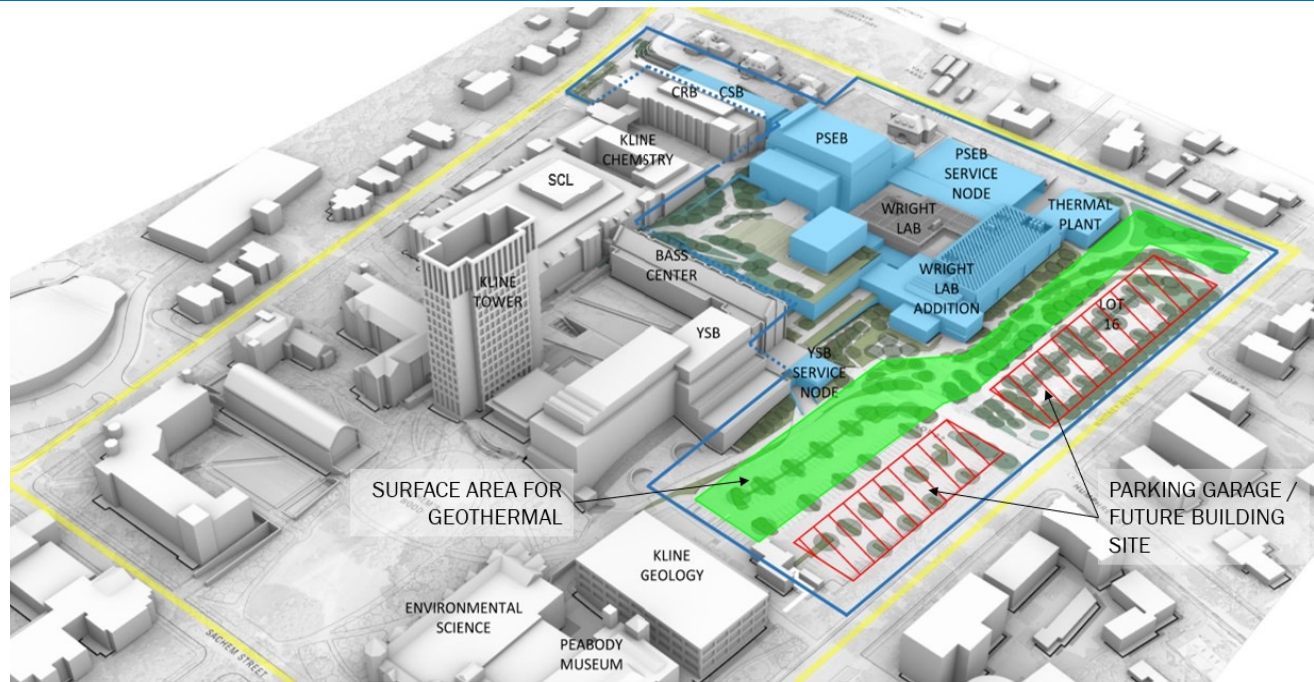


## Operational Improvements

- New parking garage (Lot 16)



# Upper Science Hill Development – Thermal Utilities Plant

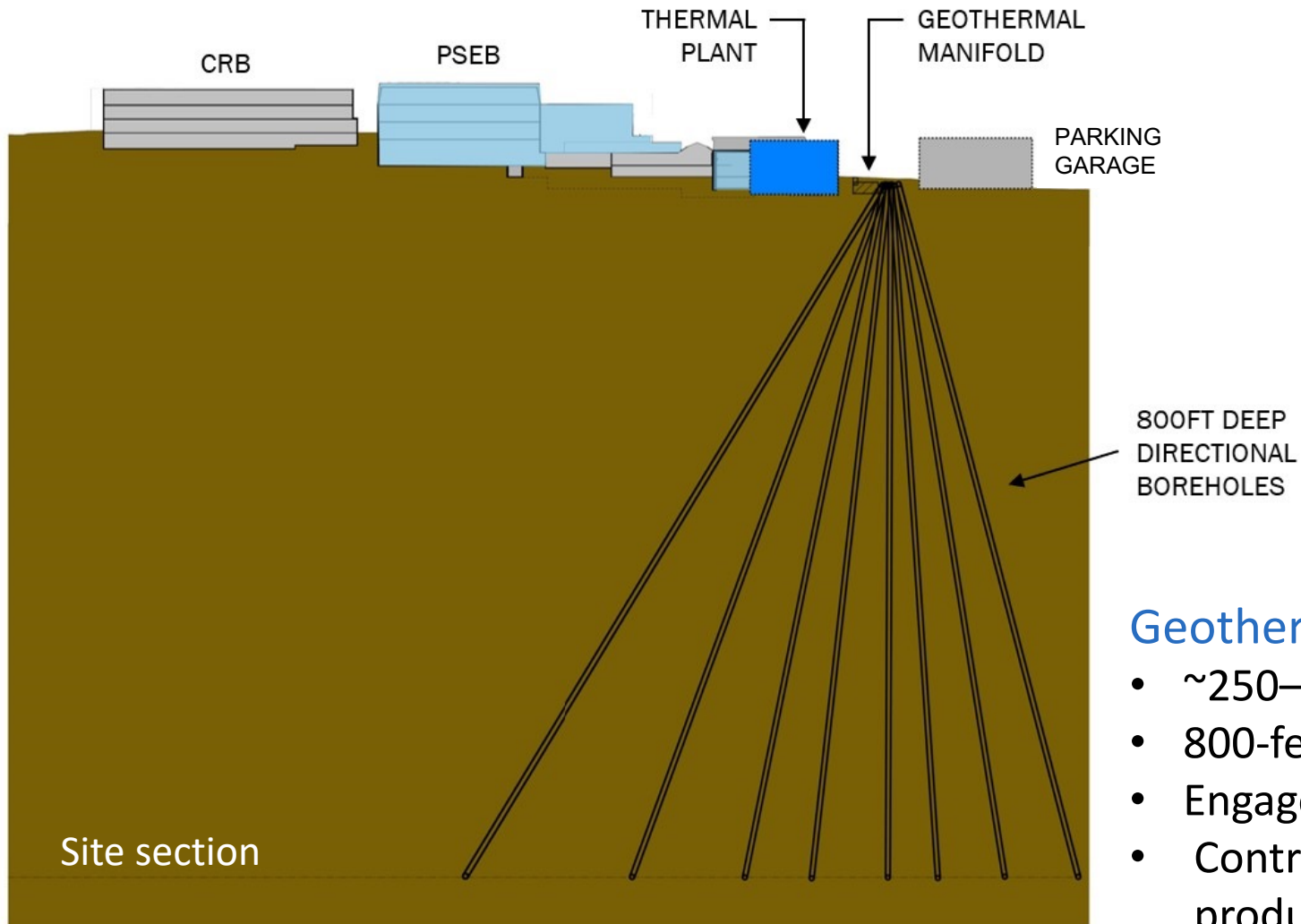


The Thermal Utilities Plant will provide electrified thermal energy to Upper Science Hill

- New development: PSEB, CSB, WL, AIDC
- Six existing buildings: CRB, KCL, SCL, YSB, SPL, Bass Center

When complete, the plant will directly serve more than 50% of the thermal energy load on Science Hill and reduce Central Campus emissions by approximately 10%.

# Upper Science Hill Development – Thermal Utilities Plant

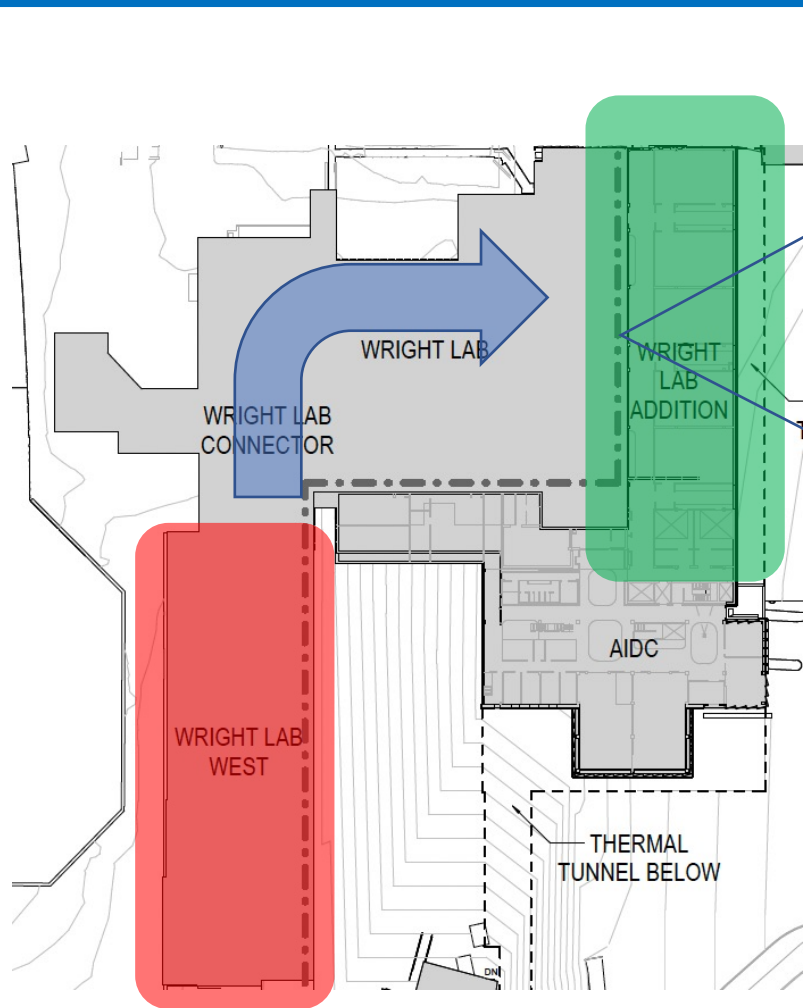


## Geothermal field design

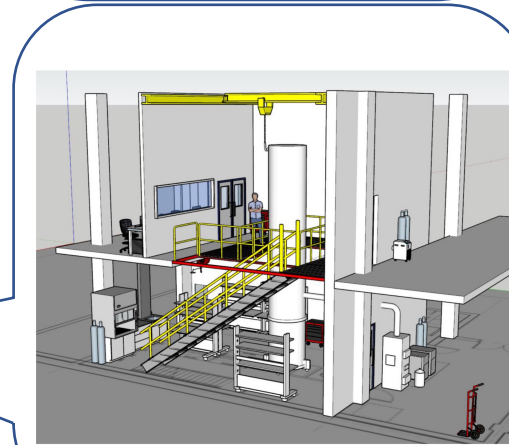
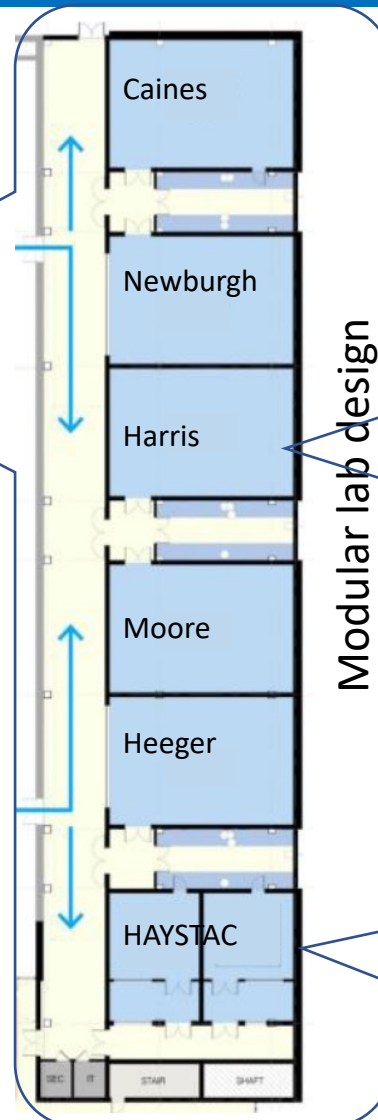
- ~250–300 boreholes
- 800-foot deep
- Engage new drilling technology
- Contributes to 14,000 MBH of hot water production and heat recovery at Plant



# Phase 1 – Moving Wright Lab West into Wright Lab



\*Enables Phase 2

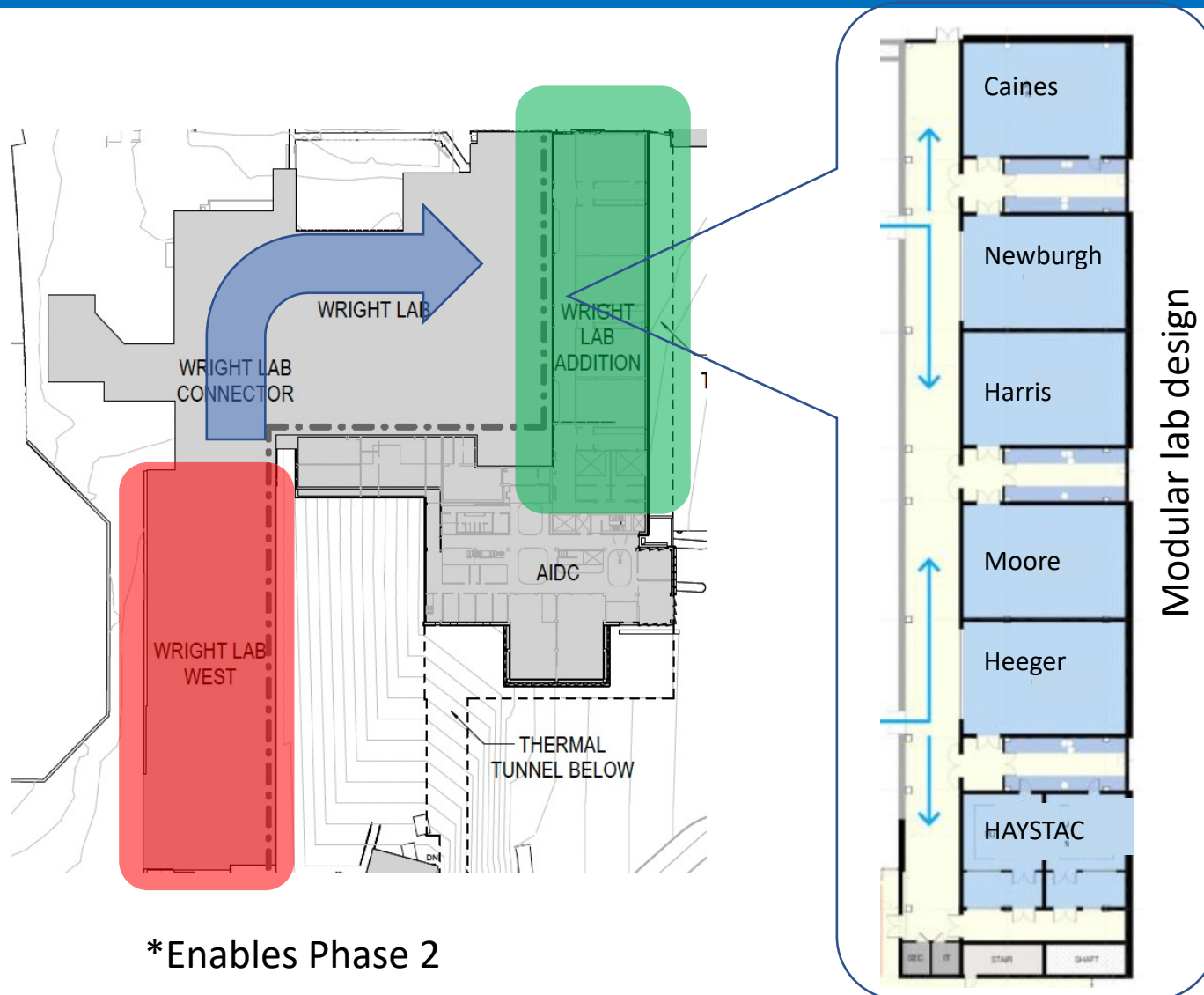


Variety of research labs for

- Cryogenics
- Table-top experiments
- Large magnetic fields
- Precision measurements
- Quantum-enabled experiments
- Instrumentation R&D and testing



# Phase 1 – Moving Wright Lab West into Wright Lab



WLA is enabling project for demolition of WL West, relocates several experimental labs.

Co-location and synergies of instrumentation R&D with AIDC.

Synergies of WL quantum-enabled research with PSEB program.



HAYSTAC:  
quantum-enabled axion  
dark matter search.

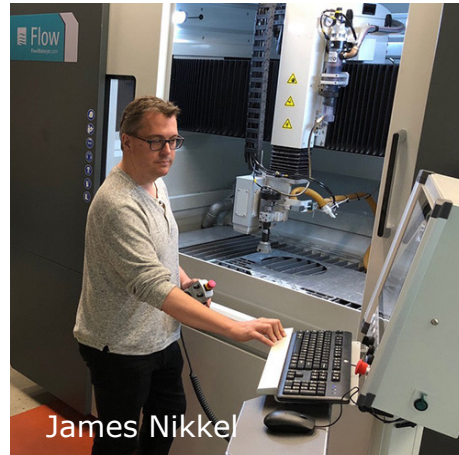
# Phase 1 - Advanced Instrumentation Development Center



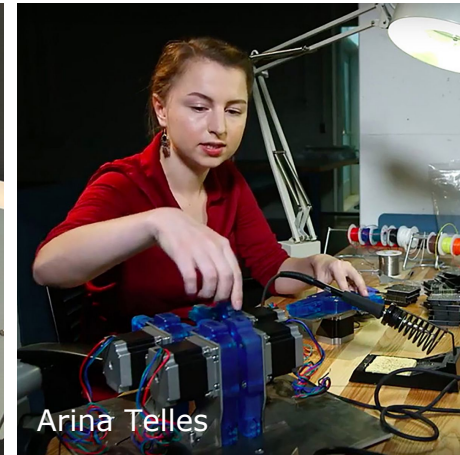
## USSC Report

*"We recommend that Yale develop high-capacity centralized instrumentation and engineering facilities to serve as intellectual 'hub' for instrumentation development."*

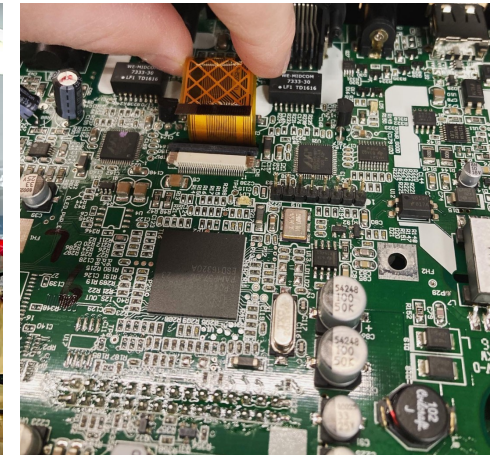
**AIDC** is one of the cross-cutting USSC priorities and an evolution of the existing **Advanced Prototyping Center (APC)** at WL.



James Nikkel



Arina Telles



**APC** is a single room in Wright Lab with 2 part-time staff.

**AIDC** will have dedicated staff, machine space, assembly area, electronics core, and short-term R&D labs **serving users across campus.**



# A Generational Complex with Modular Structure

## Performance

Technically outstanding, labs for scientists at the absolute cutting edge of **Quantum Science**  
Flexibility for change, in anticipation of current and future research requirements  
Lead by example in supporting the goals of Yale's Planetary Solutions

---

## Experience

Building should convey innovative thinking, "we are going forward"  
Provide for community and "collisional frequency," to boost creativity, better discoveries  
Interactive and inclusive; welcoming, inviting, approachable  
A network of spaces that develop identity and interconnectivity, indoor and outdoor

---

## Context

Bring together physical sciences and engineering like never before  
Positioning Yale at the forefront of **Quantum Science, Engineering, and Materials**  
Flexibility for the future

---

## Opportunity

**AIDC** draws people from across university  
A community around cutting-edge instrumentation design and fabrication  
Dramatically improving and expanding **Science Hill**

# Phase 2 – Faculty Advisors and Process

Charles Ahn	Hui Cao	Jack Harris	Vidvuds Ozolins	Rob Schoelkopf
Eric Altman	Michael Crair	*Karsten Heeger	Shruti Puri	Jan Schroers
Jeff Brock	Steven Girvin	*Sohrab Ismail-Beigi	Diana Qiu	Hong Tang
Gary Brudvig	Larry Gladney	Rajit Manohar	Peter Rakich	

---

## Key responsibilities:

1. Planning – Partner closely with Yale Facilities and the architect to aid in designing spaces that will meet programmatic needs
2. Communications – Disseminate information to respective departments and stakeholders and gather feedback
3. Observation – Participate in the coordination of the construction of PSEB
4. Response – Provide consult and/or binding decisions for the project

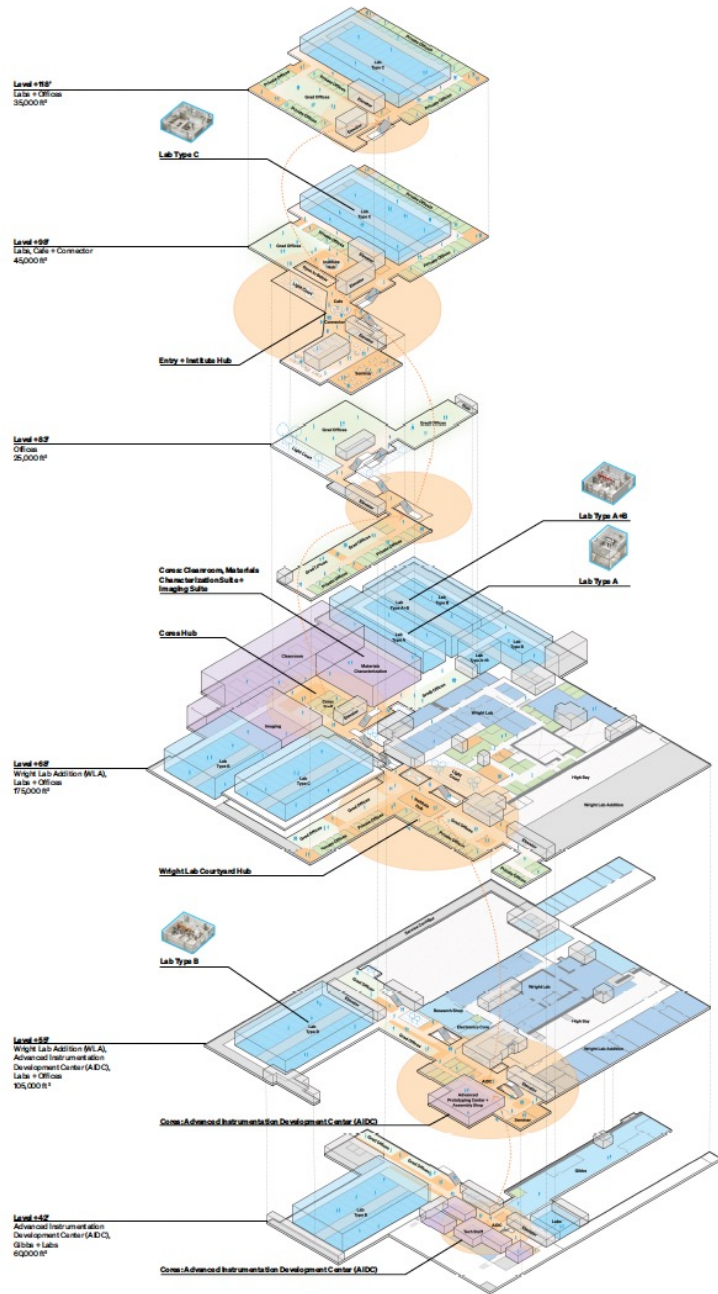
---

Met regularly over past year with the design team in a collaborative and iterative process with the following goals:

1. Confirm and advance design of laboratory typologies with specific performance criteria
2. Develop design strategies for office and shared spaces
3. Consider the identity of the building and connectivity within the building and with adjacent buildings
4. Convened external review committee to validate program and building standards and best practices



# Overall PSEB Design



West to Prospect St



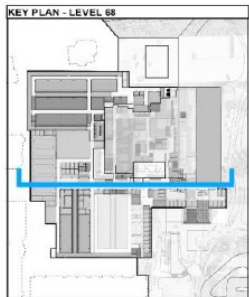
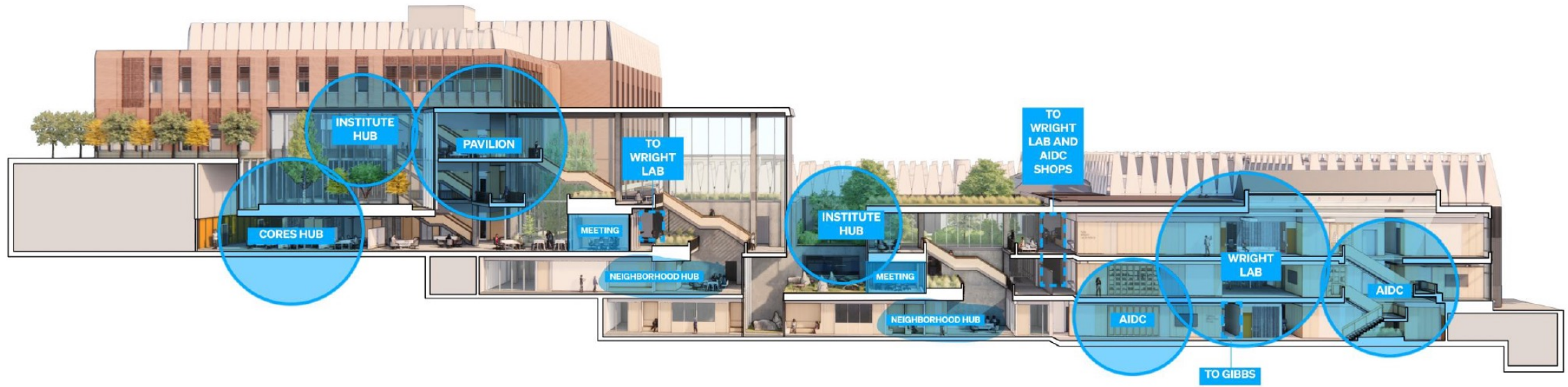
East to Whitney Ave



East to Whitney Ave



West to Prospect St



West to Prospect St

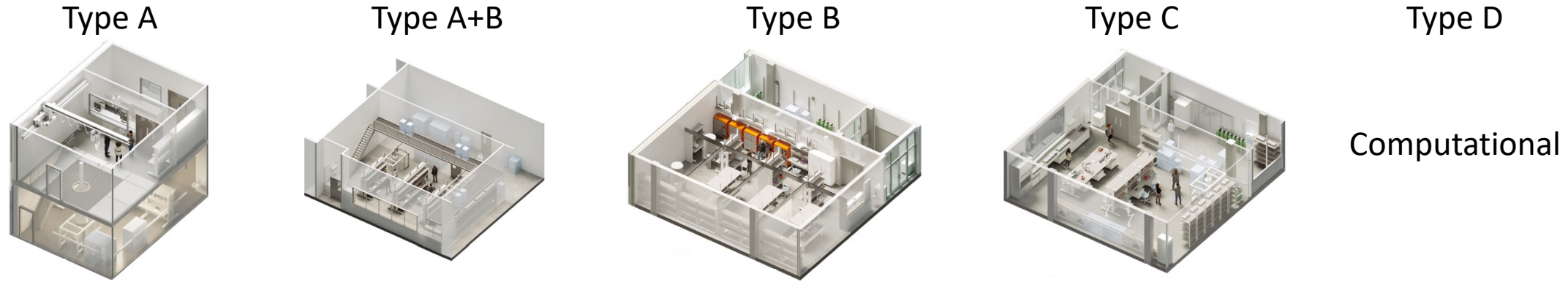


East to Whitney Ave

**Phase 2 Terraced Street: North Section**



# Laboratory Design



% of Labs in PSEB	5%	5%	40%	30%	20%
Clear Height	24'	14'	14'	9'	-
Vibration (max)	VC-E	VC-E	VC-E	VC-E	-
NSF (typical)	1320	1320	1320	1320	-

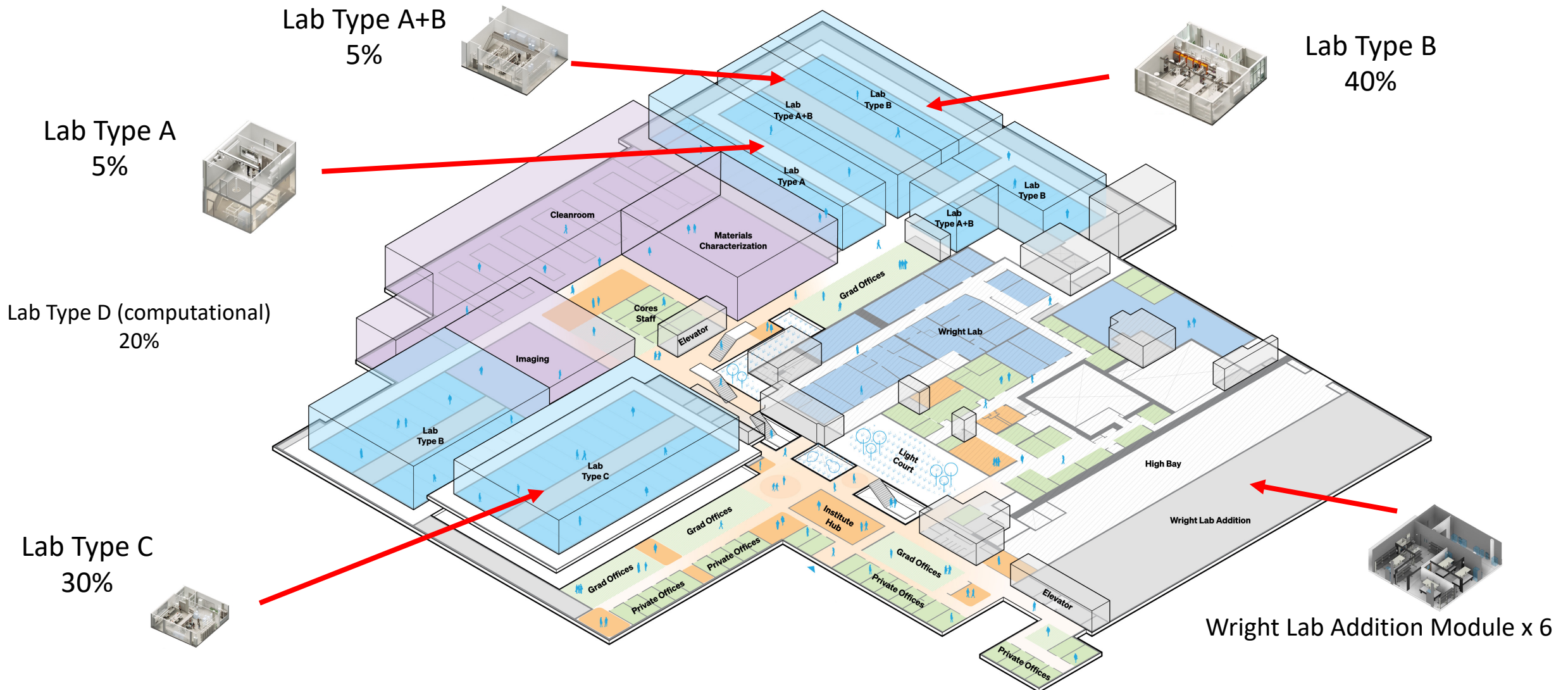
Lab Grade	Temperature	Humidity (rh at 72°F)
Standard	72°F +/- 4°	30-50%
Enhanced	72°F +/- 2°	30-50%
Specialized	72°F +/- 1°	40-45% (single set point)

**Modular approach to maximize future flexibility**

**Typologies to serve a wide range of research needs**

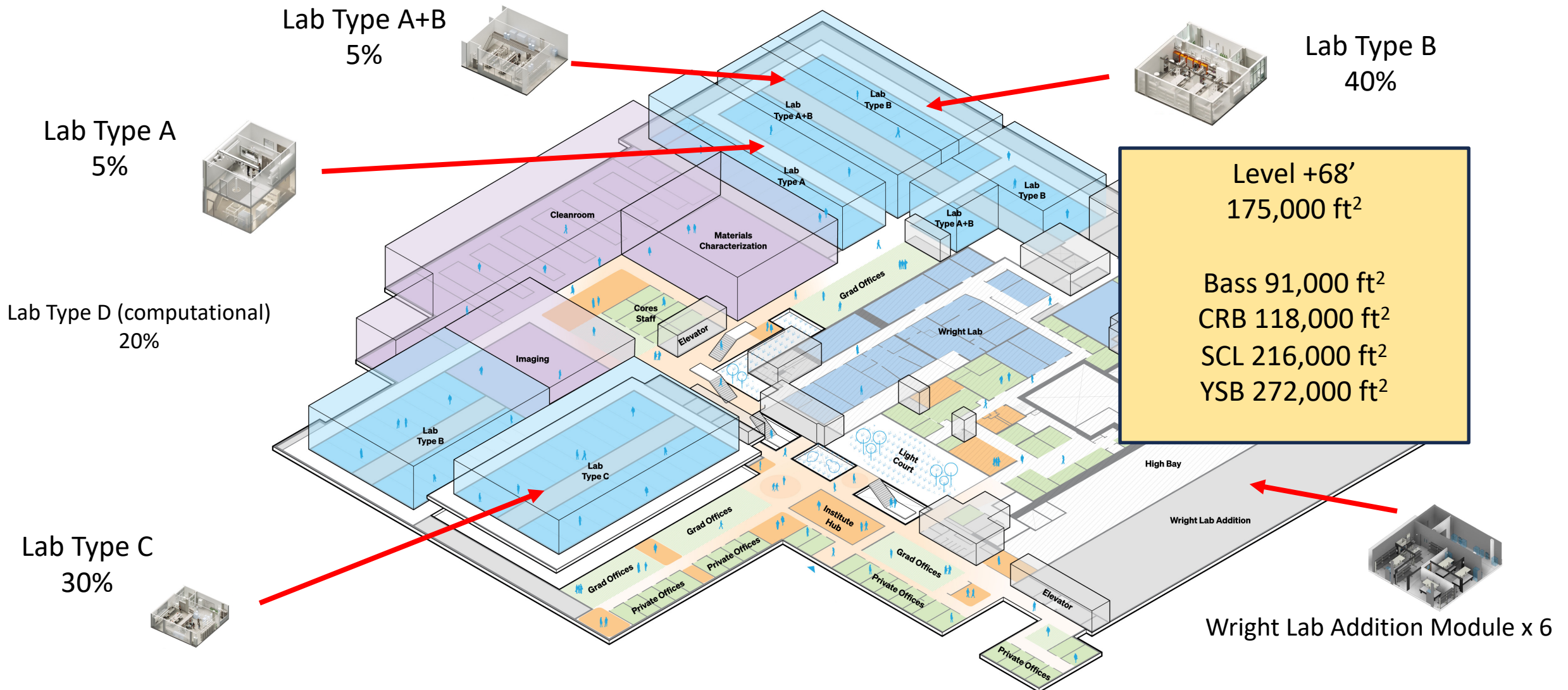
**High performance environmental conditions**

# Laboratory Design – Assembling PSEB





# Laboratory Design – Assembling PSEB

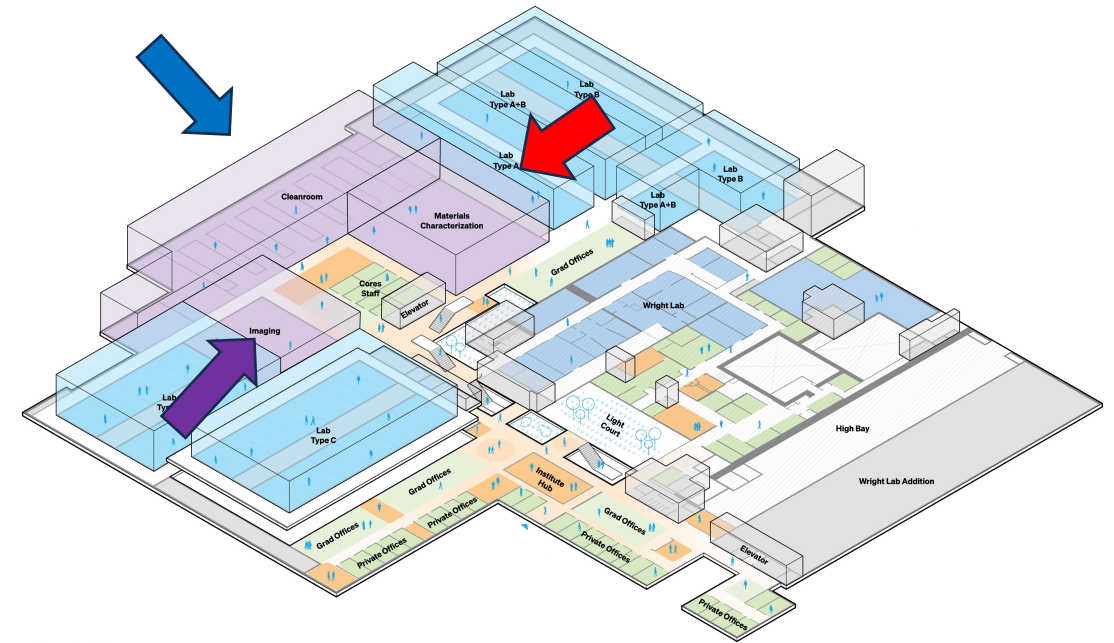
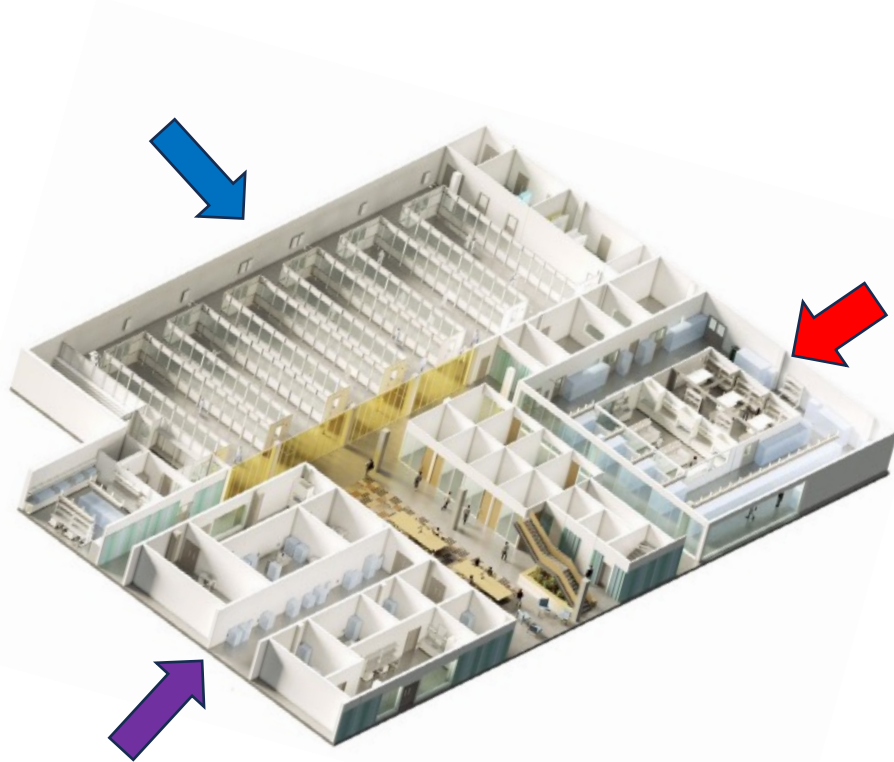


# Cores Design – 20,000 ft<sup>2</sup> of Opportunity and Growth

Cleanroom – 10,000 ft<sup>2</sup>

Materials Characterization – 5,000 ft<sup>2</sup>

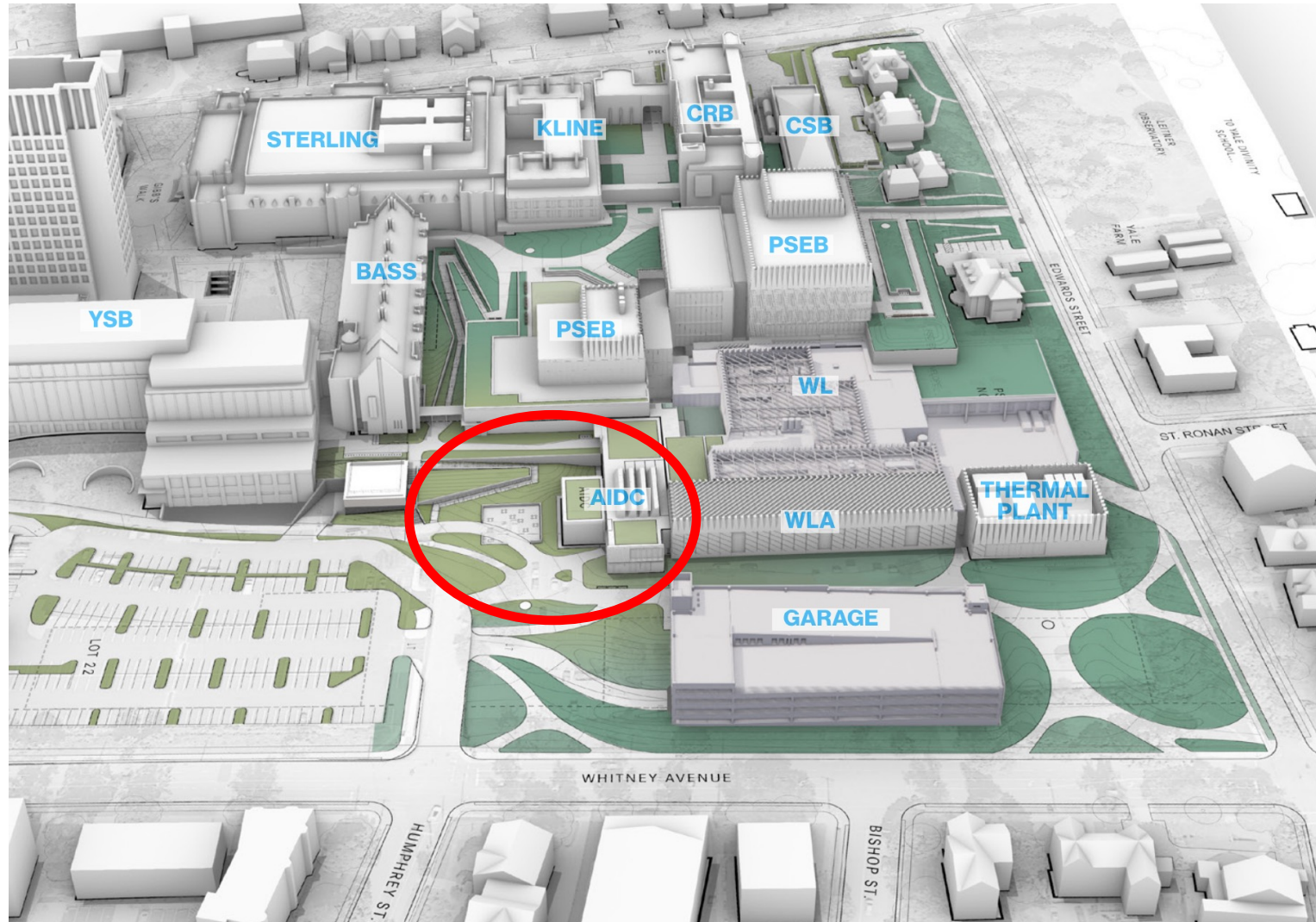
Imaging – 5,000 ft<sup>2</sup>



Level +68'  
Wright Lab Addition (WLA),  
Labs + Offices  
175,000 ft<sup>2</sup>



# Transforming Science Hill – A New Gateway



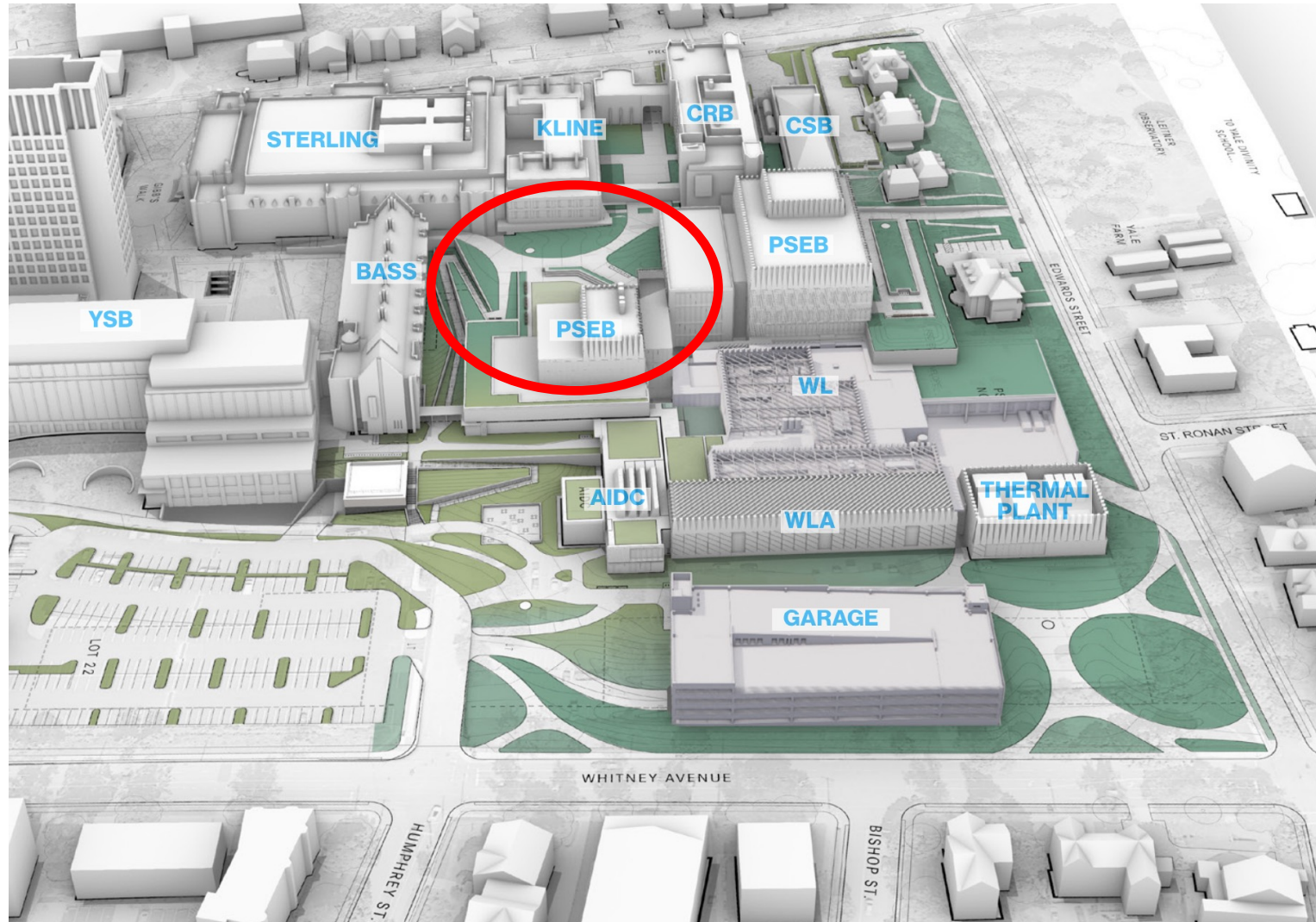
View from East

# Transforming Science Hill – A New Gateway





# Pavilion and Upper Courtyard



View from East

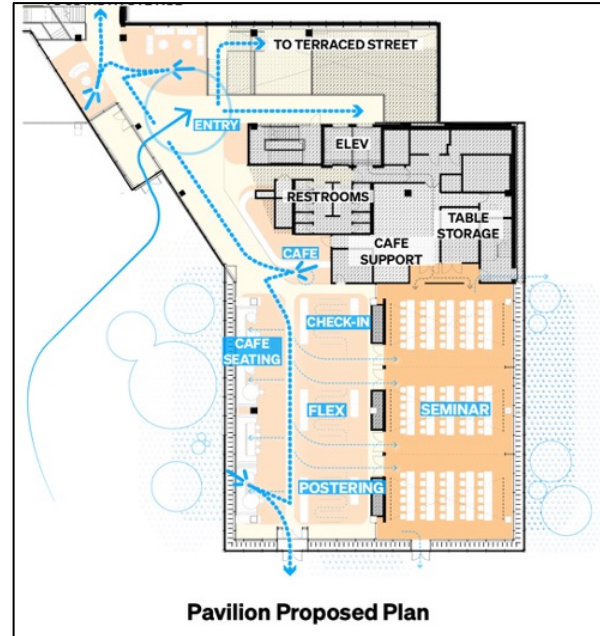
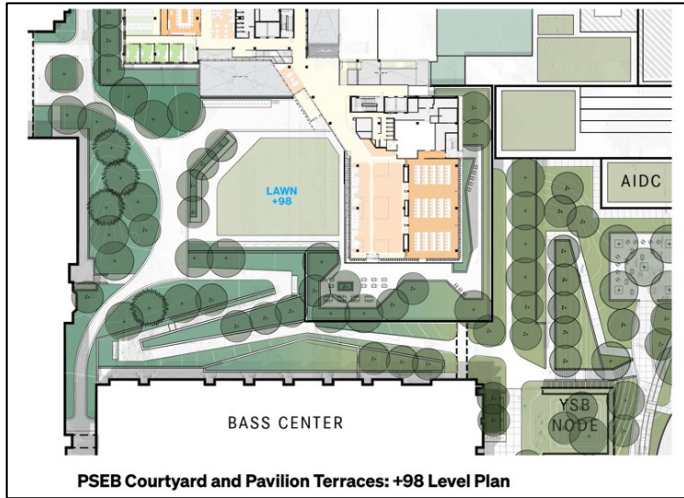


# Pavilion and Upper Courtyard





# Pavilion and Upper Courtyard



A convening hub for the community

Café with seating

Large event space









**+68 Hub**







# Anticipated Milestones – All Phases

▶ Chemical Safety Building Complete

▶ Thermal Utilities Plant Complete

June  
2025

Aug  
2027

March  
2028

▶ PSEB Construction Starts

Mid  
2026

▶ AIDC / WL-A Construction Starts

June  
2024

- ▶ AIDC and WL-Addition Complete
- ▶ WL-West Demolition Begins
- ▶ Geothermal Wells Complete

Late 2029 – Early 2030

PSEB Commissioning  
&  
Occupation



# A generational complex to support quantum science, engineering and materials

- We continue to recruit new faculty in the physical sciences and engineering
- Though space is limiting, we have space available now – YWC, SPL, YSB, Lower Hillhouse, **25 Science Park**
- We continue to invest heavily in physical sciences core labs



## Acknowledgements

Faculty and Staff Advisors

Yale Facilities

Ballinger – *architect and engineer of record*

TenBerke Architects – *design architect*

Turner Construction – *construction manager*

[research.yale.edu/pseb](https://research.yale.edu/pseb)

[vpr@yale.edu](mailto:vpr@yale.edu)