Yale

Physical Sciences and Engineering Building Project

A Generational Complex to Support Initiatives in Quantum and Materials Science

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

Town Hall #2 - December 12, 2022

Agenda

- Welcome
- Progress since 2018
- Design Principles and Vision
- Phased Approach
- New Capabilities
- Current status
- Q&A

Milestones to Date

2018
USSC report
Quantum Science, Engineering and Materials

"As part of this initiative, we recommend the construction of a new building for the physical sciences with Quantum Science, Engineering and Materials as its major focus."

2020
Town Hall – Site Announced

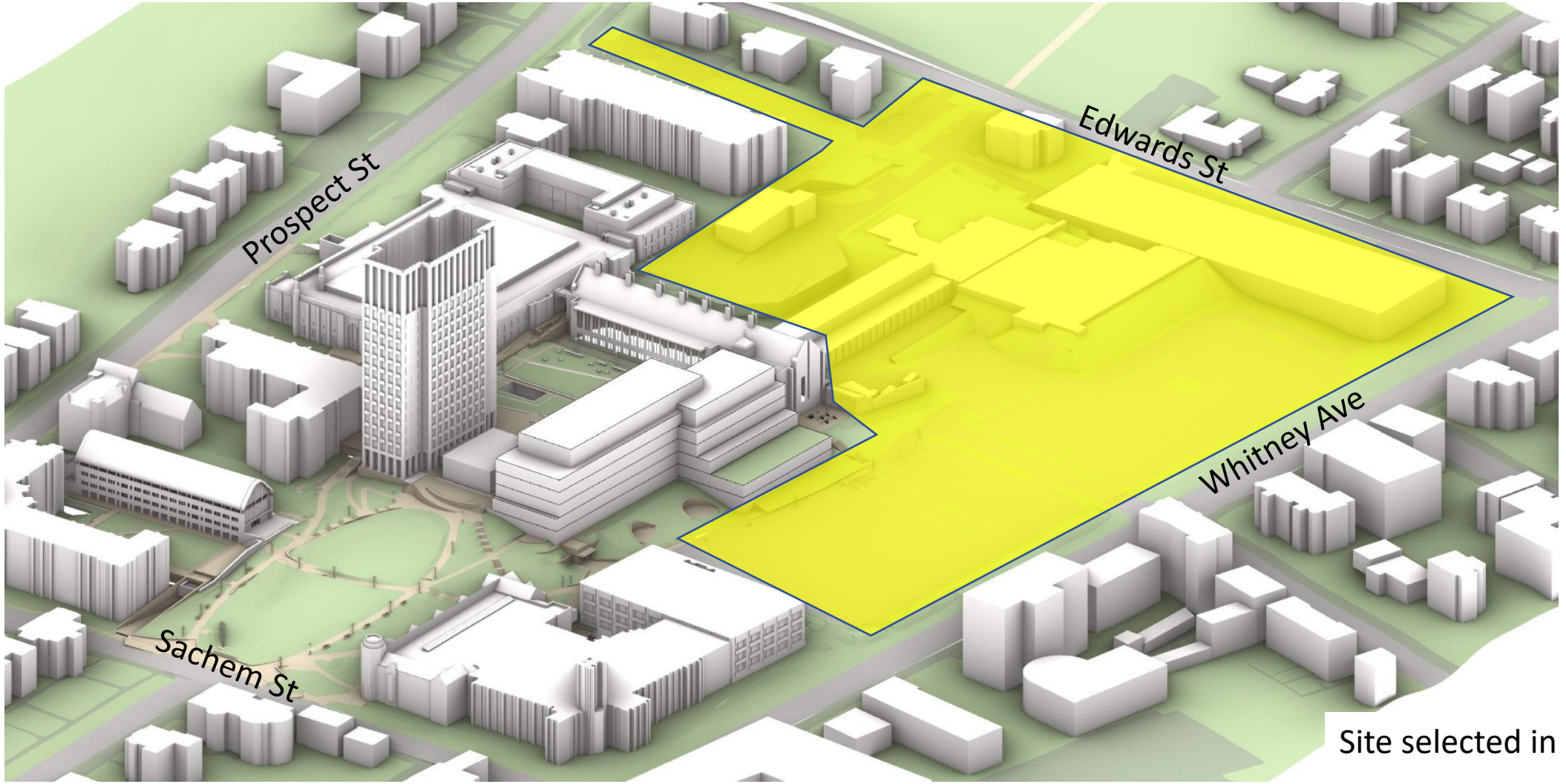
2020-2021
Initial Work:
- PSEB Working Group
- Instrumentation Initiative Task Force

2021-2022

Faculty Advisory Committees Formed
- Phase 1 – AIDC
- Phase 1 – Addition to Wright Lab (Physics)
- Phase 2 – Cores
- Phase 2 – PSEB

December 12, 2022
Town Hall

PSEB on Science Hill



Site selected in 2020

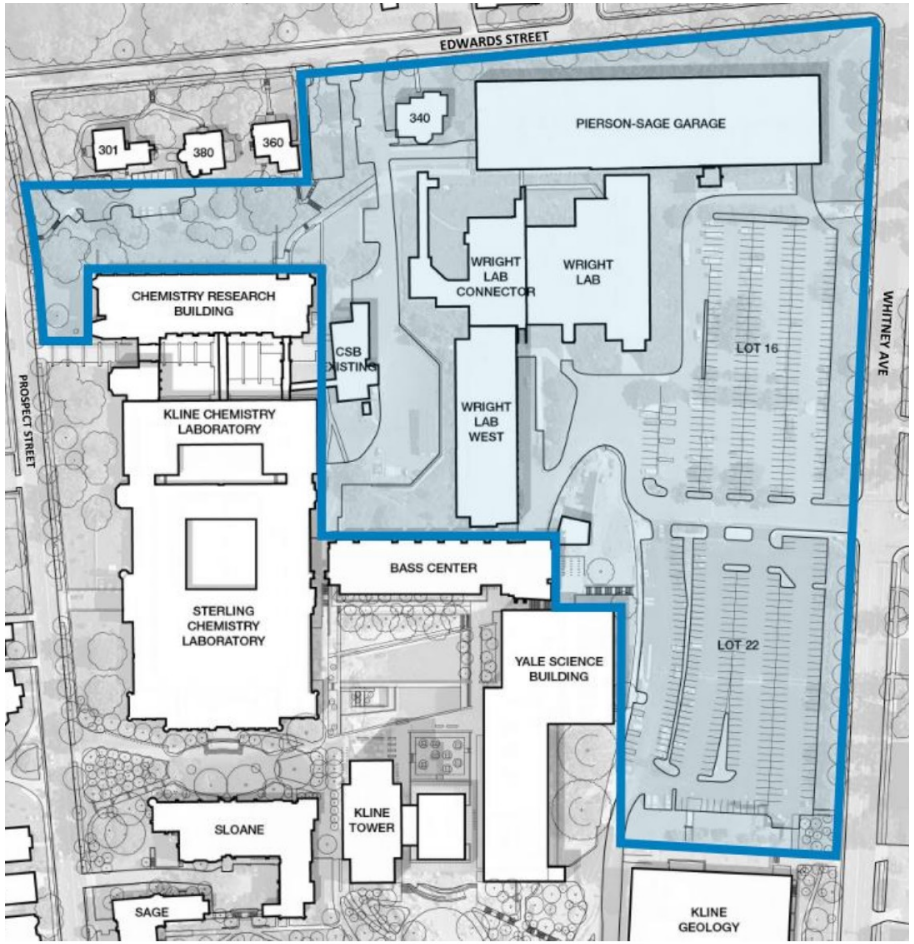
Project Goals and Vision

- A generational complex to support quantum research, and physical sciences and engineering
- Space to house ~40 faculty labs from the Departments of Physics and Applied Physics, and several other departments across FAS and SEAS
- Space for new and existing research institutes, centers, and programs. A hub, convening space, and destination for science and engineering at Yale
- A facility to support the design and development of custom instrumentation (AIDC)
- A larger and modern cleanroom
- Dedicated space for materials characterization including a new AC-TEM

A Generational Complex with Modular Structure

Performance	Technically outstanding, labs for scientists at absolute cutting edge; Flexibility for change, in anticipation of researchers that haven't yet been recruited to Yale Lead by example in supporting Yale's goals of zero operational emissions on campus by 2050
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 A clear new sign positioning Yale at the forefront of these fields Flexibility for the future
Opportunity	AIDC draws people from across university A community around cutting-edge instrumentation design and fabrication Completing Science Hill: the "right puzzle piece," while setting trajectory for future development

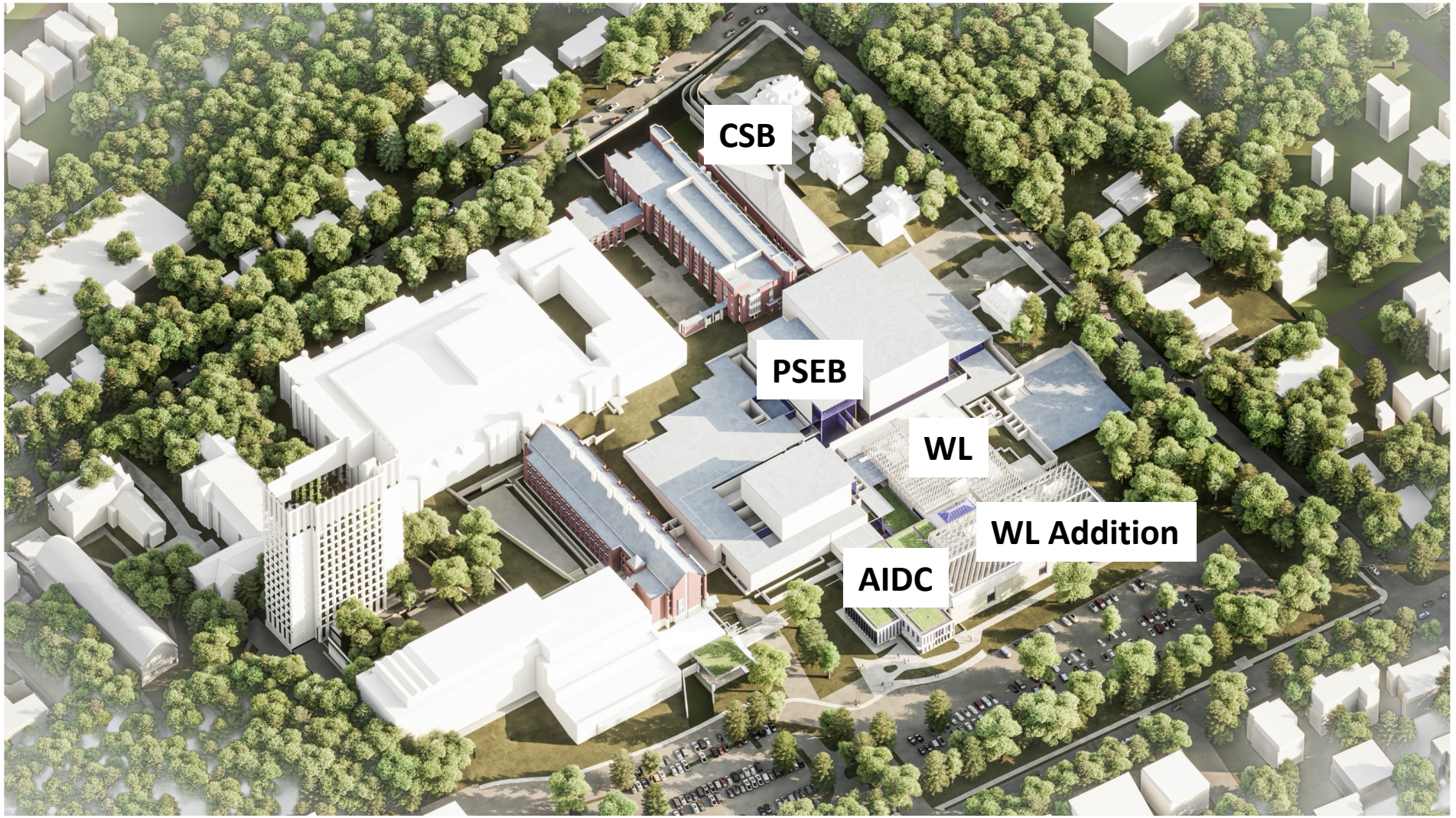
Site and Project Elements



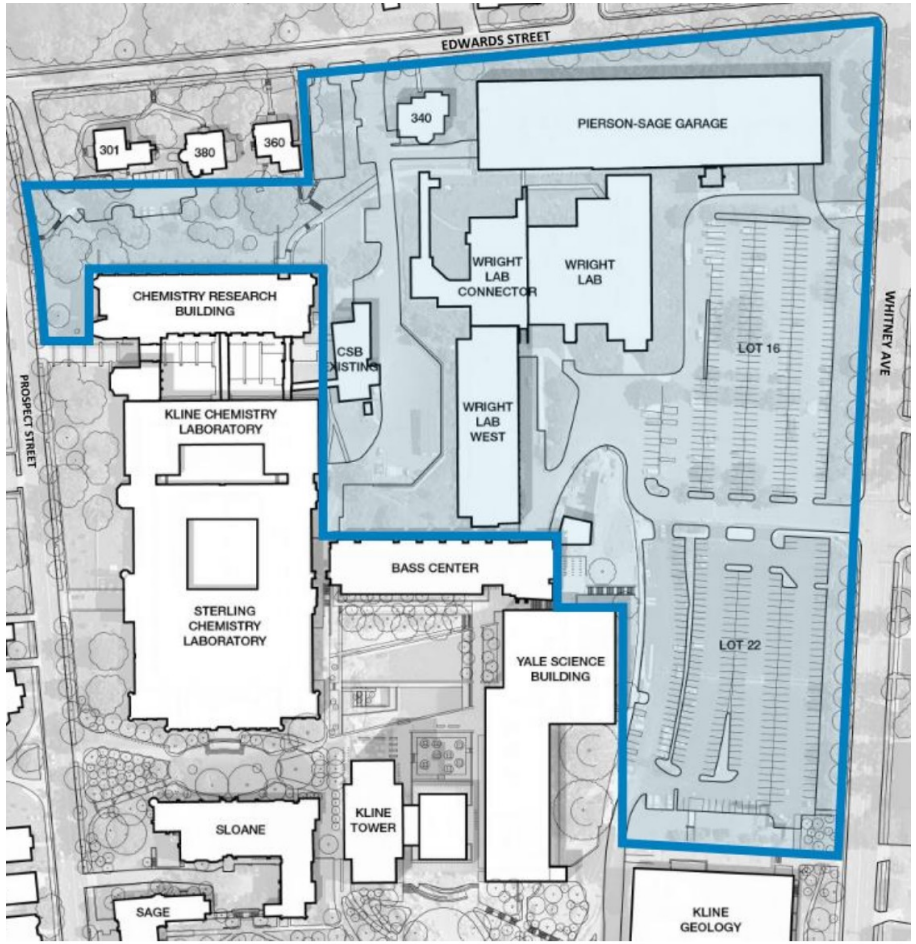
Existing Site Plan

Phase 1 (enabling)	Phase 2
New Buildings	
Advanced Instrumentation Development Center (AIDC)	Physical Sciences and Engineering Building
Addition to Wright Lab (WL-A)	
Chemical Safety Building (CSB)	
New Program	
Metrology	Cleanroom
Electronics Core	Materials Characterization Core
Expanded APC	Convening/Event Space
New Infrastructure	
Wright Lab Improvements	Service Node
Utilities and Thermal Plant	
Parking Improvements	

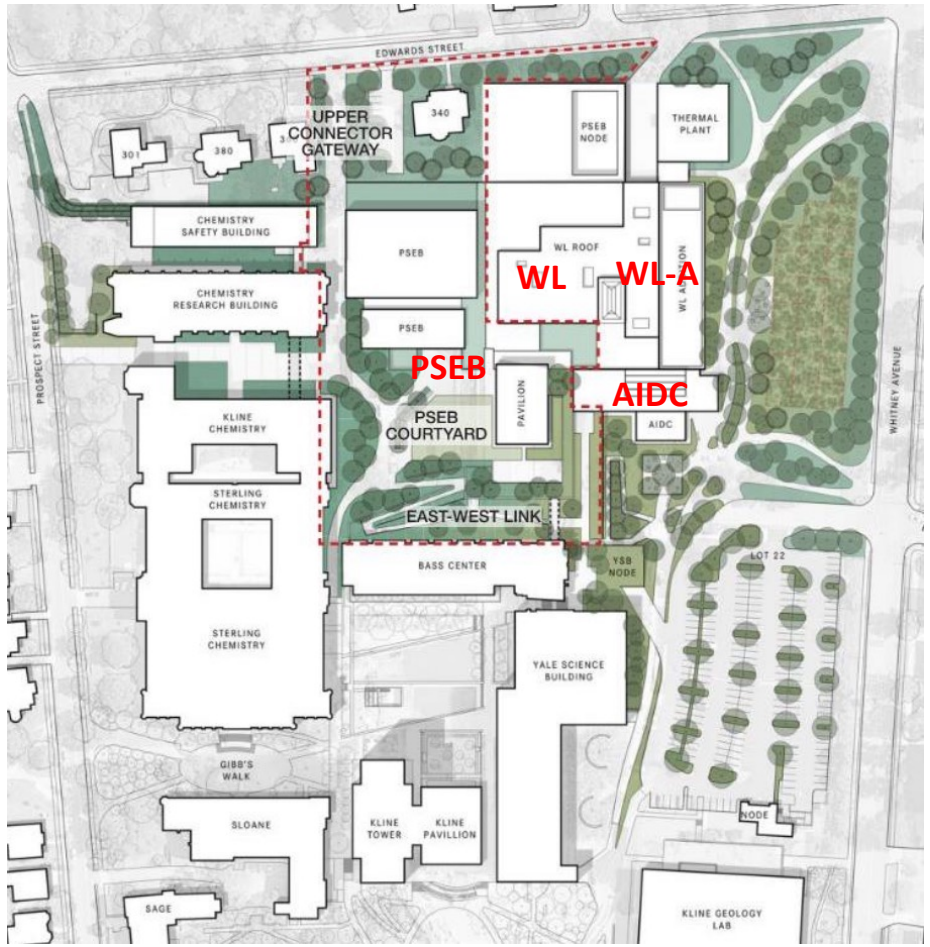
An Integrated Complex – Connecting Science Hill



Site Plan Bird's-Eye View

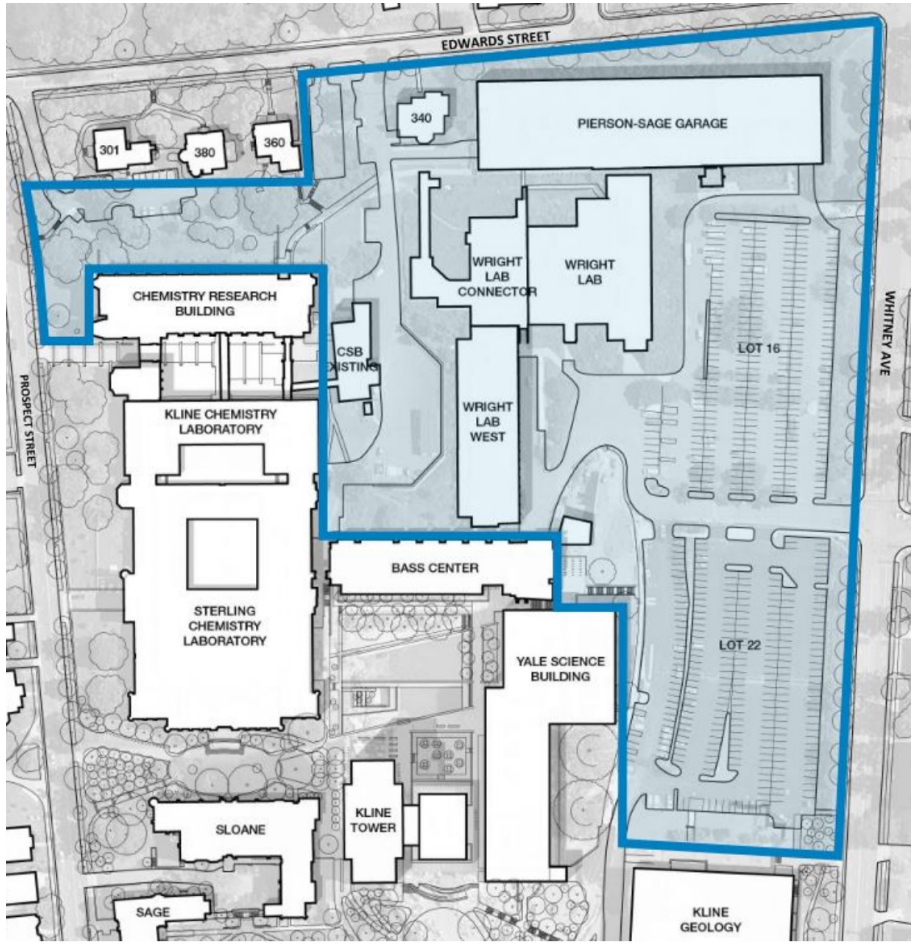


Existing Site Plan



Proposed Site Plan

Site Plan Bird's-Eye View



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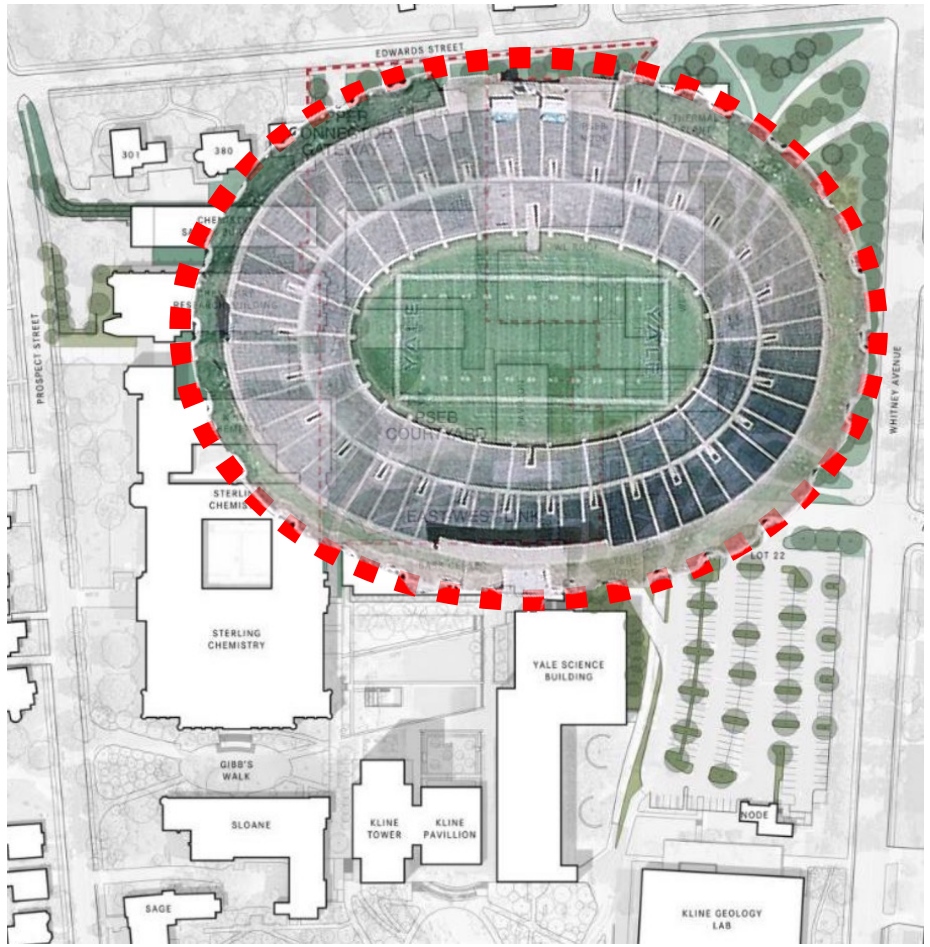
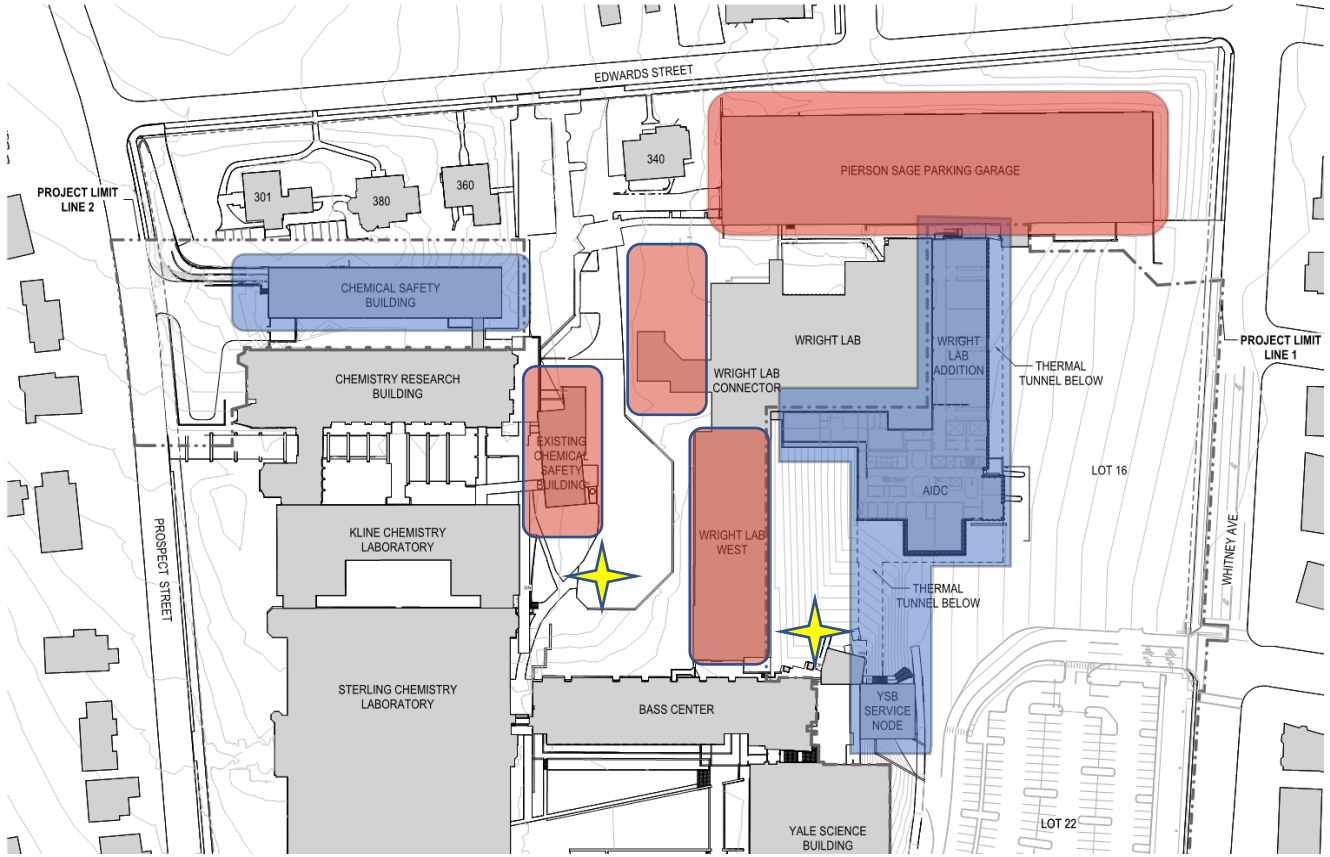


Proposed Site Plan

Phase 1 - Enabling



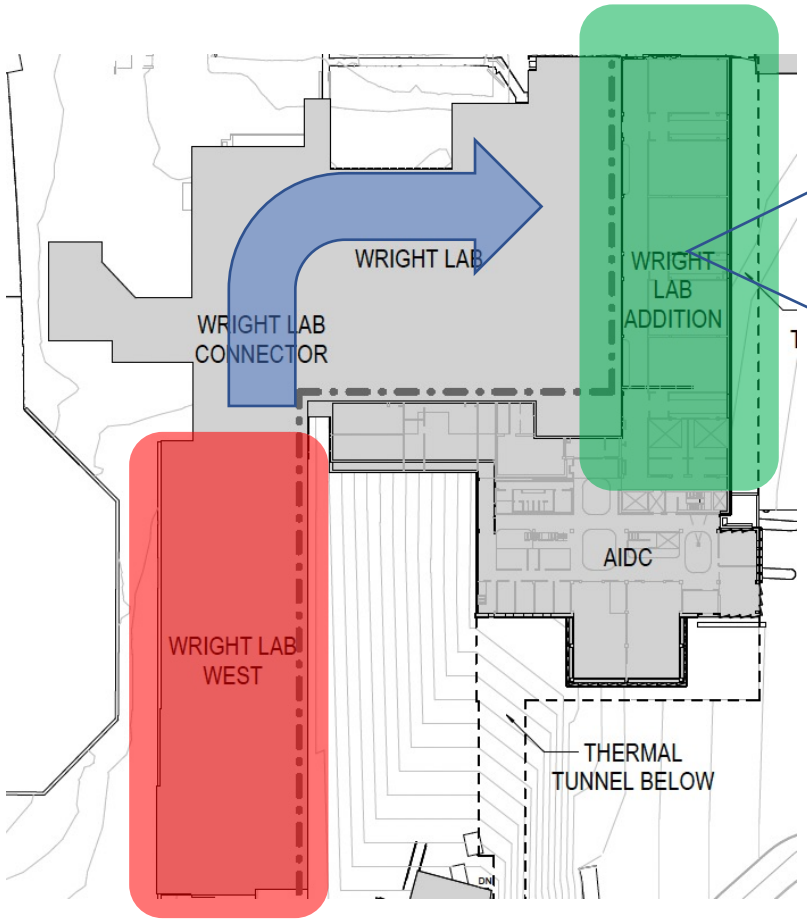
Enabling Infrastructure

- New Chemical Safety Building
- New Thermal Plant
- Geothermal Field
- Major utility infrastructure
- Relocate EHS operations
- Service Node (Phase 1 start)
- Demolish old CSB, Wright Lab West, and PSG

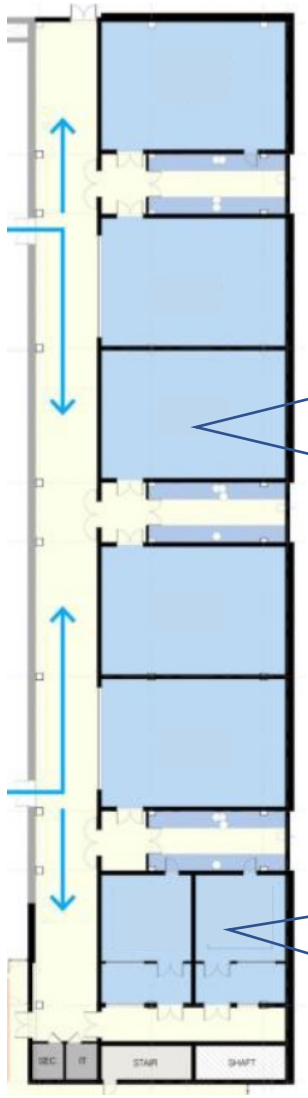
Enabling Lab Spaces

- Addition to Wright Lab
- Move Wright Lab high bay access to the north

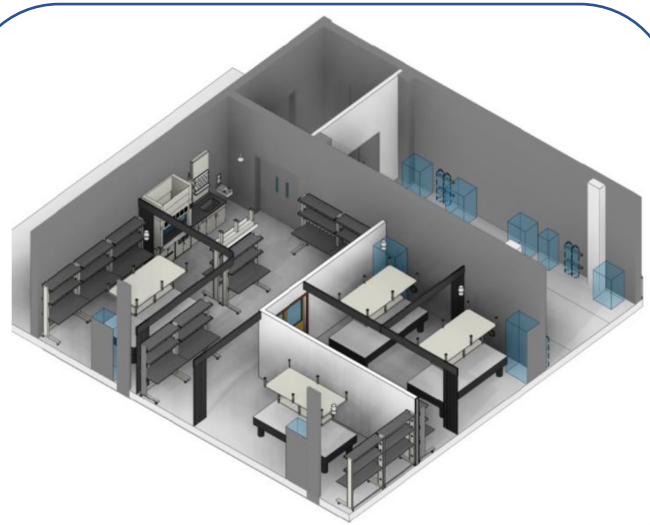
Phase 1 – Moving Wright Lab West into Wright Lab

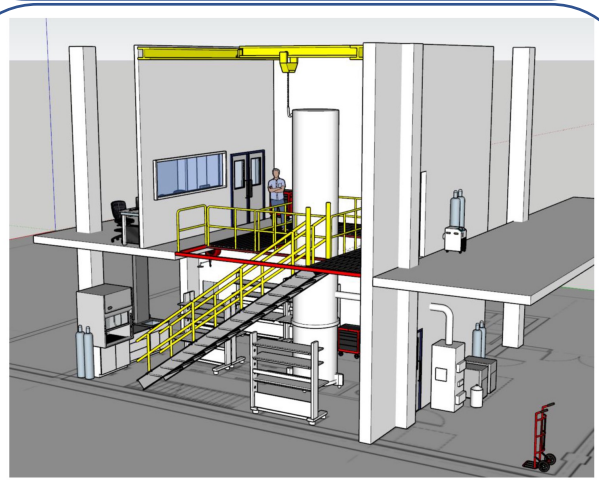


*Enables Phase 2



Modular lab design





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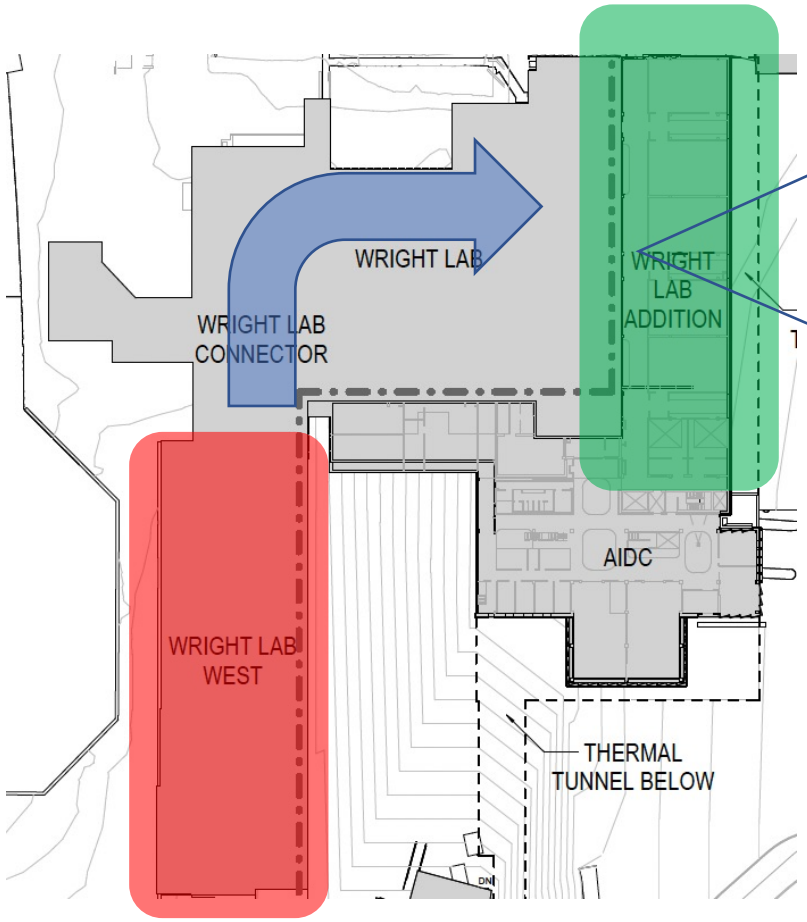
Phase 1 – Moving Wright Lab West into Wright Lab



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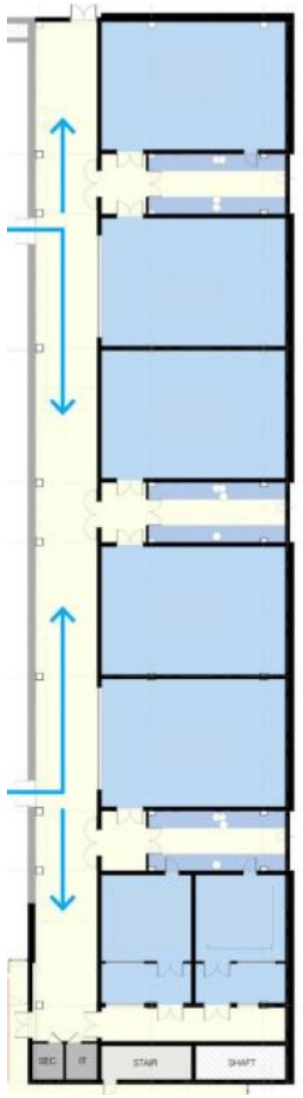

Modular lab design

Enabling project for demolition of WL West, relocates several PI labs

Opportunity to better integrate WL research with PSEB program

Co-location and synergies with AIDC

Haystac:
quantum-enabled dark matter experiment

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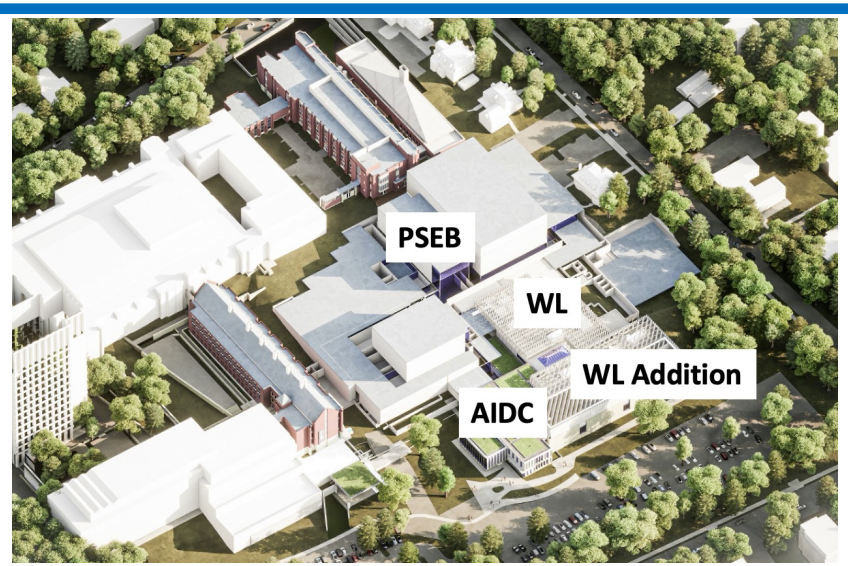
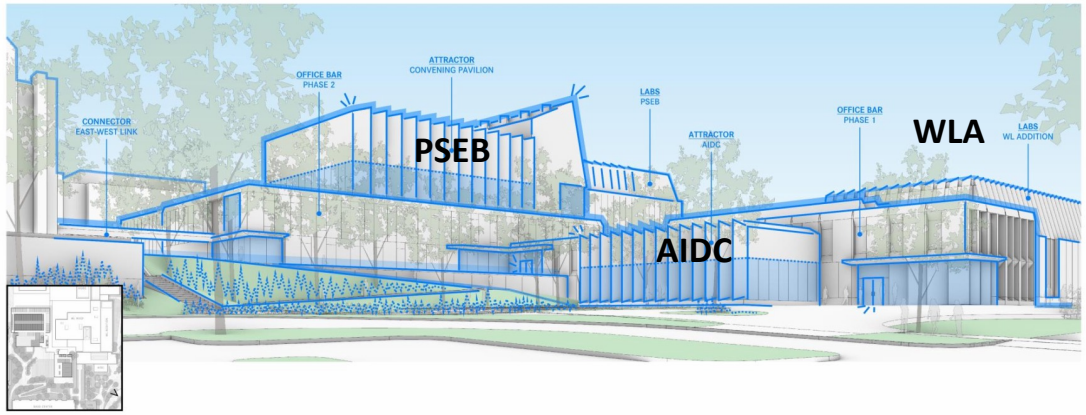
Phase 1 - Advanced Instrumentation Development Center



USSC Report

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



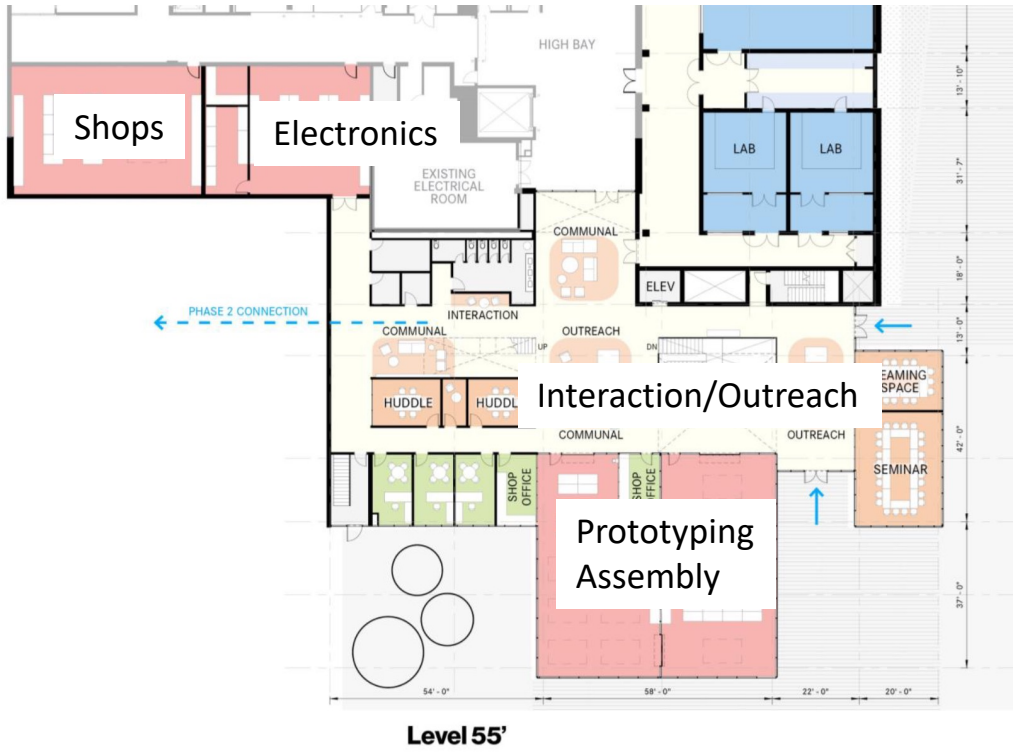
Arrival from Whitney

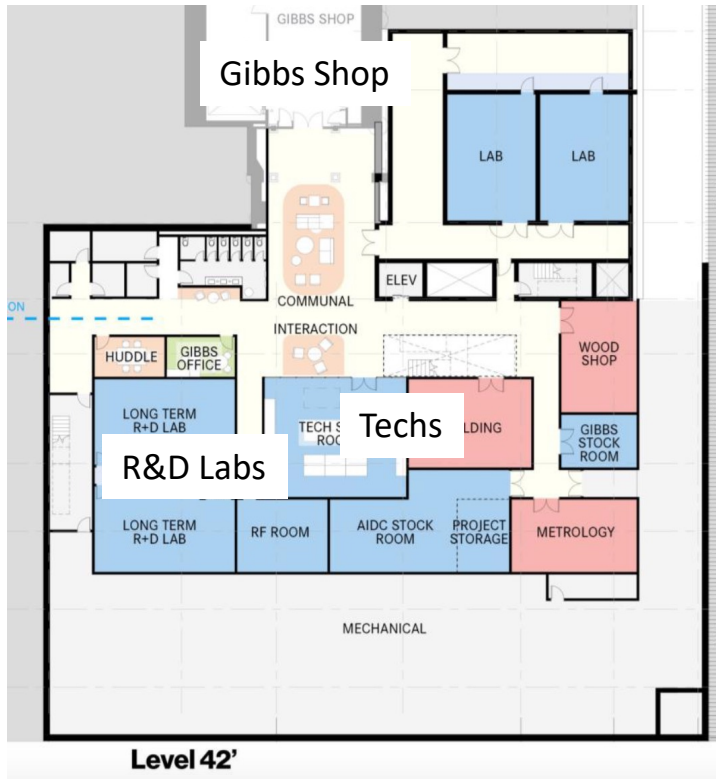
Establishes instrumentation development hub
New entrance to Science Hill

AIDC realizes cross-cutting priority by 2026

Instrumentation Development – Planned Layout

Developed Conceptual Layout





Program developed over 3 years with community engagement:

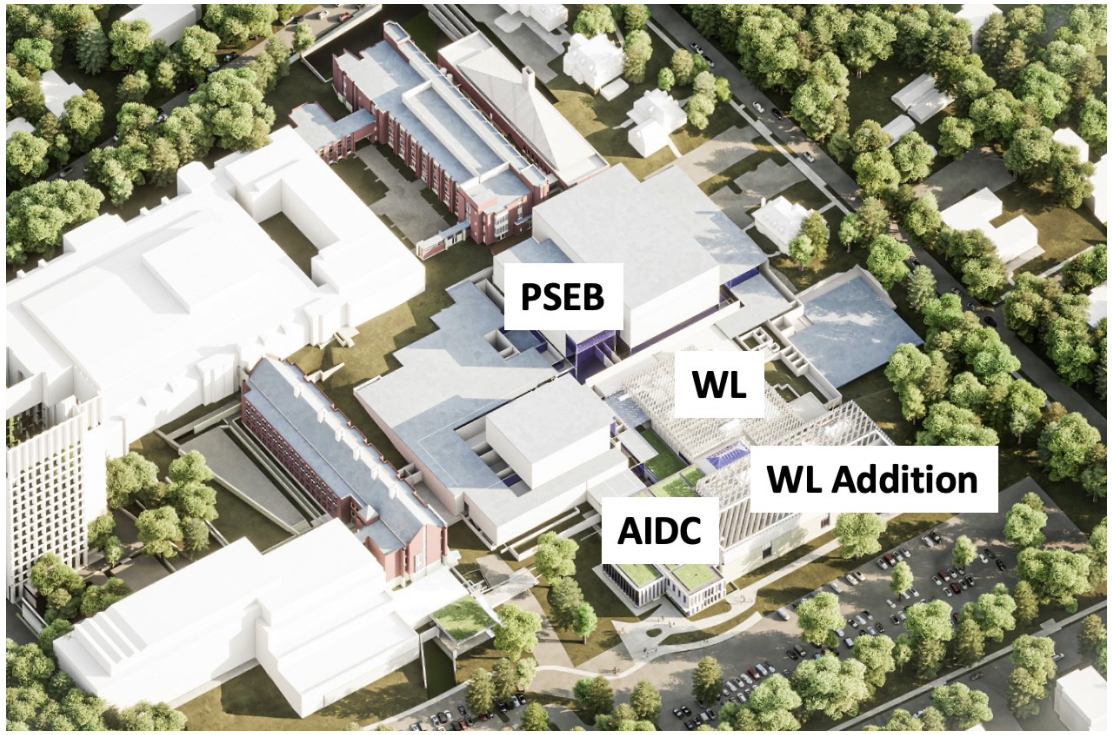
Days of Instrumentation, workshops, committees

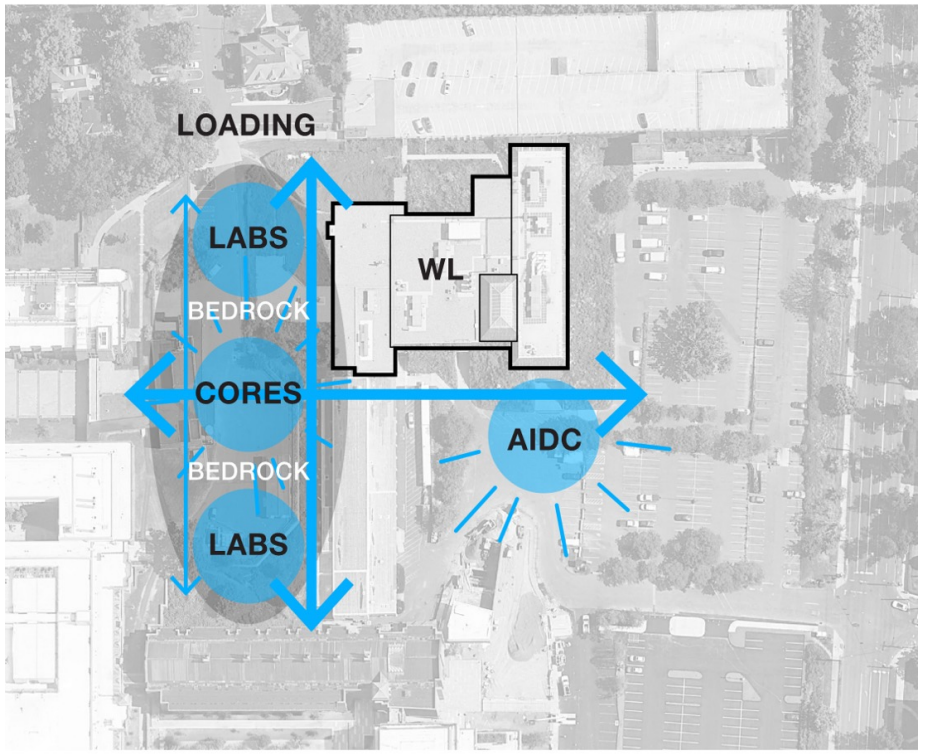
AIDC Elements

- Expanded Advanced Prototyping
- Electronics
- Instrumentation assembly
- R&D labs
- Better integration of shops
- Interaction and training spaces
- Outreach

working on detailed requirements

Phase 2 - PSEB Connectivity





Excellent connectivity throughout building, co-location and synergies with AIDC

Opportunity to better integrate AIDC and WL research with PSEB program

Phase 2 – Faculty Advisors and Process

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

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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

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Met ~15 times in past year with the design team in a collaborative and iterative process with the following goals:

1. Establish a basis of design for laboratory, common, and office spaces
2. Develop laboratory typologies with specific performance criteria to be used to plan the building
3. Determine the mix of typologies to be used to plan the building
4. Consider and refine the appropriate balance of PI research space versus core/shared laboratory space in the building

Phase 2 - Cores

<u>Significant space (targeting 20,000+ sf) for expansion of Core resources</u>

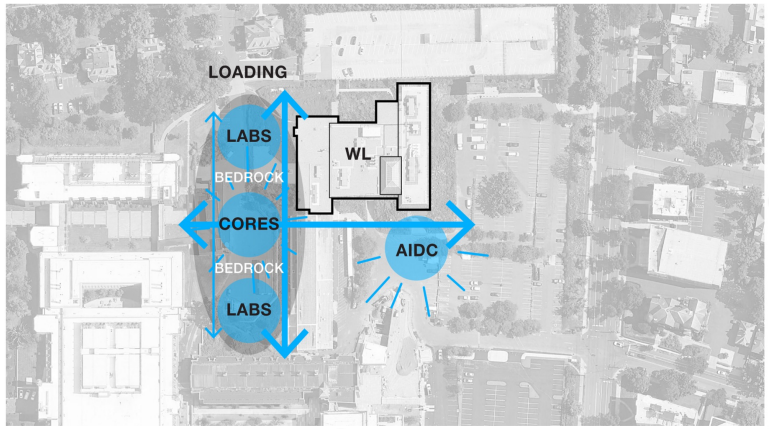
- Cleanroom
- Materials Characterization
- AC-Transmission Electron Microscopy

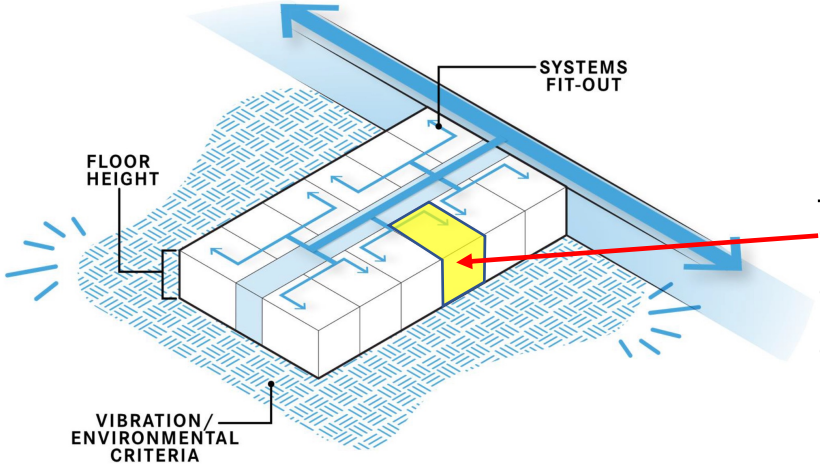
- Space for opportunity and growth
- As yet unknown instrumentation

"State-of-the-art core facilities are crucial for innovation across the University. Research in every laboratory is dependent upon these services. We recommend making strategic investments to better organize, coordinate and support the University cores."

- University Science Strategy Committee report

Phase 2 – Lab Typology and Mix





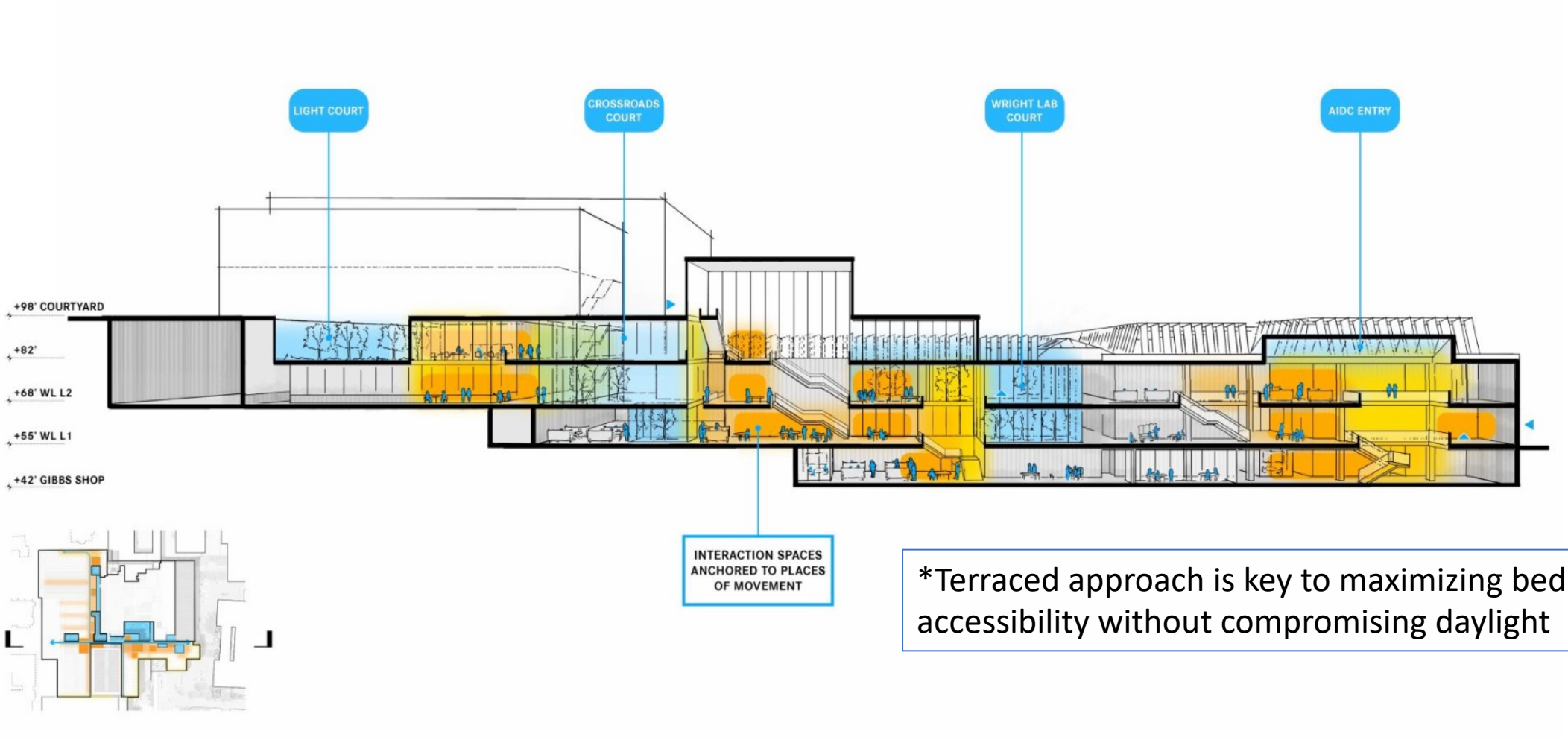
Adaptable labs depend on a few key attributes.

Modular Design

- Repeating units of 330 ft^2
- Typical faculty lab consisting of 3-6 units
- Service/utility chases to support labs

Typology	Vibration Criteria	Height (ft)	Lab Module (ft)	Anticipated Use	Approximate distribution
A	VC-E	24	~11 x 30	Specialized high bay	5%
A+B	VC-E	20		Quantum, CM, AMO	5%
B	VC-E	14		Quantum, CM, AMO	40%
C	VC-B	14		Engineering and fabrication	30%
D	-	9	-	Theory	20%

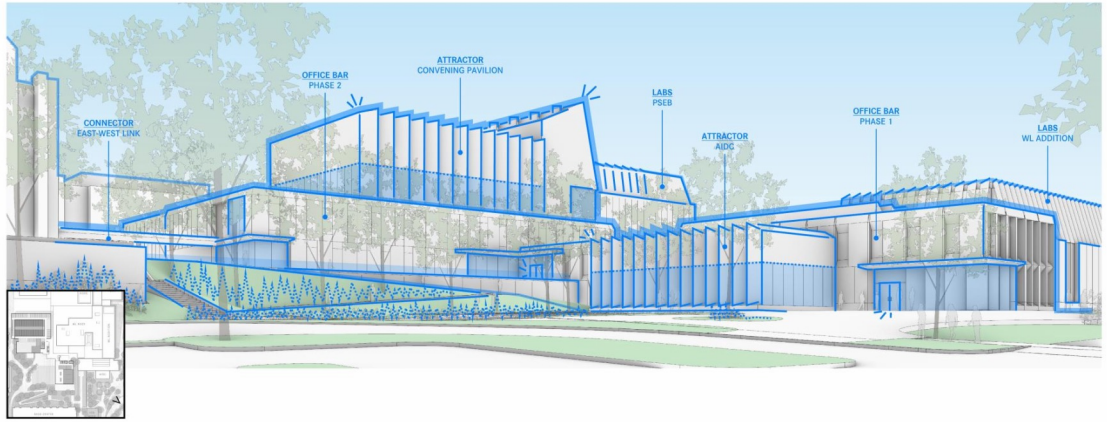
Phase 2 – Cross Section (East/West)



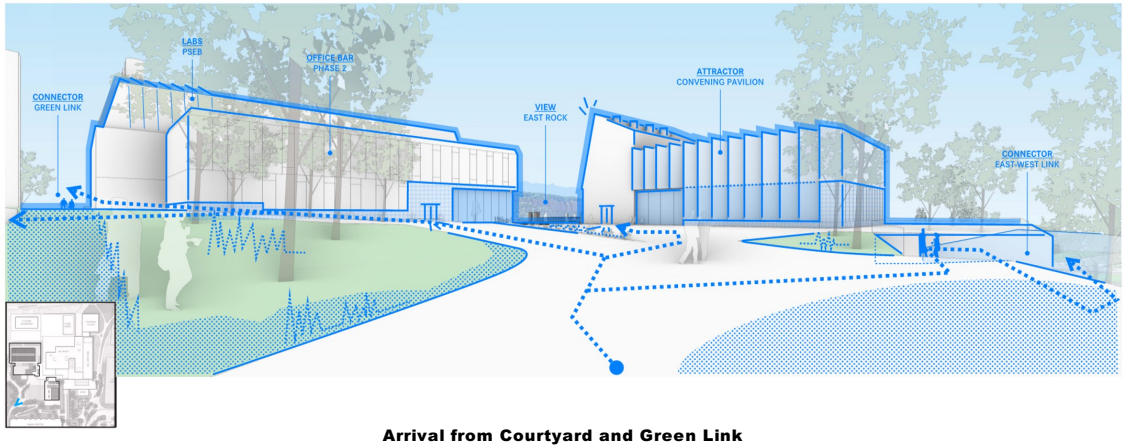
*Terraced approach is key to maximizing bedrock accessibility without compromising daylight

Terraced Streets: Section through primary circulation

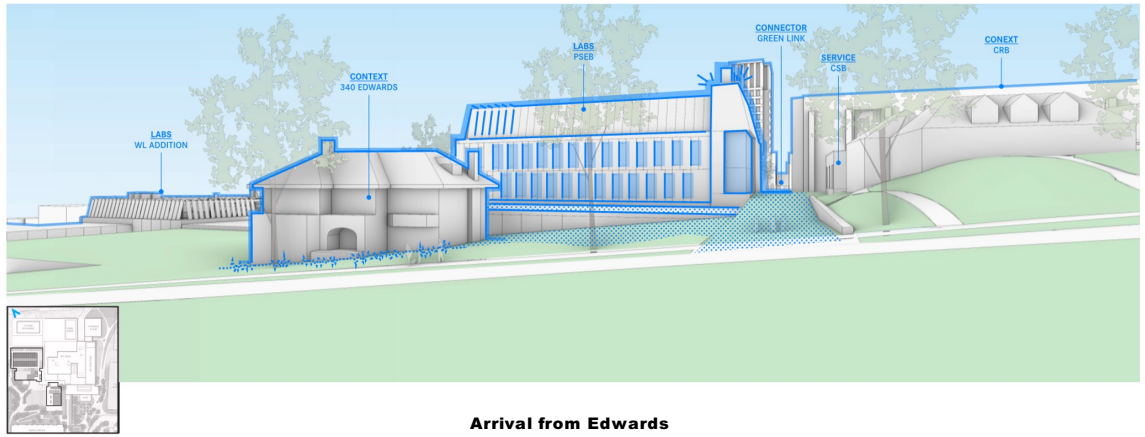
Phase 2 – Exterior (proposed)



Arrival from Whitney



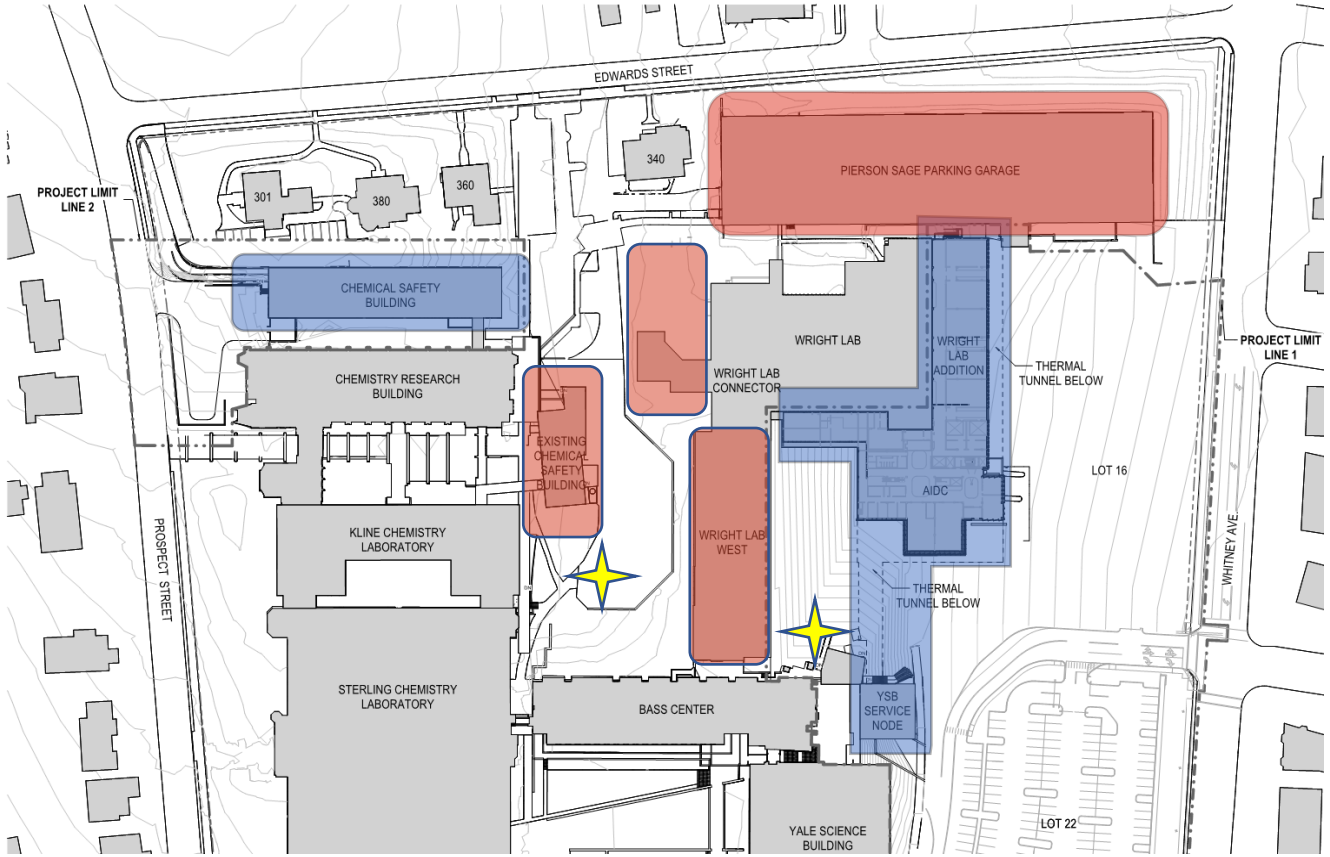
Arrival from Courtyard and Green Link



Arrival from Edwards

- **Convening Space** for seminars, workshops, meetings, events
- Capacity for ~200 plus pre-event space
- Destination for daily interactions
- Highly visible and accessible to Science Hill

Phase 2 - Schedule Drivers



Enabling Infrastructure

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Enabling Lab Spaces

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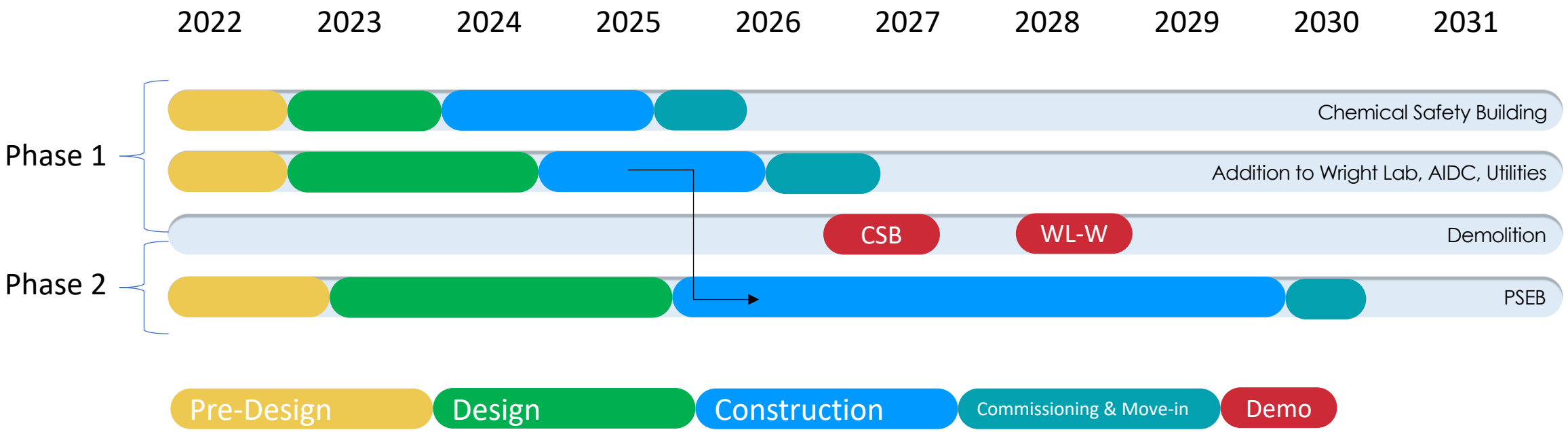
Anticipated Schedule – All Phases



Concurrent Planning Exercises

- Benchmarked design and program elements from physical sciences buildings at other institutions
- Visited several peer institutions
- Feedback from Town Hall
- Assembling/hosting a group of research leaders from peer institutions with recent new building experience

A generational complex to support quantum research, and physical sciences and engineering

- 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
- We continue to invest heavily in physical sciences core labs

Acknowledgements

Faculty and Staff Advisors

Yale Facilities

Ballinger – *architect and engineer of record*

Deborah Berke Partners – *design architect*

Turner Construction – *construction manager*

sciencehillprojects.yale.edu

vpr@yale.edu