



SUBJECT	Seismic Resilience Plan Update
SUBMITTED TO	Property Committee
MEETING DATE	September 20, 2022
SESSION CLASSIFICATION	Recommended session criteria from Board Meetings Policy: OPEN
REQUEST	For information only - No action requested
LEAD EXECUTIVE	John Metras, Interim Vice-President Operations
SUPPORTED BY	Andrew Parr, Associate Vice-President Student Housing and Community Services Bhushan Gopaluni, Vice-Provost and Associate Vice-President Faculty Planning <i>pro tem</i> Rae Ann Aldridge, Executive Director, Safety & Risk Services Jennifer Sanguinetti, Managing Director, Infrastructure Development

PRIOR SUBMISSIONS

The subject matter of this submission was most recently considered on [February 12, 2019](#) (OPEN SESSION). Regular updates are also provided in bi-annual Capital Projects Updates to the Property Committee.

The following Executive Summary provides a status update from the date of the most recent submission.

EXECUTIVE SUMMARY

UBC places the life safety of students, faculty and staff as its highest priority, and reducing or mitigating the risk of injury or death as a result of a seismic event is critical. UBC's seismic resilience planning on the Vancouver campus continues to evolve through a collaborative, iterative process. There has been significant progress on the majority of the key actions noted in the 2019 Seismic Resilience Plan Report to the Board of Governors, aimed to improve UBC's seismic resiliency within its logistical and financial constraints across the short, medium and long-term planning horizons. Infrastructure Development provides summary updates regarding UBC's ongoing seismic resilience planning and implementation work in the bi-annual Capital Projects Update reports. This report is intended to give a more detailed update on ongoing efforts to improve campus life safety.

Buildings

Real Estate Framework, Resilience Roadmap and REDi for UBC Guidelines

Current Building Codes require that new buildings achieve a specified level of performance in a seismic event. UBC's building-related resilience planning aims to go a step further to ensure that there are new and existing buildings intact following a seismic event so that UBC can quickly and effectively recover and resume operations. UBC's consultant, ARUP, has been working with UBC to create a draft Real Estate Framework and Resilience Roadmap to guide decision making on resilience and mitigation strategies for new construction and existing buildings (the latter may include replacement or retrofit). The overarching life safety goal for this work is prevention of fatalities in future earthquakes, and the document aims to outline tolerable risk targets and specify building performance objectives for new construction and renewals. This work has led to a revised definition of the life safety risk tiers as follows:

- Previous definition: Collapse probability of a *building* in a 975- year earthquake, which accounts for:
 - building performance at one level of earthquake intensity

- Updated definition: Annual fatality risk of an *individual* within a building, which accounts for:
 - Building performance at multiple levels of earthquake intensity
 - Collapse extent of the building
 - Fatality potential based on building material and height
 - Exposure duration of individual within each type of occupancy

Buildings that are safety risk Tier IV and V according to the updated definition require more immediate planning for mitigation than those in Tiers I, II and III.

As a guide to resilience planning, the document proposes three operational categories for buildings – critical, important, and normal – with associated performance and timeline targets to maintain critical functions and to recover important functions. The principles laid out in the Framework and Roadmap documents have guided the development of Resilience-based Design Guidelines (i.e. REDi for UBC) for new construction and renewal of existing buildings. These more practical implementation Guidelines are intended to specify:

- Design and planning criteria to achieve resilience objectives;
- Criteria for detailed structural modeling;
- Criteria for risk analysis; and
- Quality assurance and peer review.

The development of the Seismic Real Estate Framework and REDi for UBC Guidelines is an iterative process, and will remain in draft form as the guidelines are tested against new construction and renewal pilot projects. Pilot projects include those outlined below.

- The MacLeod Renew project was used to pilot several enhanced resilience measures. The project was structurally designed to achieve Immediate Reoccupancy¹ and lessons learned have formed the basis of the draft Guidelines for building renewals. The team also worked to develop enhanced non-structural resilience measures, however these could not be refined in time to be incorporated into the project. Securing of all non-structural elements (e.g. piping, lights, ceiling) is in accordance with the Building Code so these are not expected to fall in a seismic event, but they may require some repair.
- Renewal of the Jack Bell Building for the School of Social Work will pilot and further inform the draft structural and non-structural design guidelines.
- UBC's new buildings will be designed to a much higher level of performance than the existing buildings, simply by virtue of meeting current Codes. Enhanced measures are intended to make buildings with critical and important functions more resilient so that they can be returned to use more quickly after a seismic event. New building projects currently in design or construction with set budgets are too far advanced to pilot enhanced measures; UBC will identify a next project early in the planning stage to pilot new construction resilience measures.

Advanced 3D Modeling and Non-Detailed Analysis of Additional Buildings

As reported in 2019, detailed modeling and analysis by ARUP of recommended buildings provides UBC with a more accurate and confident understanding of building vulnerabilities and the potential seismic impact on the UBC campus. This modeling:

¹ Definition: Structurally designed to be occupied immediately after a 1-in-475 yr earthquake, and collapse prevention during a 1-in-2,475 yr earthquake.

- Evaluates the vulnerability of buildings at different levels of earthquakes and for different ground motions;
- Provides information that help UBC to evaluate which buildings are good candidates for retrofit; and
- Provides detailed insight into specific areas of weakness at different levels of earthquakes, which is critical to developing targeted upgrade plans.

To inform the updated safety risk tier definition, ARUP re-modelled the original list of 18 priority buildings using two levels of intensity. The tier rankings of several of the previously modelled buildings were subsequently adjusted to account for multiple levels of earthquake intensity, fatality potential, and building importance. This work led to identification of 9 additional buildings for detailed 3D modeling and analysis. Local structural consultants have completed structural analysis using more conventional structural modelling techniques on 26 additional buildings where building record information was incomplete or lacking. *Refer to Appendix 1: Tier V and IV Critical and Important buildings rankings based on updated safety risk tier definition.*

Academic Buildings Seismic Implementation Plan / Project progress

The Advanced 3D Modeling and Non-Detailed building analyses help inform the major and routine capital planning prioritization process for academic buildings, in conjunction with the University's strategic goals and logistical and financial capacity. UBC has made considerable progress in mitigating academic buildings that are seismically vulnerable, but identification of funding remains a concern. The Ministry of Advanced Education and Skills Training (AEST) provides annual Routine Capital funding for mitigation of deferred maintenance (75%/25% AEST/UBC) in core academic buildings and has agreed that some of this funding may be directed towards existing building seismic upgrades. For various reasons, however, the number of candidate buildings is a small percentage of the total number of vulnerable buildings, and the bulk of the Routine Capital funding is critical for mitigating deferred maintenance over UBCV's vast building portfolio. In other discussions to date, AEST has indicated that a specific seismic mitigation funding program, like that provide through the Ministry of Education for K-12 facilities, is not forthcoming. UBC will continue to develop creative capital planning scenarios for upgrade and replacement of vulnerable buildings that do not rely on a single source of funding.

The following summary of planning and progress for the Tier IV and V Important and Critical academic buildings is also illustrated *Appendix 2: Academic Buildings Seismic Implementation Plan Progress and Appendix 3: Academic Buildings Detailed Seismic Implementation Plan Progress.*

Capital planning for seismic mitigation of academic buildings - funding approved:

- Buildings appropriate for upgrade/renewal to be funded through Routine Capital (assuming continued AEST funding support): Hebb and MacLeod Buildings complete; Museum of Anthropology Great Hall in progress; Jack Bell Building for the School of Social Work in design.
- Potential targeted upgrades to be funded through Routine Capital: Insertion of steel columns in the Douglas Kenny Building have improved the building's seismic performance, and further strengthening of concrete stair walls in the building is being modelled to determine whether this measure will significantly improve the building's performance. Over the next year, the team will be delving further into the completed Concept Retrofit Studies, and exploring whether this kind of disruptive work is possible and of value in other vulnerable buildings that are not yet part of a larger plan. ARUP is also preparing information to help UBCV evaluate potential projects on the basis of maximum life safety payback.
- Approved major capital projects – Gateway and Sauder - will replace three vulnerable buildings and a fourth vulnerable building was demolished to clear the School of Biomedical Engineering project site.

Capital planning for seismic mitigation of academic buildings - identification of approximately \$2,647 million funding required:

- Five-Year Capital Plan 2023-24 to 2027-28 (proposed): The high priority Chemistry Laboratory Complex involves replacement of at least three highly vulnerable buildings which house approximately 1,700 students, faculty, and staff at peak times and, in 2019, had over 4,900 enrolments for first year chemistry classes, alone. Identifying funding to undertake this project would have a significant impact on improving campus life safety and would be an enormous seismic mitigation win for UBC. The remaining Five-Year Plan projects would replace an additional seven vulnerable buildings. Approximate cost \$1,374 million.
- Other priority capital projects not proposed for the current Five-Year Plan would replace an additional four vulnerable buildings. Approximate cost \$336 million.
- Three vulnerable buildings have been vacated and will be demolished when funding is identified. Approximate cost \$12 million.
- The team is working on planning for the seven remaining vulnerable buildings. There may be opportunities for interim targeted upgrades to improve safety, however these buildings will ultimately require replacement. Approximate cost \$925 million.

Student Housing Seismic Implementation Plan / Project Progress

More detailed seismic modelling of student housing buildings led to higher rankings than previously identified for Walter Gage and Place Vanier buildings. Student Hospitality and Community Services (SHCS) is developing plans for renewal or replacement of these buildings. Planning for mitigation of student housing buildings is considered separately from planning for mitigation of academic buildings due to differences in funding streams, but it is critical to note that while this work is important in regards to life safety, the cost of this work will be significant. High level budgets are still in development, but if this cost is fully borne by SHCS the result will likely result in a slowing of growth in new student housing in the years to come.

At the time this report was written SHCS, in collaboration with Campus and Community Planning, Infrastructure Development and UBCPT, is developing a plan to demolish and replace most of the houses at Place Vanier in order to eliminate the seismic risk and add additional student beds to the area, up to double the current bed count of 1,464. This project would be completed in phases in the years ahead in order to mitigate short term loss of housing beds that could impact first year student access to housing. Informal discussions with the provincial government suggest that low-interest financing may be available for a phase 1 project. UBC will continue to explore this opportunity with the intent of initiating a UBC capital project approval process before the end of 2022. Current modelling suggests the seismic stability of Walter Gage Residence could be improved through retrofitting instead of being replaced.

The results of these explorations at both Place Vanier and Walter Gage Residence will inform emerging housing directions for Campus Vision 2050.

Utilities

UBC has made progress on all key action items identified in the 2019 report:

- **Relocation of UBC's Main Water Pump:** The ARUP study identified the existing Power House as extremely vulnerable, and placed a high priority on relocation of the University's water pumps to a more secure location. This work has been completed, and the new Pump House on University Boulevard was built to post-disaster standards. As part of the Sauder Power House Expansion project (currently in design), the Power House will be demolished, and the Power House Addition may be seismically upgraded and renewed for incorporation into the Sauder project or may be demolished.
- **Emergency Diesel Fuel:** Providing the physical and operational infrastructure for storing up to three days of diesel fuel for the campus utility systems was recommended, and Energy and Water Services has added a 100,000 litre tank adjacent to the Campus Energy Centre to supply diesel for heating purposes. Diesel is also required to refuel emergency standby generators that support critical research. Safety & Risk Services (SRS) has engaged with the VP Research Office to start a process of identifying and prioritizing critical research buildings. Total capacity requirements and a high-level distribution plan will be developed. A large decommissioned fuel storage tank is being stored at south campus pending funding for placement and supply.
- **Back-up Water Supply for Firefighting:** UBC met with Vancouver Fire and Rescue (VFRS) in June 2022 regarding a back-up water supply for firefighting. VFRS confirmed that the pool water stored in UBC's Aquatic Center is sufficient to meet fire suppression needs for the campus. VFRS further confirmed that it maintains equipment appropriate to pump water out from the aquatic center pools; this solution is contingent on an uncompromised hydrant system for distribution and the ability to move the pumped water from the Aquatic Center to UBC's fire hydrant system. VFRS and UBC continue to engage on the latter, including the possible sourcing or purchase of an addition 4km of hose reels to bridge this gap. A practical pumping test/exercise is tentatively scheduled for early fall 2022.
- **Emergency Potable Water Supply:** UBC continues to progress on identifying a strategy for sourcing and distributing emergency potable water on campus. A consultant has been retained to identify a viable potable (or potable with treatment) groundwater source, with sufficient quantities and access, to supply UBC population emergency projections for 3-4 days post-disaster at specific Mass Care locations. In July 2022, the consultant conducted a desk-top water supply assessment, confirming that UBC's Lower Aquifer is a viable emergency drinking water source for UBC's emergency population estimates post-disaster. Next immediate steps include securing funding to install 3 test wells at key locations tied to mass care sites to confirm demand estimates and potability.

Operations

- **Emergency Operations Center:** In January 2020, UBC Executive approved funding for inclusion of a dedicated Emergency Operations Centre (EOC) in the proposed TEF 4 building, which is slated to break ground in 2022. SRS is currently working on confirming TEF 4 major building infrastructure requirements to support the EOC, including potable water storage, sanitary storage, and back-up generator power. In addition, SRS has reviewed and renewed the space agreement for the current Orchard Commons EOC location.

- **Business Continuity Planning:** SRS has developed a framework for business continuity planning and business impact analysis for academic continuity, and is working with UBCIT for validation. Eighteen continuity plans, for units delivering critical services, have been completed to date, as well as a draft template and draft guidebook which includes the guidelines for protection of building contents completed previously. SRS is currently working with UBCIT and the Office of Enterprise Risk and Assurance for a pilot in June of this year. A full roll-out is expected to start in Fall 2022. Term funding has been identified for a staff position to facilitate this work, which ties into UBCIT's refresh of High Availability and Disaster Recovery Planning.
- **Institutional Emergency Plans Update:** SRS' annual refresh of the Crisis Management Plan and Emergency Response Plan is near completion. Plans for additional specific scenarios, to be housed in associated Annexes, are being developed and considered for finalization and publishing.
- **Non-Structural Hazard Assessment:** A building non-structural hazard assessment checklist has been created, and SRS is working with Joint Occupational Health and Safety Committees to determine the feasibility and appropriateness of undertaking inspections as part of their roles and responsibilities.

APPENDICES

1. Tier V and IV Critical and Important buildings rankings based on updated safety risk tier definition
2. Academic Building Portfolio Seismic Implementation Plan Progress
3. Academic Building Portfolio Detailed Seismic Implementation Plan Progress

PRESENTATIONS

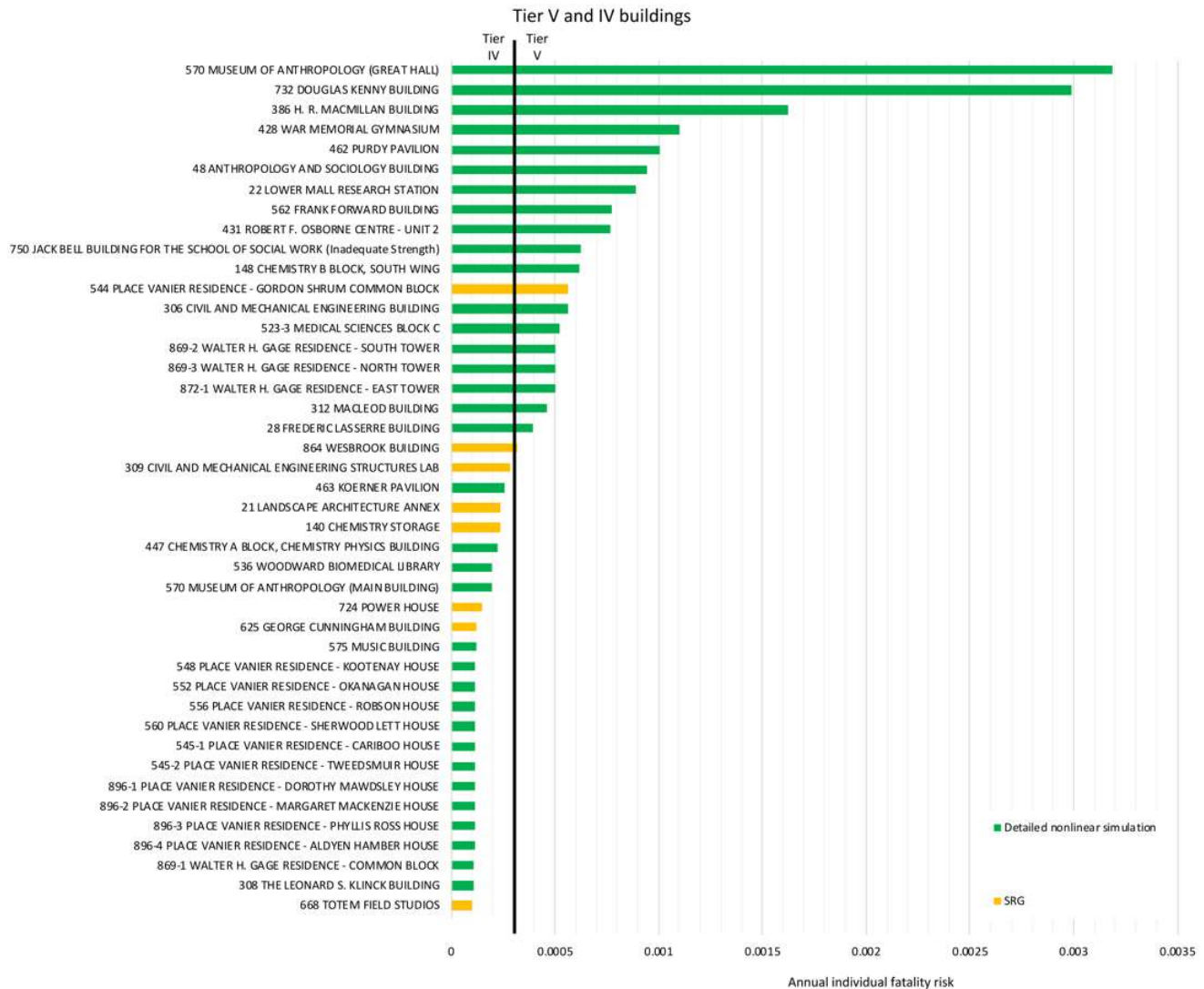
1. Seismic Resilience Plan Update

SUPPLEMENTAL MATERIALS (optional reading for Governors)

1. Campus Map – Retrofitted and Tier IV, V Buildings

Appendix 1 – Tier V and IV Critical and Important buildings rankings based on updated safety risk tier definition

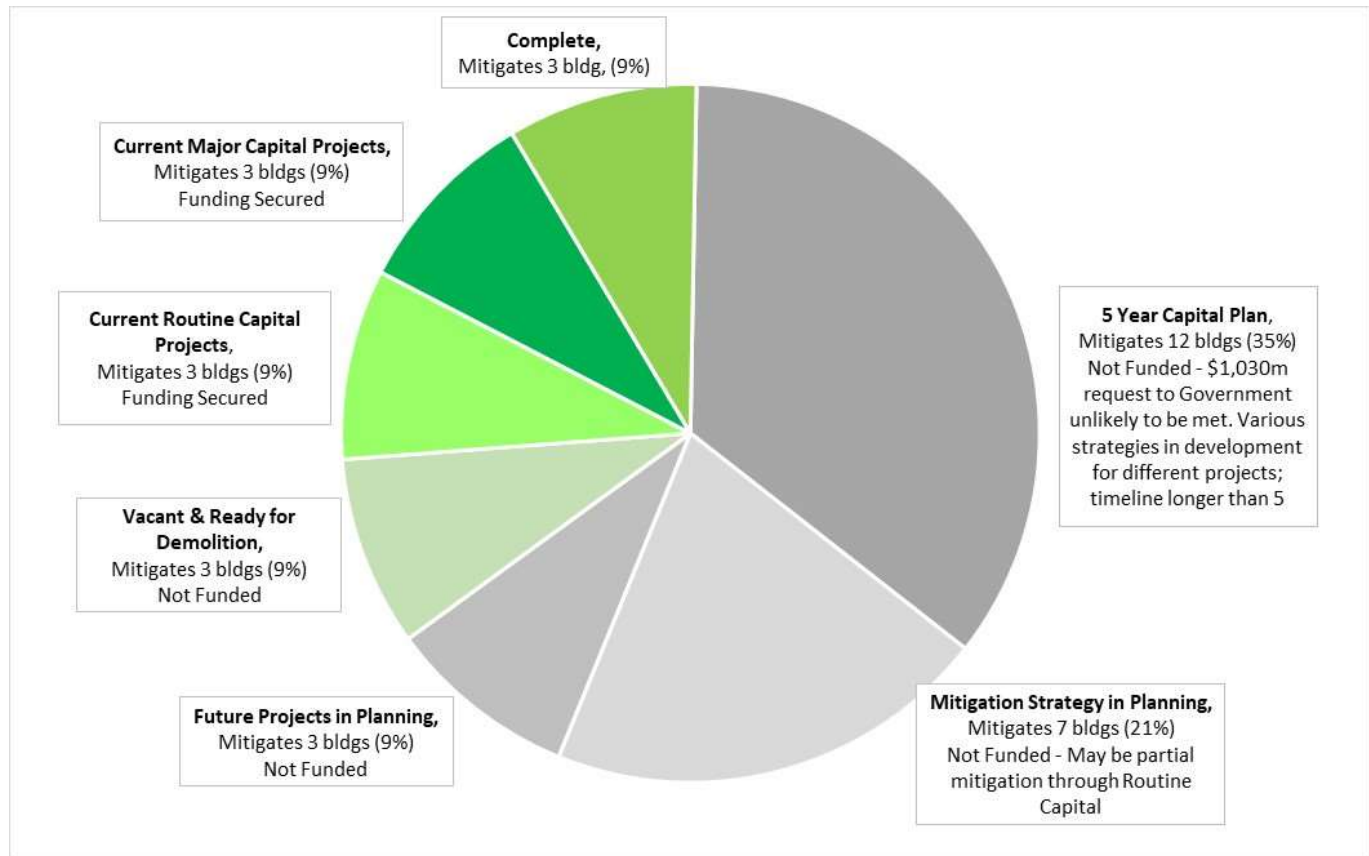
Updated definition: annual fatality risk of an individual within the building.



Notes:

1. This table has not been updated to reflect recent targeted upgrades at Douglas Kenny building and renewal of the MacLeod Building.
2. "SRG" refers to buildings assessed using the "Seismic Retrofit Guidelines", a simplified screening tool developed by the Engineers & Geoscientists of British Columbia that was adopted by the Province of British Columbia to rapidly assist with the implementation of a seismic upgrade to BC schools. Place Vanier Commons Block will undergo further detailed modeling to inform mitigation planning.
3. Purdy Pavilion and Koerner Pavilion are part of the UBC Hospital. UBC owns the buildings but they are leased to Vancouver Coastal Health (VCH), who are responsible for all aspects of their operations, maintenance and capital renewal.

Appendix 2 – Academic Building Portfolio Seismic Implementation Plan Progress



Note: This chart does not include 28 retrofit / seismic upgrade projects completed prior to 2019, including 13 buildings renovated under UBC Renew Phases 1 and 2.

Appendix 3 – Academic Building Portfolio Detailed Seismic Implementation Plan Progress



Note: All buildings noted are Tier IV or V except Chemistry C, Geography, and Osborne 1 which are Tier III buildings

Seismic Resilience Plan Update

September 20, 2022

Jennifer Sanguinetti

Managing Director, Infrastructure Development



Introduction and summary



Since 2016, have been working to improve seismic resilience of Vancouver campus:

- With a view to life safety and re-occupancy
- Within financial & logistical constraints
- Looking holistically – all buildings plus utilities, emergency preparedness, continuity

Additional details - Progress



Continued working on priorities outlined before:

- Draft Real Estate Framework & Resilience Roadmap complete; REDi UBC (design guidelines) in draft & piloting on MacLeod
- Advanced 3D Modeling progressing
- Walter Gage & Place Vanier – new results

Additional details – Operational Categories



Critical

Supports functions that must be continued without disruption

- Emergency operations centers
- Hospitals
- Post-disaster shelters
- Fire and police stations
- Research facilities that support hospitals or “perishable” research (i.e., critical research labs)

Important

Supports functions that would be difficult to accommodate elsewhere

- Teaching facilities with large classrooms (150 seats or more) or highly-specialized teaching labs
- Research facilities with highly specialized labs that cannot be accommodated elsewhere
- Student housing
- Iconic or culturally significant facilities

Normal

Supports functions that can more easily be accommodated in temporary spaces

- Teaching facilities with small classrooms
- Research facilities with labs that can be moved to temporary spaces
- Administrative and academic offices
- Student gathering spaces

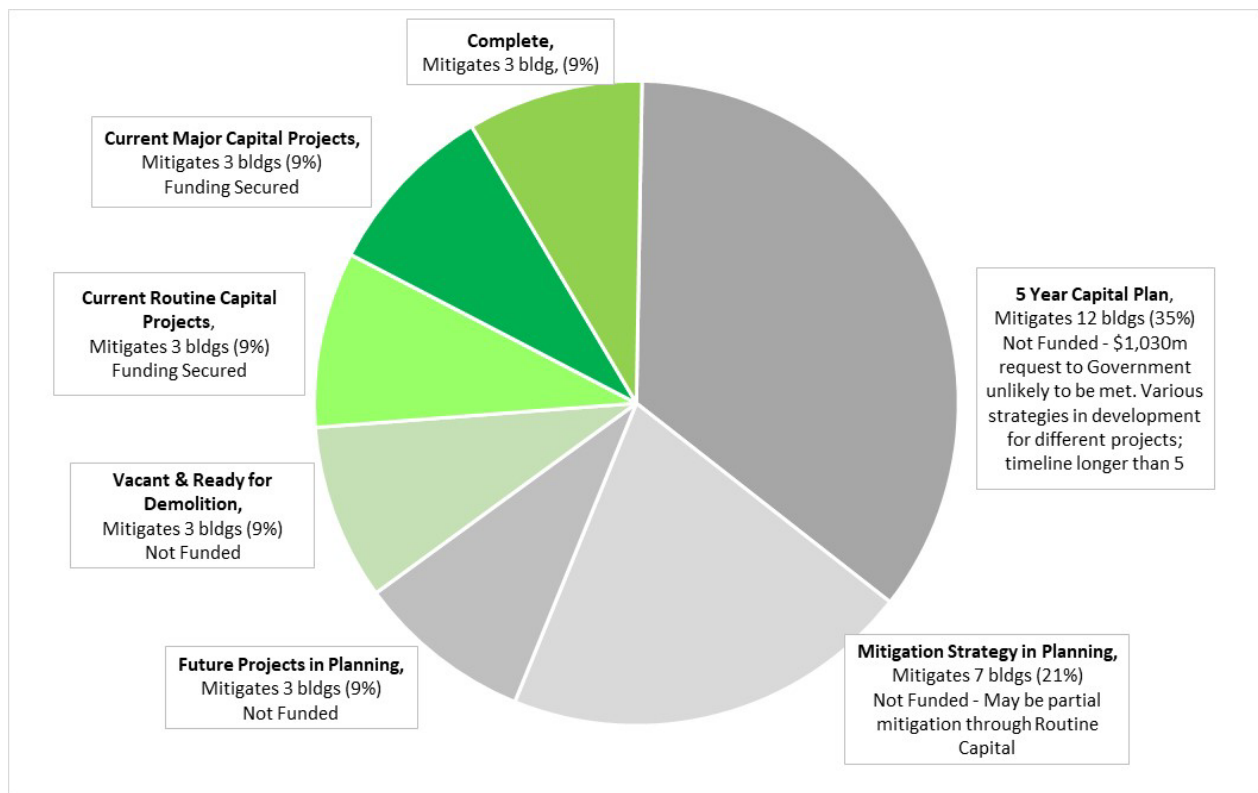
Additional details – Completed work



Additional completed project highlights:

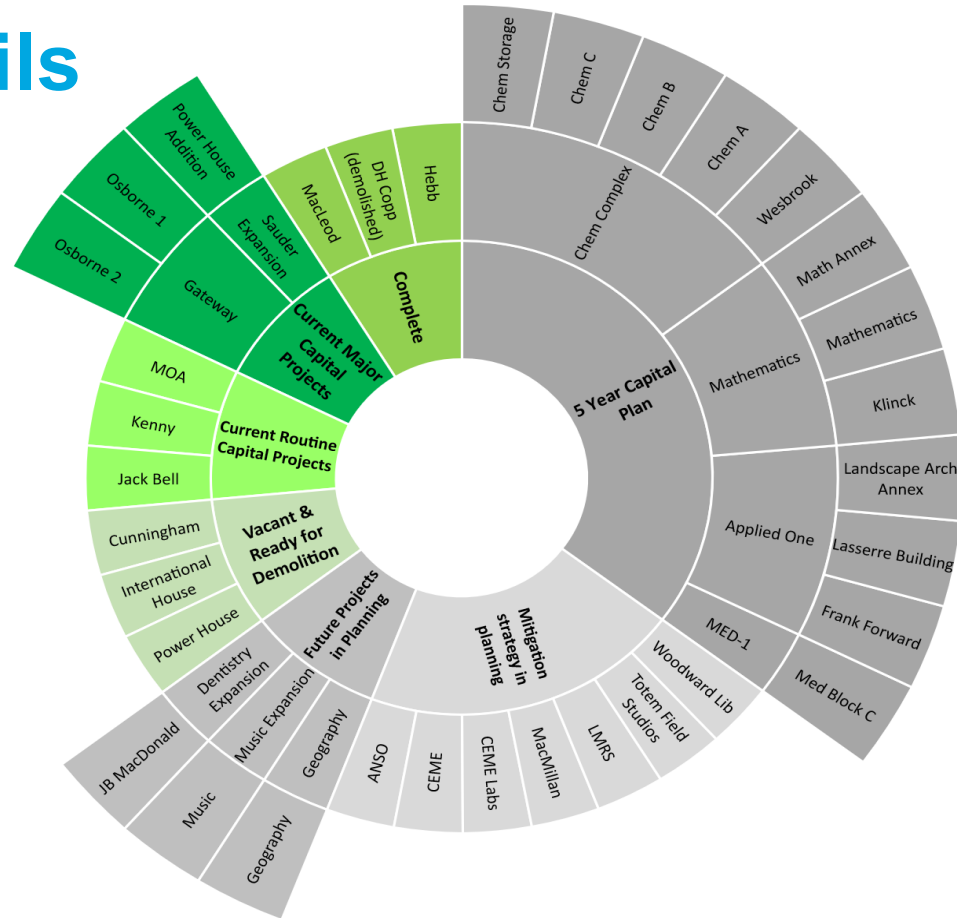
- Continue to upgrade/renew with Routine Cap
- Targeted upgrades e.g. Douglas Kenny
- New Pump House on U Blvd; new fuel tank
- Dedicated EOC planned for TEF4
- Business Continuity Planning progressing

Additional details – Academic Plan



Note: This chart does not include 28 retrofit / seismic upgrade projects completed prior to 2019, including 13 buildings renovated under UBC Renew Phases 1 and 2.

Additional details



Note: All buildings noted are Tier IV or V except Chemistry C, Geography, and Osborne 1 which are Tier III buildings



Discussion and decision points



Key next steps include:

- Continued progress on retrofits e.g. Jack Bell
- Options for Walter Gage & Place Vanier
- Continued iterations of REDi to optimize life safety/resilience benefits vs cost
- Investigation of targeted upgrades

Supplemental Materials 1 – Campus Map – Retrofitted and Tier IV, V Buildings

