UNIVERSITY OF BRITISH COLUMBIA

UBC LEED Implementation Guide

For Building Design and Construction v4.1

FEBRUARY 2022

Vision

UBC is committed to sustainability across teaching, learning and research, operations and infrastructure, and community.

The Climate Action Plan 2030 (Vancouver and Okanagan Campus Plans) set targets and actions toward zero emissions across UBC. On our Vancouver campus the Green Building Action Plan commits us to the vision that by 2035, UBC buildings will make net positive contributions to human and natural systems. In the Okanagan, our Whole Systems Infrastructure Plan (WSIP) sets climate adaptive guidelines along with a goal for net positive performance in both energy and carbon by 2050. As part of these commitments, our campus planning offices are encouraging high performance and high-quality built infrastructure, that aligns with the established provincial green building requirements for LEED Gold and encourages accountability through exemplary LEED ratings.

UBC aspires to demonstrate leading green building design and is committed to accountability in building performance.

Earth Sciences Building, UBC Vancouver Campus

LEED v4.1

LEED v4.1 has been launched by the USGBC as a **beta version**, to allow the market to work with the draft rating system and provide feedback based on real-world application.

The beta rating system is not final, and feedback from users will inform the public comment draft(s) to come. The LEED v4.1 BD+C Reference Guide (Beta version) will be updated as needed and as more program features become available. The v4.1 BD+C Beta Reference Guide (and online credit library) contains guidance that is new or modified from LEED v4.

This Implementation Guide provides specific direction for the UBC Vancouver and Okanagan Campuses to implement the LEED BD+C v4.1 rating system. It has been developed to support all UBC policy and is aligned with the UBC Vancouver and Okanagan Campus Plans, the Technical Guidelines, the Green Building Action Plan, and the Climate Action Plan 2030.

In cases where it is more appropriate for projects to be applying another LEED rating system such as Interior Design + Construction (ID+C) or Core and Shell (CS), this Implementation Guide should be used where applicable and reasonable.

LEED v4

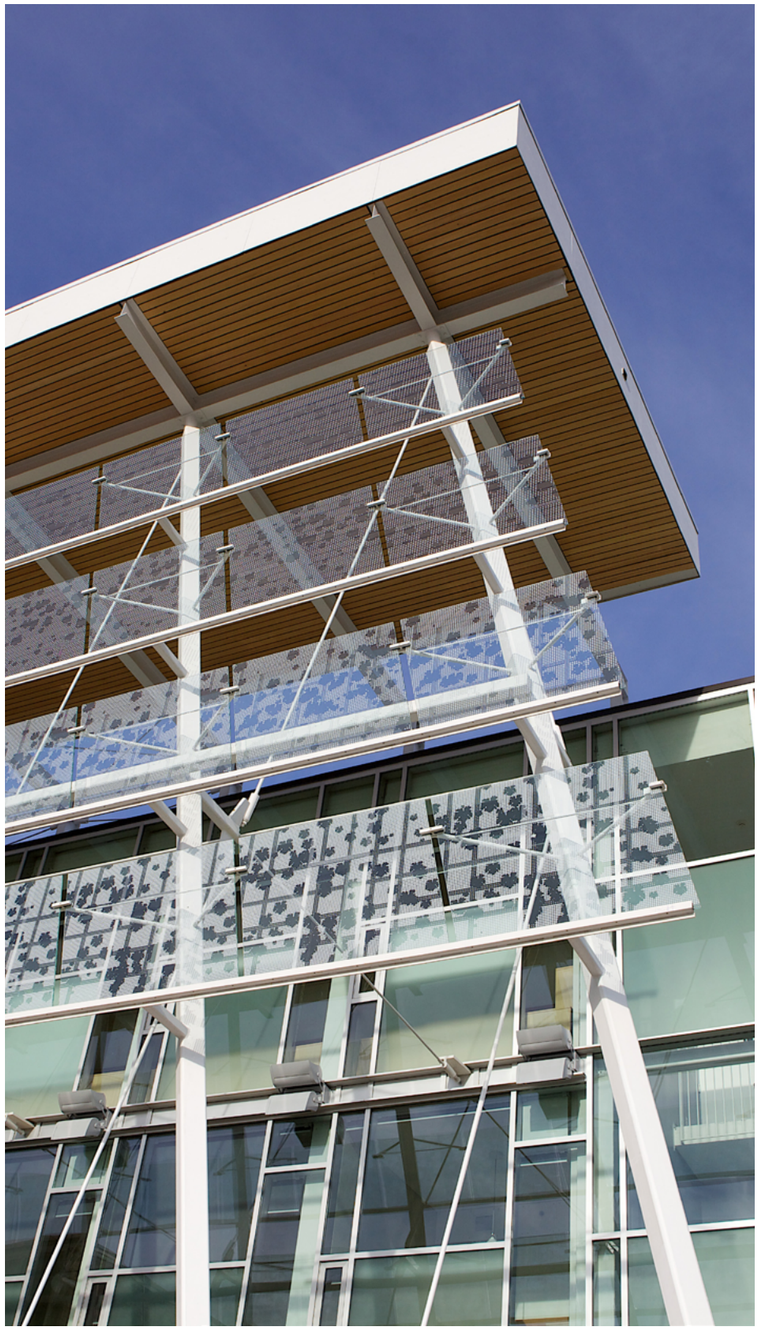
The UBC LEED Implementation Guide for LEED v4 will continue to guide projects registered under applicable rating systems until LEED v4 projects are complete and certified. Projects may elect to apply v4.1 credit compliance paths as applicable, and in accordance with USGBC guidance.

ACKNOWLEDGEMENT

UBC's Campus and Community Planning (Sustainability and Engineering) and UBCO's Campus Planning (Sustainability Office) developed this guide with support from **hcma**, reLoad Sustainable Design Inc. and the following UBC departments:

- UBC Vancouver Campus and Community Planning
- UBC Sustainability Initiative
- UBC Building Operations
- UBC Project Services
- UBC Vancouver Energy and Water Services
- UBC Okanagan Facilities Management
- UBC Okanagan Energy Team
- UBC Properties Trust

UBC is a member of the US and Canada Green Building Councils and is proud to support the Councils' mission to lead and accelerate the transformation to high-performing green buildings.



Reichwald Health Sciences Centre Building, UBC Okanagan Campus

Table of Contents

Appendices

APPENDIX A:

UBC Integrated Sustainability Process

APPENDIX B: SURROUNDING DENSITY AND DIVERSE USES MAPS

Vancouver | Okanagan

APPENDIX C: TRANSIT MAPS

Vancouver | Okanagan

APPENDIX D: CYCLING NETWORK AND DIVERSE USES MAP

Vancouver | Okanagan

APPENDIX E: RAINWATER INFILTRATION MAP

Vancouver | Okanagan

APPENDIX F: LIGHTING ZONE MAP

Okanagan

APPENDIX G:

Okanagan Campus: Process Water Data

APPENDIX H: DISTRICT ENERGY SYSTEM GUIDANCE AND UTILITY DATA

Vancouver | Okanagan

APPENDIX I:

UBC's Whole Building Life Cycle Assessment Guidelines

Buchanan Courtyard, UBC Vancouver Campus

Introduction

Introduction and Purpose

The purpose of the Implementation Guide is to facilitate an efficient LEED process for UBC projects and align it directly with UBC policy and aspirational goals.

The Guide aims to leverage the provincial LEED Gold mandate; it identifies compliance paths, resources, and credits that are part of UBC's priorities, for the most effective outcomes at both the Vancouver and Okanagan campuses.

This Guide was informed by a series of workshops with campus stakeholders, a study of past performance of LEED projects at UBC, an analysis of UBC policy and programs on both campuses within the context of LEED requirements, and engagement with users of previous versions of the Guide. The study identified credits within the BD+C v4.1 rating systems that most clearly align with UBC policy and sustainable design priorities, in addition to building performance thresholds that are either consistently being met, surpassed, or can be expected to be reasonably attained.

The LEED v4.1 UBC Implementation Guide is aligned with campus-wide policies at both the Vancouver and Okanagan campuses, to support sustainable development. These guiding documents include:

- Strategic Plan: Shaping UBC's Next Century
- 20-Year Sustainability Strategy for the University of British Columbia Vancouver Campus (2014);
- UBC Okanagan Outlook 2040
- The Okanagan Charter

GENERAL

- Green Building Action Plan (2018)
- UBC Technical Guidelines – Vancouver Campus or Okanagan Campus
- UBC Integrated Sustainability Process
- UBC Climate Ready Requirements
- UBC Climate Action Plan
- Zero Waste Action Plan (2014)
- UBC Sustainable Purchasing Guide (Buying into the Future 2010)
- UBC Risk Management Services - Environmental Services

VANCOUVER CAMPUS

- Vancouver Campus Plan (updated 2020)
- UBC Vancouver Climate Action Plan 2030 (UBCV CAP 2030)
- UBC Water Action Plan (2019)
- UBC Integrated Stormwater Management Plan (2017)
- UBC Transportation Plan (Oct 2014)
- Bird Friendly Design Guidelines
- UBC Building Operations
- UBC Custodial Green Cleaning Program

OKANAGAN CAMPUS

- UBC Okanagan Campus Plan (2015)
- UBC Okanagan Whole Systems Infrastructure Plan (2016)
- UBC Okanagan Integrated Rainwater Management Plan (2017)
- UBC Okanagan Transportation Plan
- UBC Okanagan Climate Action Plan 2030 (UBCO CAP 2030)
- UBC Okanagan Design Guidelines
- UBC Okanagan Green Cleaning Program

It is the intention of UBC to update this Guide annually, or when major changes to the rating system are published, to maintain consistency with campus policy and priorities as they evolve, and as industry best practice and building performance strategies progress. Any revisions will be tracked and documented, and version identification will be identified by date: month and year of publication.

How To Use This Guide

This Guide is intended provides project teams with the UBC-specific guidance required to optimize LEED for the Vancouver and Okanagan campuses.

The USGBC LEED BD+C v4.1 Credit Library and current Reference Guide remain the core sources for guidance on achieving and documenting each prerequisite and credit. This Guide interprets and supplements the LEED BD+C v4.1 beta rating systems for projects built on the UBC Vancouver and Okanagan campuses.

All major capital projects (>$5 million) and over 1,000 square meters in area are required to earn LEED Gold certification. Other third party verified building performance certification programs, such as the Living Building Challenge, Passive House, or the Zero Carbon Building Standard may be permitted, under specific circumstances which are agreed to in advance with the UBC Vancouver or Okanagan Planning departments.

COMPANION DOCUMENTS AND REFERENCE GUIDE

The UBC LEED Implementation Guide is a companion document to the Campus Plans, Design Guidelines, the Green Building Action Plan, and the UBC Technical Guidelines. Project teams should reference all relevant UBC policy and guidance documents along with this Guide.

CREDIT ACHIEVEMENT AND APPLICATION

This Guide identifies **mandatory** and **priority** credits or points for UBC projects. Mandatory credits must be achieved by all UBC projects, and priority credits or points are strongly encouraged to be pursued.

Direction is only given where applicable to the UBC context for each campus as necessary. Where campus specific direction is not provided, the guidance applies to both the Vancouver and Okanagan campuses. Where no direction is given, follow the current LEED Reference Guide.

Buchanan Courtyard, UBC Vancouver Campus

Engineering Management and Education Building, UBC Okanagan Campus

LEED at UBC

UBC LEED Requirements

This Guide identifies LEED Credits as **mandatory** or **priority** for achievement at UBC.

The mix of credits is different for each campus, to reflect the local context and policies accordingly. UBC expects all credits identified as **mandatory** to be achieved; projects may earn an exemption for credits or thresholds that cannot be reasonably met with a LEED Variance Request. Refer to the campus specific scorecards for the list of credits identified as mandatory and priority.

VARIANCE PROCESS

Projects may obtain an exemption from earning a **mandatory** credit if the credit or performance threshold is determined not to be feasible under specific circumstances. To earn an exemption, projects must submit a LEED Variance Request. The aim of the variance process is to engage in transparent discussion and learn why certain credits may not be relevant or achievable.

LEED CAMPUS GUIDANCE AND GROUP APPROACH

The *USGBC document LEED Campus Guidance for Projects on a Shared Site (April 2014)* provides direction for projects where individual, or group certification will be pursued for multiple buildings on a shared site. UBC has elected not to establish a single Master Site for either campus, each project is required to prepare documentation demonstrating site specific compliance. There may be future circumstances where a Master Site or Group Approach is appropriate (such as where multiple buildings are pursuing certification on a sub-site within the larger campus); in such cases project teams are encouraged to liaise with the relevant Campus Planning to coordinate an approach.

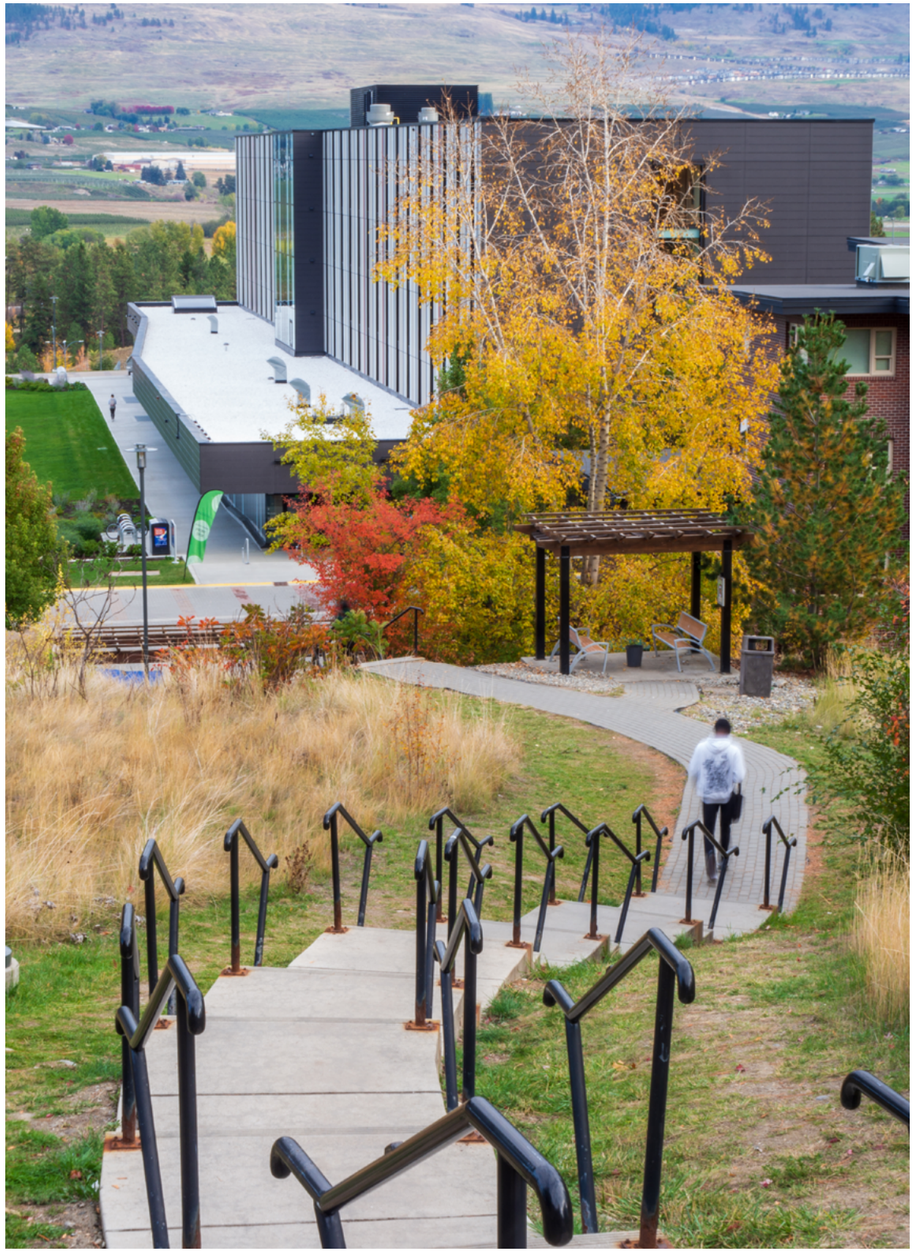
LEED Variance requests must be emailed to:

VANCOUVER CAMPUS
Green Building Manager Campus and Community Planning

penny.martyn@ubc.ca

OKANAGAN CAMPUS
Associate Director Sustainability Operations and Campus Planning

leanne.bilodeau@ubc.ca



Steps to Nechako Student Residence, UBC Okanagan Campus

Scorecards

CREDIT/PREREQUISITE			VANCOUVER CAMPUS		OKANAGAN CAMPUS	
INTEGRATIVE PROCESS		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Credit	Integrative Process	1	1		1	
		1	**1**		**1**	
LOCATION AND TRANSPORTATION		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Credit	LEED for Neighborhood Development Location	N/A				
Credit	Sensitive Land Protection	1	1		1	
Credit	High Priority Site	2		2		2
Credit	Surrounding Density and Diverse Uses	5	2	3	2	3
Credit	Access to Quality Transit	5	2	3	2	3
Credit	Bicycle Facilities	1	1		1	
Credit	Reduced Parking Footprint	1		1		1
Credit	Electric Vehicles	1		1		1
		16	**6**	**10**	**6**	**10**
SUSTAINABLE SITES		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Prerequisite	Construction Activity Pollution Prevention					
Credit	Site Assessment	1	1		1	
Credit	Protect or Restore Habitat	2		2		2
Credit	Open Space	1		1	1	
Credit	Rainwater Management	3	2	1	2	1
Credit	Heat Island Reduction	2	2		2	
Credit	Light Pollution Reduction	1	1		1	
		10	**6**	**4**	**7**	**3**

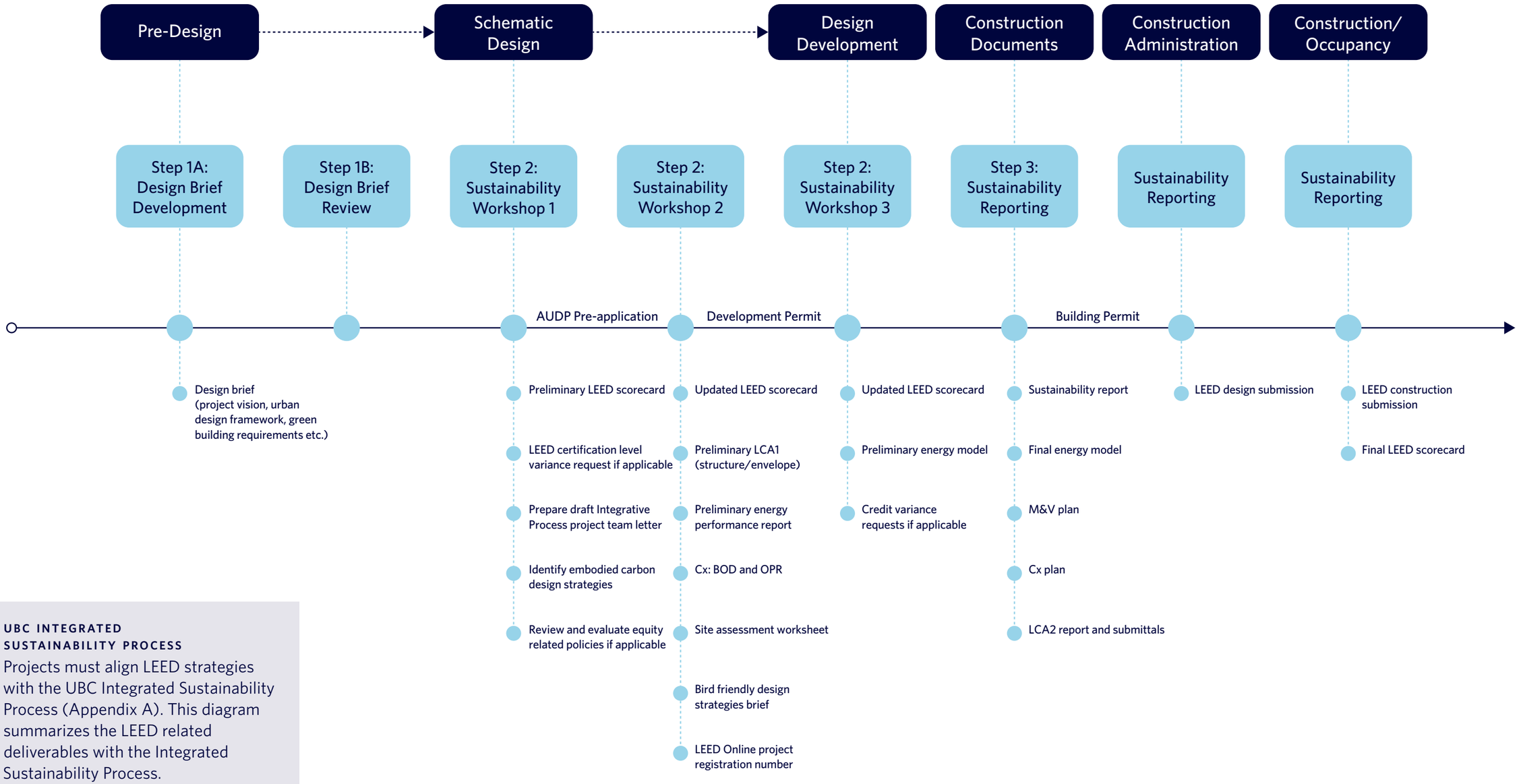
CREDIT/PREREQUISITE			VANCOUVER CAMPUS		OKANAGAN CAMPUS	
WATER EFFICIENCY		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Prerequisite	Outdoor Water Use Reduction					
Prerequisite	Indoor Water Use Reduction					
Prerequisite	Building-Level Water Metering					
Credit	Outdoor Water Use Reduction	2	1	1	1	1
Credit	Indoor Water Use Reduction	6		4		4
Credit	Optimize Process Water Use	2		2	1	1
Credit	Water Metering	1	1		1	
		11	**2**	**7**	**3**	**6**
ENERGY AND ATMOSPHERE		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Prerequisite	Fundamental Commissioning and Verification					
Prerequisite	Minimum Energy Performance					
Prerequisite	Building-Level Water Metering					
Prerequisite	Fundamental Refrigerant Management					
Credit	Enhanced Commissioning	6	4	2	4	2
Credit	Optimize Energy Performance	18	10	8	10	8
Credit	Advanced Energy Metering	1	1		1	
Credit	Grid Harmonization	2	1		1	
Credit	Renewable Energy	5		1		1
Credit	Enhanced Refrigerant Management	1	1		1	
		33	**17**	**11**	**17**	**11**
MATERIALS AND RESOURCES		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Prerequisite	Storage and Collection of Recyclables					
Credit	Building Life-Cycle Impact Reduction	5	3	2	3	2
Credit	Building Product Disclosure - Environmental Product Declarations	2	1	1	1	1
Credit	Building Product Disclosure - Sourcing of Raw Materials	2	1	1	1	1
Credit	Building Product Disclosure - Material Ingredients	2	1	1	1	1
Credit	Construction and Demolition Waste Management	2	1	1	1	1
		13	**7**	**6**	**7**	**6**

CREDIT/PREREQUISITE			VANCOUVER CAMPUS		OKANAGAN CAMPUS	
INDOOR ENVIRONMENTAL QUALITY		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Prerequisite	Minimum Indoor Air Quality Performance					
Prerequisite	Environmental Tobacco Smoke Control					
Credit	Enhanced Indoor Air Quality Strategies	2	1	1	1	1
Credit	Low-Emitting Materials	3	2	1	2	1
Credit	Construction Indoor Air Quality Management Plan	1	1		1	
Credit	Indoor Air Quality Assessment	2	1	1	1	1
Credit	Thermal Comfort	1		1		1
Credit	Interior Lighting	2		1		1
Credit	Daylight	3		1		1
Credit	Quality Views	1				
Credit	Acoustic Performance	1				
		16	**5**	**6**	**5**	**6**
INNOVATION AND DESIGN		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Credit	Innovation in Design:	1	1		1	
Credit	Innovation in Design:	1	1		1	
Credit	Innovation in Design:	1	1		1	
Credit	Innovation in Design:	1	1		1	
Credit	Innovation in Design:	1	1		1	
Credit	LEED Accredited Professional	1	1		1	
		6	**6**		**6**	
REGIONAL PRIORITY		**AVAILABLE**	**MANDATORY**	**PRIORITY**	**MANDATORY**	**PRIORITY**
Credit	Optimize Energy Performance (10 Points)	1	1		1	
Credit	Building Life-Cycle Impact Reduction (3 Points)	1	1		1	
Credit	Rainwater Management (2 Points)	1	1		1	
Credit	Regional Priority Credit 4	1	1		1	
		4	**4**		**4**	

TOTALS	AVAILABLE	MANDATORY	PRIORITY	MANDATORY	PRIORITY
	110	**54**	**44**	**56**	**42**

UBC Integrated Design Process Timeline

Deliverables



UBC INTEGRATED SUSTAINABILITY PROCESS

Projects must align LEED strategies with the UBC Integrated Sustainability Process (Appendix A). This diagram summarizes the LEED related deliverables with the Integrated Sustainability Process.

REGISTRATION

Projects must be registered with the USGBC/GBCI Canada and submit a preliminary LEED checklist to Campus and Community Planning, Green Building Manager (Vancouver) or the Associate Director, Sustainability Operations (Okanagan), prior to Development Permit application. The UBC Green Building Manager or Associate Director, Sustainability Operations must be included as a member of the LEED Online project team at the time of registration.

CERTIFICATION

Projects must be registered with the USGBC/GBCI Canada and submit a preliminary LEED checklist to Campus and Community Planning, Green Building Manager (Vancouver) or the Associate Director, Sustainability Operations (Okanagan), prior to Development Permit application. The UBC Green Building Manager or Associate Director, Sustainability Operations must be included as a member of the LEED Online project team at the time of registration.

The split review option allows project teams to document all design related credits during the construction administration period, prior to project teams dissolving. It also permits clarification of issues while the project team is still actively working with the larger project team, greatly simplifying the certification process. For details on the certification process refer to USGBC Guide to Certification, and the LEED BD+C Reference Guide.

Campus Energy Centre, UBC Vancouver Campus

Credit Guidance

The Hanger Gym Expansion, UBC Okanagan Campus

Credit Guidance

Integrative Processes

IP Credit: **Integrative Processes**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1.

RESOURCES

Appendix A – UBC Integrated Sustainability Process

GUIDANCE

Projects teams should reference the UBC Integrated Sustainability Process (Appendix A) for alignment with the credit requirements. UBC considers an integrative process vital to a holistic, systems-based approach to sustainable design and construction. Early analysis of interrelationships among systems can support efficient, simplified, and cost-effective strategies for high performance outcomes.

Project teams may choose to analyze any available issue area but must still comply with the established UBC Integrated Sustainability Process which requires energy- and water-related systems to be assessed early in the project and documented in alignment with the requirements of this credit.

The UBC Integrated Sustainability Process in Appendix A shows alignment with the project milestones and the requirements of the Integrative Process credit. Projects are required to submit a draft Project Team Letter following Sustainability Workshop 1.

Centre for Interactive Research on Sustainability – Living Wall Lecture Hall, UBC Vancouver Campus

Credit Guidance

Location and Transportation

LT Credit: LEED for Neighborhood Development Location (not available)

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			N/A
Okanagan			

GUIDANCE

Currently there are no sites certified under the LEED ND rating system on the UBC Vancouver or Okanagan Campus. Should this condition change, the Guide will be updated to reflect this credit and project teams may apply the available points toward their score.

LT Credit: Sensitive Land Protection

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1.

VANCOUVER RESOURCES

Appendix A – UBC Integrated Sustainability Process

BC Conservation Data Centre

Vancouver Campus Plan

OKANAGAN RESOURCES

Appendix A – UBC Integrated Sustainability Process

BC Conservation Data Centre

Okanagan Campus Plan

Okanagan Whole Systems Infrastructure Plan

UBC Okanagan Campus Environmental Sensitivity Analysis, refer to Ecological Assessment Figure 2 – Ecosystem Polygons – ESA Full Campus

GUIDANCE

Projects must comply with Option 1: Previously Developed Land whenever applicable. Should Option 1 be unavailable, credit achievement is required via Option 2: Avoidance of Sensitive Land.

Projects must assess current site conditions and ecological status of the site at the time of design. It is imperative that an assessment of species and ecosystems at risk, floodplains and water bodies are considered for each development project on the campus; site assessments should be conducted early in the process and align with and inform the steps required by the Integrative Process credit the Site Assessment credit, both identified as mandatory for both campuses. Public online resources such as the provincial registry of red list and blue lists, ecologically sensitive mapped areas, human health, and campus resources can be used for this credit.

LT Credit: High Priority Site and Equitable Development

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		2	2
Okanagan		2	

REQUIREMENTS

Projects teams are strongly encouraged to pursue this credit through any available option.

VANCOUVER RESOURCES

UBC Engagement Principles

Equity & Inclusion Policies

Vancouver Campus Plan

UBC Risk Management Services

OKANAGAN RESOURCES

UBC Engagement Principles

Equity & Inclusion Policies

Okanagan Campus Plan

UBC Risk Management Services

GUIDANCE

Option 1

Path 1: Economically Disadvantaged Community Location

Path unavailable to both Vancouver and Okanagan campuses.

Path 2: Brownfield Remediation

No contaminated sites have been identified on either campus. However, project teams are advised to consult with UBC Risk Management Services if future conditions indicate contamination may have occurred

Option 2

Path 1: Equity & Community Benefits

Project teams pursuing this option should aim to address disparities in the project's community by engaging local stakeholders who are vulnerable, disadvantaged, or under-represented. An equity plan should comply with UBC's Equity-related Policies. Projects are encouraged to liaise with the relevant Campus Planning office to develop a plan that aligns with current practices and processes already in place, such as consultation and stakeholder engagement or established relationships with partner organizations.

Path 2: Equitable Development

This path may be applicable to student housing projects. Teams wishing to pursue this credit should be in touch with the relevant Campus Planning office to determine compliance.

Student Union Building, UBC Vancouver Campus

LT Credit: **Surrounding Density and Diverse Uses**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	2	3	5
Okanagan	2	3	

REQUIREMENTS

All projects must comply to earn at least two points. Vancouver projects may comply via any available option; for Okanagan projects, Option 2 is the most likely and efficient compliance path.

VANCOUVER RESOURCES

Appendix B – Vancouver Campus: Surrounding Density and Diverse Uses Maps

Walk Score

UBC Vancouver GIS Data

VANCOUVER GUIDANCE

Option 1: *Surrounding Density (2–3 points)*

To confirm compliance with Option 1, locate the project on the Vancouver Campus Surrounding Density and Diverse Uses Maps in Appendix B. Campus development density has been calculated using the Combined Density methodology and mapped for use by all future projects. Most project sites will be in zones with surrounding density of greater than 8,035 sq.m/ha buildable land to earn three points. UBC Vancouver GIS data can be accessed online to calculate density.

Option 2: *Diverse Uses (1–2 points)*

To confirm compliance with Option 2, locate the project site on the Vancouver Campus Surrounding Density and Diverse Uses Map in Appendix B. The map provides only general use types to account for the wide range and variability of campus amenities over time. Project teams are encouraged to consult online campus maps, Google maps and to review amenities on the ground to confirm applicable amenities at the time of certification. If the analysis indicates a lack of amenities within the required distance, contact Campus Planning to determine if future planned amenities may be able to contribute.

Option 3: *Walkable Location (1-5 points)*

The majority of the Vancouver Campus will achieve a Walk Score between 67-72 earning two or three of a possible five points. Note that projects attempting Option 3 are not eligible to pursue points under Option 1 or 2.

OKANAGAN RESOURCES

Appendix B – Okanagan Campus: Surrounding Density and Diverse Uses Maps

Walk Score

UBC Okanagan GIS Data

OKANAGAN GUIDANCE

Option 1: *Surrounding Density (2–3 points)*

Depending on where a project site is located, Okanagan campus surrounding density may be below the minimum threshold to earn points under this option. Refer to the Okanagan Campus Surrounding Density and Diverse Uses Maps in Appendix B. UBC Okanagan GIS data can be accessed online to calculate density.

Option 2: *Diverse Uses (1–12 points)*

To confirm compliance with Option 2, locate the project site on the Okanagan Campus Surrounding Density and Diverse Uses Maps in Appendix B. The map provides only general use types to account for the wide range and variability of campus amenities over time. Project teams are encouraged to consult online campus maps, Google maps and to review amenities on the ground to confirm applicable amenities at the time of certification. If the analysis indicates a lack of amenities within the required distance, contact Campus Planning to determine if future planned amenities may be able to contribute.

Option 3: *Walkable Location*

The majority of the Okanagan Campus currently has a Walk Score below the minimum threshold to earn points under this option, but teams may wish to consider it if circumstances change. Project teams are encouraged to check the Walk Score for their specific project location.

LT Credit: Access to Quality Transit

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	2	3	5
Okanagan	2	3	

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1 to earn at least two points.

VANCOUVER RESOURCES

Appendix C – Vancouver Campus: Transit Map

TransLink Transit Schedules

VANCOUVER GUIDANCE

Transit analysis completed for the Vancouver campus includes the UBC Bus Exchange and trolley loop as well as all bus stops in and around UBC. The UBC Vancouver campus is served by local, regional, and rapid bus service. However, note that the rapid bus service does not meet the definition of Bus Rapid Transit used by LEED, which states that buses must operate on exclusive lanes or other transit rights of way. To confirm compliance, refer to the Vancouver Campus: Transit Map in Appendix C to determine if the project site is within 400m walking distance of a bus stop, bus loop or the UBC Exchange.

Current daily one-way transit service on campus is:

- Wesbrook Mall north of UBC Bus Exchange: 192 weekday trips, 93 weekend trips
- Wesbrook Mall between UBC Bus Exchange and University Boulevard: 747 weekday trips, 520 weekend trips
- Wesbrook Mall south of University Boulevard: 488 weekday trips, 337 weekend trips
- University Boulevard west of Wesbrook Mall: 199 weekday trips, 151 weekend trips
- Along the 68 Bus Route on local campus roads: 50 weekday trips, 47 weekend trips

Transit trip counts are provided for the convenience of estimation only. Daily transit service should be confirmed for each project at the time of documentation.

OKANAGAN RESOURCES

Appendix C – Okanagan Campus: Transit Map

Kelowna BC Transit Schedules

OKANAGAN GUIDANCE

UBC Okanagan Exchange is a bus terminal for the Kelowna Regional Transit System located at the Okanagan campus. Buses serve Lake Country, Vernon, Kelowna International Airport, Kelowna, and West Kelowna, including the 97 RapidBus. Note that the 97 RapidBus does not meet the definition of Bus Rapid Transit used by LEED, which states that buses must operate on exclusive bus lanes or other transit rights of way.

A transit analysis has been conducted for the Kelowna campus; to confirm project compliance, refer to the Okanagan Campus: Transit Map in Appendix C to determine if the project site is within 400m walking distance of a bus stop or the Exchange.

Current daily one-way transit service on campus is:

- Innovation Drive: 72 weekday trips; 33 weekend trips
- University Way: 213 weekday trips; 108 weekend trips
- Alumni Avenue: 21 weekday trips; 0 weekend trips

Transit service is provided for the convenience of estimation only. Daily transit service should be confirmed for each project at the time of documentation.

LT Credit: **Bicycle Facilities**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1.

VANCOUVER RESOURCES

Appendix D – Vancouver Campus: Cycling Network and Diverse Uses Map

UBC Vancouver Cycling Map

Vancouver Campus Plan Part 3: 2.5.5 Bicycle parking and 2.5.6 End of Trip Facilities

UBC Vancouver Campus Map

City of Vancouver Cycling Map

VANCOUVER GUIDANCE

All roads on campus have a speed limit of 30km/hr, allowing them to be considered as part of the bicycle network as defined by the LEED BD+C LEED v4.1 Reference Guide. All other infrastructure that may be considered as part of the network is identified in Appendix D Vancouver Campus: Cycling Network and Diverse Uses Map.

All projects must ensure that bicycle parking and end of trip facilities are provided and installed in accordance with the Vancouver Campus Plan Design Guidelines sections 2.5.5: Bicycle Parking and 2.5.6: End-of-Trip-Facilities. In some cases the Design Guidelines may be more stringent than LEED. Projects must comply with the most stringent requirement.

On-site bike sharing stations within the project boundary are eligible to count for 50% of long-term and short-term storage.

OKANAGAN RESOURCES

Appendix D – Okanagan Campus: Cycling Network and Diverse Uses Map

UBCO Campus Map

Okanagan Campus Design Guidelines section 2.4.2: Bike Racks and Lockers

City of Kelowna Bike Routes

OKANAGAN GUIDANCE

All local roads on campus have a speed limit of 30 km/hr, allowing them to be considered as part of the bicycle network as defined by the LEED BD+C LEED v4.1 Reference Guide. All other infrastructure that may be considered as part of the network is identified in Appendix D Okanagan Campus: Cycling Network and Diverse Uses Map.

All projects must ensure that bicycle parking and end of trip facilities are provided and installed in accordance with the UBC Okanagan Campus Design Guidelines section 2.4.2: Bike Racks and Lockers. In some cases the Design Guidelines may be more stringent than LEED. Projects must comply with the most stringent requirement

On-site bike sharing stations within the project boundary are eligible to count for 50% of long-term and short-term storage.

LT Credit: **Reduced Parking Footprint**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	1
Okanagan		1	

REQUIREMENTS

All projects are strongly encouraged to pursue this credit.

VANCOUVER RESOURCES

UBC Parking

UBC Vancouver Parking Rates

TransLink Fares

VANCOUVER GUIDANCE

Projects are encouraged to pursue Option 3: Unbundled Parking as the most efficient path to compliance. In the rare instance that a project includes parking within the project site boundary, teams should liaise with Campus Planning and UBC Parking to confirm that spaces will be allocated and used in manner aligned with the credit requirements.

Note that all buildings must provide off-street loading bays; these spaces are not to be included in the parking footprint calculation.

Option 1: *No Parking or Reduce Parking* **and Option 2:** *Carshare*

Option 1 or 2 may be pursued if circumstances are appropriate. Parking calculations must account for all existing and new off-street parking spaces that are leased or owned by UBC, including parking that is outside the project boundary but is used by the project (all parkades and surface parking lots across campus). Any new parking spaces created by the project, or existing parking spaces that are intended to be used or reserved by the project, must be clearly identified for review and approval by Campus Planning and UBC Parking accordingly.

Option 3: *Unbundling Parking*

The current daily parking rate at the UBC Vancouver campus exceeds the cost of TransLink's daily, three-zone round trip using a **stored value rate**. The daily **cash value rate** for a round trip three-zone fare is more expensive than the current daily parking rate. Projects are encouraged to submit for credit compliance using the **stored-value rate**. Parking rates and transit fares are subject to change, so projects must confirm costs in advance of credit documentation. Project teams are encouraged to work with UBC Parking to ensure parking cost is greater than the transit fare.

OKANAGAN RESOURCES

UBC Okanagan Parking Services

UBC Okanagan Parking Rates

BC Transit Fares – Kelowna

OKANAGAN GUIDANCE

Projects are encouraged to pursue Option 3: Unbundled Parking as the most efficient path to pursue compliance. In the rare instance that a project includes parking within the project site boundary, teams should liaise with Campus Planning and Parking Services to confirm that spaces will be allocated and used in manner aligned with the credit requirements.

Note that all buildings must provide off-street loading bays; these spaces are not to be included in the parking footprint calculation.

Option 1: *No Parking or Reduce Parking* **and Option 2:** *Carshare*

Option 1 or 2 may be pursued if circumstances are appropriate. Parking calculations must account for all existing and new off-street parking spaces that are leased or owned by UBC, including parking that is outside the project boundary but is used by the project (all parkades and surface parking lots across campus). Any new parking spaces created by the project, or existing parking spaces that are intended to be used or reserved by the project, must be clearly identified for review and approval by Campus Planning and Parking Services accordingly.

Option 3: *Unbundling Parking*

The daily parking rate at the UBC Okanagan campus exceeds the cost of BC Transit's round trip adult fare. Parking rates and transit fares are subject to change, so projects should confirm costs in advance of credit documentation. Project teams are encouraged to work with Parking Services to ensure parking cost is greater than the transit fare.

LT Credit: **Electric Vehicles**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	1
Okanagan		1	

REQUIREMENTS

Projects are encouraged to pursue compliance with credit requirements if appropriate within the context of the project.

VANCOUVER RESOURCES

UBC Transportation Plan (Oct 2014)

UBC Electric Vehicle Charging Locations

UBC Parking

OKANAGAN RESOURCES

UBC Okanagan Transportation Plan

UBC Okanagan Parking Services

GUIDANCE

Electric vehicle charging stations are encouraged and may be appropriate for select projects with on-site parking. All electric vehicle parking spaces and supply equipment are designated and managed by UBC Parking according to campus demand. Where electric vehicle parking currently exists, spaces are provided at the same cost as regular vehicles and electric charging is offered for a nominal hourly rate. Project teams are encouraged to liaise with UBC Parking to explore options and opportunities for electric vehicle charging stations.

Alternatively, LEED v4.1 awards points for installing charging infrastructure for 10% of parking or at least six stalls. Project teams are encouraged to consider this option where relevant and appropriate.

Electric Vehicle Parking, UBC Okanagan Campus

Earth Sciences Building, UBC Vancouver Campus

Credit Guidance

Sustainable Sites

Prerequisite: Construction Activity Pollution Prevention

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

Prerequisite

VANCOUVER RESOURCES

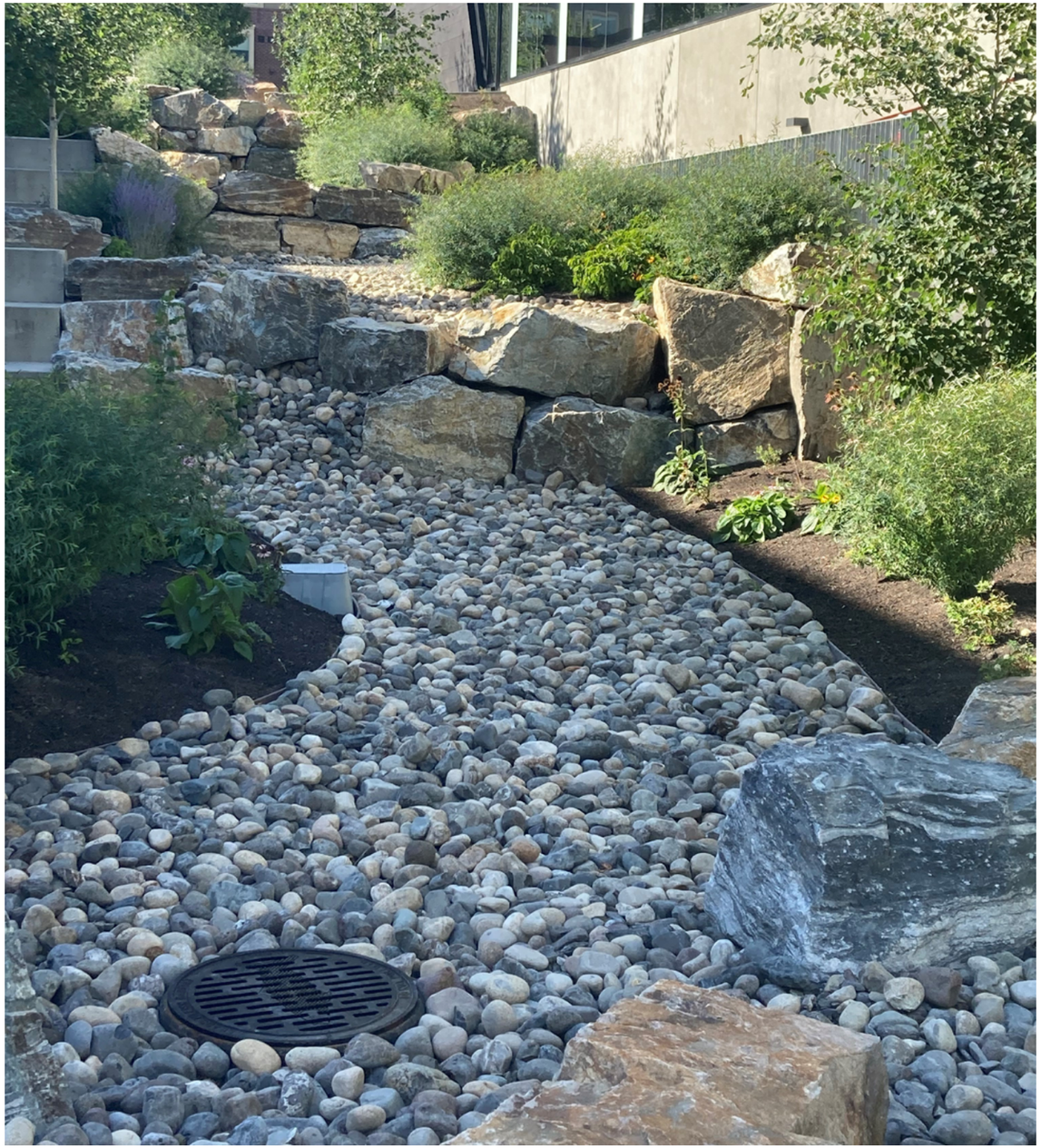
Appendix H – Greater Vancouver Regional District Best Management Practices Guide for Stormwater

OKANAGAN RESOURCES

City of Kelowna Schedule 4 of Bylaw 7900 section 3.14 Erosion and Sediment Control (ESC)

GUIDANCE

The erosion and sedimentation control plan must conform with the EPA's CGP 2017 or local code, whichever is more stringent. Stringency is determined by evaluating the specific needs of each site, and each measure required and implemented to control pollution and other impacts of construction accordingly. In some cases, the EPA's CGP measures may be more stringent, and in others it may be local code. Project teams are encouraged to engage with civil engineering consultants early in the design process to evaluate the specific site conditions and associated control measures. The project's civil engineering consultant is responsible for comparing the EPA's CGP to local code for each control measure implemented, and for providing documentation showing that the most stringent requirement was applied to each measure accordingly.



Nechako Rain Garden, UBC Okanagan Campus

SS Credit: Site Assessment

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1.

RESOURCES

USGBC LEED v4.1 Site Assessment Worksheet

BC Conservation Data Centre

Appendix A – UBC Integrated Sustainability Process

GUIDANCE

Projects must complete a site-specific assessment to account for unique local conditions and changing ecological status. Project teams are encouraged to consider the requirements of this credit early and to align the assessment and research with the Integrative Process credit, Sensitive Land Protection credit, as well as reference the UBC Integrated Sustainability Process.

Projects are required to submit a Site Assessment Worksheet following Sustainability Workshop 2 as per the UBC Integrated Sustainability Process (Appendix A).

SS Credit: Protect or Restore Habitat

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		2	2
Okanagan		2	

REQUIREMENTS

Projects are encouraged to comply as per LEED BD+C v4.1 to earn two points.

VANCOUVER RESOURCES

UBC Vancouver Campus Plan – Part 3 Design Guidelines Section 2.4.3 - Planting Guidelines

Green Building Action Plan (Biodiversity section)

OKANAGAN RESOURCES

UBC Okanagan Campus Design Guidelines Section 2.3.1 – Planting

UBCO Whole Systems Infrastructure Plan (Refer to Ecological Landscape and Biodiversity)

GUIDANCE

Projects are encouraged to carefully consider vegetation and soil condition requirements of the areas to be restored and vegetated and align with rainwater management strategies. Most projects will not be required to protect 40% of greenfield area, because there are very few greenfield sites left on either campus.

SS Credit: **Open Space**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	1
Okanagan	1		

VANCOUVER REQUIREMENTS

All project are encouraged to comply as per LEED BD+C v4.1 to earn one point.

VANCOUVER RESOURCES

Vancouver Campus Plan

VANCOUVER GUIDANCE

Projects are encouraged to pursue compliance with the credit requirements and to satisfy them within the project site area if possible. Site boundaries and the urban nature of most sites on campus make this credit challenging to achieve. Pedestrian oriented hardscape and green roofs can contribute.

OKANAGAN REQUIREMENTS

All projects must comply as per LEED BD+C v4.1 to earn one point.

OKANAGAN RESOURCES

Okanagan Campus Plan

OKANAGAN GUIDANCE

The minimum requirement for 25% of open space to be vegetated aligns with the UBCO Integrated Rainwater Management Plan, and the more suburban nature of the Okanagan campus allows for site boundaries to accommodate increased landscape and planted area. Pedestrian oriented hardscape and green roofs can contribute towards credit calculations.

Note that wetlands are valued as natural and ecological features and several low-lying areas on campus have developed into stormwater retention. Wetlands and naturally designed ponds with vegetated side slope gradients of 1:4 or less may also be counted as open space.

Public Art Installation by Les Louis, UBC Okanagan Campus

SS Credit: Rainwater Management

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	2	1	3
Okanagan	2	1	

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1 to earn a minimum of two points.

VANCOUVER RESOURCES

Appendix E – Vancouver Campus: Rainwater Infiltration Map

UBC Climate Ready Building Requirements

USGBC LEED v4.1 Rainfall Events Calculator

Vancouver Campus Plan

UBC Water Action Plan

UBC Integrated Stormwater Management Plan

Rainfall Events on Vancouver Campus

PERCENTILE	RAINFALL EVENT (MM 24H STORM)
90th	72.7
85th	46.7
80th	37.4
75th	29.0
70th	24.0

VANCOUVER GUIDANCE

UBC requires that each new building on campus consider and manage rainwater within the project site to contribute to campus-wide stormwater management, and are required to be adaptable to the climate of 2100, as per the UBC Climate Ready Requirements. The UBC Integrated Stormwater Management Plan aims to manage runoff and overland flow to protect sensitive adjacent sites. There are limitations on the stormwater practices that may be implemented on campus to navigate challenging conditions. Infiltration may not be used within 300 metres of the top of the cliffs surrounding the campus, to ensure the cliffs are protected from erosion due to excess water received by and passing through the lower aquifer. Refer to Appendix E Vancouver Campus: Rainwater Infiltration Map for a map of infiltration zones on campus.

For projects where site boundaries can accommodate Low Impact Development (LID) strategies compliance via *Option 2: Natural Land Cover Conditions* is encouraged. Projects with limited setback distances from site boundaries, *Option 1: Percentile of Rainfall Events* is a more likely path to demonstrate compliance.

Projects are encouraged to evaluate integrated strategies that consider the use of rainwater to offset both indoor and outdoor potable water needs, in addition to LID strategies. Refer to the UBC Integrated Stormwater Management Plan for details on campus-wide management strategies, and ensure proposed site strategies are considered as part the Integrative Process and Site Assessment credits.

OKANAGAN RESOURCES

Appendix E – Okanagan Campus: Rainwater Infiltration Map

UBCO Integrated Rainwater Management Plan

UBCO Whole Systems Infrastructure Plan

Okanagan Campus Plan

USGBC LEED v4.1 Rainfall Events Calculator

Rainfall Events on Okanagan Campus

PERCENTILE	RAINFALL EVENT (MM 24H STORM)
90th	11.9
85th	9.7
80th	8.4
75th	7.6
70th	6.8

OKANAGAN GUIDANCE

As per the UBC Okanagan Campus Integrated Rainwater Management Plan, the campus is required to control and retain 100% rainwater on-site, and aims to improve hydrological and ecological conditions through responsible management of rainwater. Minimum rainwater retention targets have been established to achieve, at minimum, a "no-net impact" (or risk beyond current levels) to existing infrastructure. Refer to Appendix E Okanagan Campus: Rainwater Infiltration Map. Where opportunity exists, future projects and development are asked to stretch beyond this minimum standard and provide additional retention storage.

Where site boundaries can accommodate low impact development (LID) strategies, compliance via Option 2: Natural Land Cover Conditions is highly encouraged.

Projects are encouraged to evaluate integrated strategies that consider the use of rainwater to offset both indoor and outdoor potable water needs, in addition to LID strategies. Refer to the UBC Okanagan Campus Integrated Rainwater Management Plan for details on the campus-wide management strategies, and ensure proposed strategies are considered as part the Integrative Process, Site Assessment and Open Space credits.

Access the USGBC LEED v4.1 Rainfall Events Calculator to document management strategies and demonstrate compliance. The following tables provide rainfall data calculated from historical records for UBC Campuses. This data is made available for guidance and planning purposes; historical records should be accessed for the relevant 30-year period.

SS Credit:
Heat Island Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	2		2
Okanagan	2		

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1, Option 1: Nonroof and Roof to earn two points.

VANCOUVER RESOURCES

Vancouver Campus Plan Part 3 Design Guidelines Section 2.5.1 Paving

UBC Technical Guidelines: Division 32 – Vancouver Campus

OKANAGAN RESOURCES

UBC Okanagan Design Guidelines Section 2.2.2 Paving

UBC Technical Guidelines: Division 32 – Okanagan Campus

GUIDANCE

Project teams are encouraged to consider materials and strategies to reduce heat island effects early in the design process and avoid the use of dark, non-reflective surfaces. Light grey roofing products that meet the solar reflectance requirements are preferred over white-coloured products for easier maintenance.

Buchanan Courtyard, UBC Vancouver Campus

SS Credit: Light Pollution Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per LEED BD+C v4.1 by applying either Option 1 or Option 2 to earn one point.

VANCOUVER RESOURCES

UBC LEED v4 Implementation Guide

Vancouver Campus Plan Part 3 Design Guidelines Refer to Section 2.5.2 – Lighting

International Dark Sky Association Model Lighting Ordinance

VANCOUVER GUIDANCE

A revised Vancouver Campus: Lighting Zone Map is in progress. Until the new map is available, project teams should refer to the Lighting Zone Map in the UBC LEED v4 Implementation Guide, to identify the applicable Model Lighting Ordinance, Lighting Zone. In addition, refer to the Illuminance Hierarchy table and site plan in the Vancouver Campus Plan where required exterior lighting levels for each area of campus are described.

Note per the credit guidance that the lighting boundary may be expanded to include campus properties having the same or higher lighting zone that are contiguous to the project site.

OKANAGAN RESOURCES

Appendix F – Okanagan Campus: Light Zone Map

UBC Okanagan Campus Design Guidelines Refer to Section 6 Lighting

International Dark Sky Association Model Lighting Ordinance

OKANAGAN GUIDANCE

To determine the Uplighting and Light Trespass requirements for the project, teams should locate the project site on the UBC Lighting Zone Map in Appendix F, prepared to reflect the Model Lighting Ordinance, Lighting Zones across campus. In addition, refer to the Illuminance Hierarchy table and site plan in the Okanagan Campus Plan where required exterior lighting levels for each area of campus are described.

Note, per the credit guidance that the lighting boundary may be expanded to include campus properties having the same or higher lighting zone that are contiguous to the project site.

UBC Vancouver Campus

Credit Guidance

Water Efficiency

Prerequisite: Outdoor Water Use Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1.

VANCOUVER RESOURCES

UBC Technical Guidelines – Vancouver Campus – Section 32 80 00 Irrigation

UBC Technical Guidelines – Vancouver Campus – Section 22 11 00 Facility Water Distribution

UBC Water Action Plan

VANCOUVER GUIDANCE

The UBC Technical Guidelines – Vancouver Campus requires automatic irrigation and drought tolerant planting in all landscaped areas. Drip irrigation is prohibited on the Vancouver campus. Project teams are encouraged to consider high performance and efficient spray head systems. Drip irrigation may be acceptable in some circumstances; teams should propose it where appropriate and discuss with the relevant UBC project manager.

OKANAGAN RESOURCES

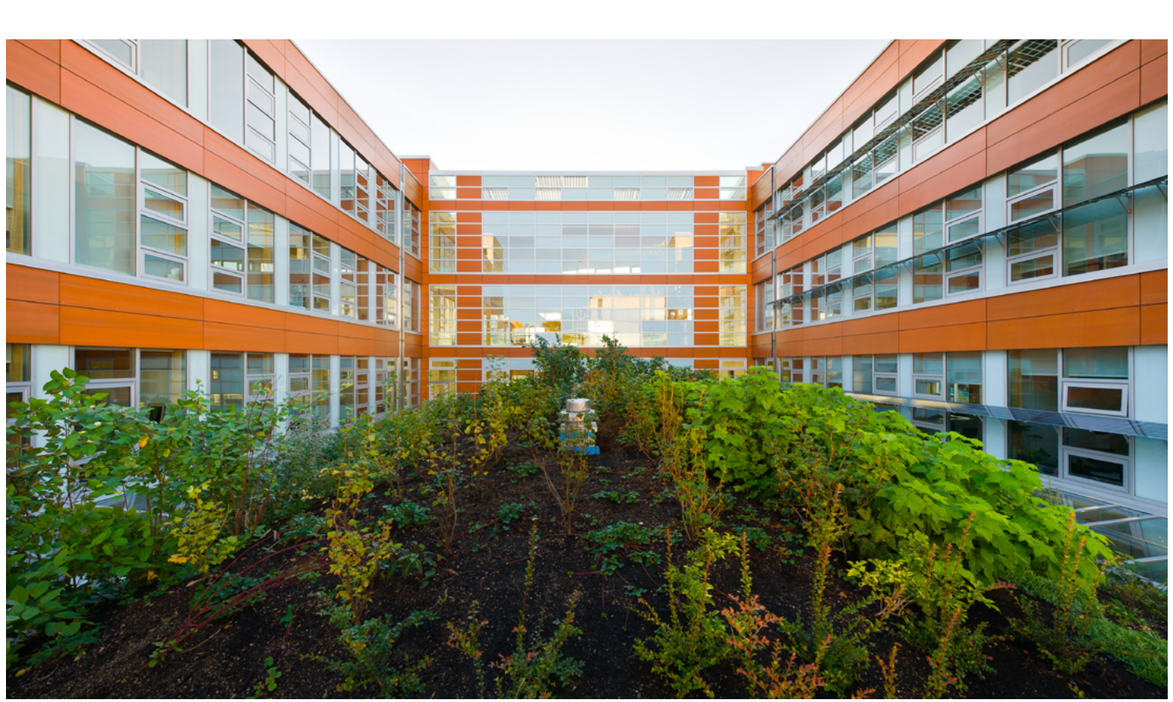
UBC Technical Guidelines – Okanagan Campus – Section 32 80 00 Irrigation

UBCO Campus Design Guidelines Section 2.3.1 Planting; Section 2.3.3. Irrigation

Whole Systems Infrastructure Plan

OKANAGAN GUIDANCE

Where irrigation is required, the UBC Technical Guidelines – Okanagan Campus require subsurface drip irrigation systems in combination with drought tolerant planting.



Centre for Interactive Research on Sustainability, UBC Vancouver Campus

Prerequisite: Indoor Water Use Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1.

RESOURCES

WaterSense Product Search

Maximum Performance (MaP) website.

UBC Technical Guidelines: Section 22 40 00 Plumbing Fixtures

UBC Water Action Plan

GUIDANCE

Low flow plumbing fixtures are preferred where appropriate and supported by UBC maintenance teams. Project teams are encouraged to consider strategies beyond fixture efficiency to reduce indoor water use.

WaterSense labelled fixtures can be challenging to source in Canada, project teams are encouraged to access the WaterSense product search website early to identify fixture options.

In addition to fixtures and fittings, LEED BD+C v4.1 includes minimum performance standards for some appliances and process water loads as per Table 2 and Table 3 of the prerequisite in the beta Reference Guide/online Credit Library. Project teams are encouraged to review and identify further opportunities for water use reduction by selecting efficient appliances such as *ENERGYSTAR* or equivalent standard, and by identifying building typologies or building spaces with unique process water loads. A water assessment is also required as part of the Integrated Process credit to assess early in the design process, specific loads from kitchens, laboratories, laundry, cooling towers, and other equipment demand volumes and reduction opportunities, as applicable.

Refer to the Integrative Process credit and the UBC Integrated Sustainability Process for related guidance.

Prerequisite: Building Level Water Metering

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1.

VANCOUVER RESOURCES

UBC Technical Guidelines – Vancouver Campus Section 01 92 00 Monitoring Based Commissioning;

UBC Technical Guidelines – Vancouver Campus Section 20 00 06 Meters

Vancouver Campus Plan – Design Guidelines

UBC Water Action Plan

OKANAGAN RESOURCES

UBC Technical Guidelines – Okanagan Campus Section 01 92 00 Monitoring Based Commissioning

Okanagan Campus Plan – Design Guidelines

GUIDANCE

Building level water metering, data collection, and reporting is aligned with UBC goals and performance targets. The UBC Water Action Plan and UBC Okanagan Whole Systems Infrastructure Plan support implementation of a comprehensive water metering and performance monitoring system to track individual buildings.

Project teams should refer to the Vancouver Campus Plan Design Guidelines (Part 3) Section 2.1 (i) and the UBC Monitoring Based Commissioning Requirements for both campuses, which require projects to include potable water metering to track water consumption for building and exterior landscape within the project scope.

WE Credit: Outdoor Water Use Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1, Option 2 Reduced Irrigation (30%) to earn at least one point.

VANCOUVER RESOURCES

UBC Technical Guidelines – Vancouver Campus Section 32 80 00 Irrigation; Section 22 11 00 Facility Water Distribution

UBC Water Action Plan

VANCOUVER GUIDANCE

The UBC Technical Guidelines – Vancouver Campus require drought tolerant planting and automatic irrigation in all landscaped areas. Drip irrigation is prohibited on the Vancouver campus. Project teams are encouraged to consider high performance and efficient spray head systems to maximize water savings accordingly. Drip irrigation may be acceptable in some circumstances; project teams should propose it where appropriate and discuss with the relevant UBC project managers.

Alternative water source systems, such as rainwater capture or "clear water waste", are another way to reduce potable water demand. To ensure any proposed systems are successful, project teams should:

- Consult the UBC Technical Guidelines – Vancouver Campus, Section 22 11 00 Facility Water Distribution, for applicability and specific design requirements, noting that these systems require a variance application to ensure the appropriate stakeholders are involved.
- Key elements that must be in place include design review by UBC, provisions for system commissioning, and approval of operations and maintenance plans including commitment of responsible parties and funding.

OKANAGAN RESOURCES

UBC Technical Guidelines – Okanagan Campus – Section 32 80 00 Irrigation

UBC Okanagan Campus Design Guidelines Section 2.3.1 Planting; and 2.3.3. Irrigation

Whole Systems Infrastructure Plan

OKANAGAN GUIDANCE

Potable water use reduction is a major priority for UBCO. Where irrigation is required, the UBC Technical Guidelines – Section 32 80 00 Okanagan Campus require subsurface drip irrigation systems in combination with drought tolerant planting.

Alternative water source systems such as rainwater capture are another way to reduce potable water demand. To ensure any proposed systems are successful, project teams should:

- Consult the UBC Technical Guidelines – Okanagan Campus, Section 22 11 00 Facility Water Distribution for applicability and specific design requirements, noting that these systems require a variance application to ensure the appropriate stakeholders are involved.
- Key elements that must be in place include design review by UBC, provisions for system commissioning, and approval of operations and maintenance plans including commitment of responsible parties and funding.

WE Credit: Indoor Water Use Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		4	6
Okanagan		4	

REQUIREMENTS

All projects are encouraged to demonstrate indoor water use reduction for at least four points (40% savings), or to the maximum extent possible.

RESOURCES

Maximum Performance (MaP)

UBC Technical Guidelines: Section 22 40 00 Plumbing Fixtures

UBC Technical Guidelines: Section 22 11 00 Facility Water Distribution

UBC Water Action Plan

Appendix A – UBC Integrated Design Process

GUIDANCE

Low flow plumbing fixtures are preferred where appropriate and supported by UBC maintenance teams. Project teams are encouraged to consider strategies beyond fixture efficiency to reduce indoor water use.

WaterSense labelled fixtures can be challenging to source in Canada, teams are encouraged to access the WaterSense product search website early to identify available fixture options.

Projects are urged to consider captured rainwater or "clear water waste" alternative sources and strategies to reduce potable water demand. To ensure any proposed systems are successful, project teams should do the following:

- Consult the UBC Technical Guidelines: Section 22 11 00 Facility Water Distribution, for applicability and specific design requirements, noting that these systems require a variance application to ensure the appropriate stakeholders are involved.
- Key elements that must be in place include design review by UBC, provisions for system commissioning, and approval of operations and maintenance plans including commitment of responsible parties and funding.

In addition to fixtures and fittings and non-potable sources, project teams are encouraged to review and identify further opportunities for water use reduction through selecting efficient appliances as per *ENERGYSTAR* or equivalent standard, and to identify building typologies or building spaces with specific process water loads. Teams are also encouraged to pursue water-related systems as part of the Integrative Process credit to assess specific loads (kitchens, laboratories, laundry, cooling towers, and other equipment as applicable) and consider design strategies for water use reduction. Teams should be aware that once-through (open loop) water cooling of equipment is a significant water use at UBC and is prohibited by the Technical Guidelines in new construction and renewal projects.

Refer to the Integrative Process credit and the UBC Integrated Sustainability Process for related guidance.

WE Credit: Optimize Process Water Use

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		2	2
Okanagan	1	1	

VANCOUVER REQUIREMENTS

All projects are encouraged to pursue two points as per the requirements of LEED BD+C v4.1.

VANCOUVER GUIDANCE

There is no district cooling system at the Vancouver campus. Applicability of this credit will depend on the building type and mechanical system approach for each project.

- Option 1 is available for projects with cooling towers or evaporative condensers.
- Option 2 is available only for certain project types where the ASHRAE 90.1-2016 baseline system per Appendix G includes a cooling tower.
- Option 3 is available for projects that use process water representing at least 10% of total building regulated water.

Water used for cooling is excluded in Option 3; Options 1 or 2 are more likely compliance paths for the building types where this credit applies.

OKANAGAN REQUIREMENTS

All projects are required to earn at least one point as per the requirements of LEED BD+C v4.1 via any compliance path.

RESOURCES

Appendix G – Okanagan Campus: Process Water Data

OKANAGAN GUIDANCE

UBC Okanagan's Low Temperature District Energy System (LDES) includes cooling towers for heat rejection and their performance qualifies for this credit. Projects connected to the district cooling system are eligible to pursue credit via any available option.

- Option 1 is available for projects based on the LDES cooling tower performance. Refer to UBCO's supporting data on LDES cooling tower performance for projects to use under Table 1 and/or Table 2 of Option 1. Refer to Appendix G Okanagan Campus: Process Water Data.
- Option 2 is available for projects not connected to the LDES and where the ASHRAE 90.1-2016 baseline system per Appendix G includes a cooling tower.
- Option 3 is available for projects that use process water representing at least 10% of total building regulated water.

WE Credit:
Water Metering

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must to comply as per the requirements of LEED BD+C v4.1.

VANCOUVER RESOURCES

UBC Technical Guidelines – Vancouver Campus Section 01 92 00 Monitoring Based Commissioning

UBC Technical Guidelines – Vancouver Campus Section 20 00 06 Meters

UBC Standard Drawings E4-6 and E4-6C

UBC Vancouver Campus Plan

UBC Water Action Plan

OKANAGAN RESOURCES

UBC Technical Guidelines – Okanagan Campus Section 01 92 00 Monitoring Based Commissioning

UBC Technical Guidelines – Okanagan Campus Section 20 00 06 Meters

UBC Okanagan Design Guidelines

GUIDANCE

Projects should focus metering on the most substantial end uses in buildings, such as domestic hot water. Projects with significant water process loads such as laboratories are encouraged consider a metering strategy early in the design process. UBC Technical Guidelines: Section 01 92 00 Monitoring Based Commissioning for both campuses require metering for irrigation. All meters must be compatible with the BMS for easy data retrieval. Refer to the Integrative Process credit and include considerations as part of the water-related analysis if pursued.

Biosciences Building, UBC Vancouver Campus

Bioenergy Research Demonstration Facility, UBC Vancouver Campus

Credit Guidance

Energy and Atmosphere

Prerequisite: Building-Level Energy Metering

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1.

GUIDANCE

UBC will provide a letter to verify UBC's commitment to share energy consumption data with the USGBC. Contact the Vancouver campus Green Building Manager or Okanagan campus Associate Director, Sustainability Operations.

Building energy meters.

EA Credit: **Enhanced Commissioning**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	4	2	6
Okanagan	4	2	

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1, Option 1, Path 2: Enhanced and Monitoring-Based Commissioning for a minimum of four points. Building enclosure commissioning is encouraged but not required.

VANCOUVER RESOURCES

UBC Technical Guidelines – Vancouver Campus – Section 01 91 00 Commissioning

UBC Technical Guidelines – Vancouver Campus – Section 01 92 00 Monitoring Based Commissioning

OKANAGAN RESOURCES

UBC Technical Guidelines – Okanagan Campus – Section 01 91 00 Commissioning

UBC Technical Guidelines – Okanagan Campus – Section 01 92 00 Monitoring Based Commissioning

GUIDANCE

A Commissioning Authority must be engaged before the completion of Design Development, and project teams are urged to consider the requirements of Fundamental Commissioning and Verification within the mandatory requirements of the Enhanced Commissioning credit. Teams are encouraged to develop a strong Basis of Design (BOD) document in response the Owners Project Requirements (OPR). Submit the BOD and OPR prior to Development Permit application, and the Commissioning and Measurement and Verification Plan prior to Building Permit application.

Project teams should refer to the UBC Technical Guidelines: Section 01 92 00 Monitoring Based Commissioning specific to the Vancouver or Okanagan campuses accordingly as well as the UBC Integrated Sustainability Process, Appendix A.

UBC Vancouver Campus Building Operations and Facilities Management

EA Credit: **Optimize Energy Performance**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	10	8	18
Okanagan	10	8	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide.

Projects teams must comply with the Prerequisite Minimum Energy Performance and the Optimize Energy Performance credit by applying *Option 1, Energy Performance Compliance to achieve ten or more points*.

In addition to the mandatory minimum LEED Energy Performance points, projects are required to meet mandatory UBC energy and GHG targets (TEUI, TEDI, GHGI) as per the project Design Brief. Note that different energy modeling methodologies are used to evaluate energy savings for LEED and the Design Brief energy targets.

UBC's Climate Action Plan (CAP) sets a target of 100% reduction in GHG emissions below 2007 levels by 2035. In support of this plan, natural gas shall not be used as the primary heating source in new and replacement air handling and space heating equipment. Natural gas may be used as a backup heating source at the unit where required to ensure heating requirements can be met.

The project's energy modeler should provide guidance to the project team on the number of Optimize Energy points likely to be achieved by meeting the UBC targets.

Points earned are based on the combined total performance of energy cost and greenhouse gas emissions reductions achieved relative to the Performance Cost Index percentage reduction for the building type.

Option 1

Energy Performance Compliance is the preferred pathway, as it aligns with UBC Green Building Action Plan and the Climate Ready Requirements for UBC Buildings. Pursuing Option 1 is required to count savings in the Renewable Energy and the Grid Harmonization credit.

Project teams may choose to follow EA Pilot ACP 143 which allows either ASHRAE 90.1 or NECB to be used as the reference energy code. Note that projects applying the pilot are evaluated based on energy consumption and greenhouse gas emissions. Projects that use NECB as the reference code must still comply with certain mandatory requirements.

District energy system (DES) modeling methodology, and guidance on how to account for DES carbon profiles and upstream equipment and distribution efficiencies, has not yet been published as part of the LEEDv4.1 Beta credit language. Until this direction becomes available project teams should consider using the LEED v4 methodology for DES modeling per Option 1, Path 2: Full accounting of DES upstream and downstream equipment. Project teams should confirm the approach used for DES modeling with GBCI Canada (via leedcoach@gbcicanada.ca) at the early stages of schematic design.

VANCOUVER RESOURCES

Appendix A – UBC Integrated Sustainability Process

Appendix H – Vancouver Campus: District Energy System Guidance and Utility Data

UBC Green Building Action Plan

UBC Climate Action Plan

UBC Climate Ready Requirements

UBC Technical Guidelines: Section 20 00 30 Thermal Comfort Requirements;

UBC Technical Guidelines: Section 20 00 05 Mechanical General Requirements; Section 23 05 00 HVAC – General Requirements

Alternative Compliance Paths for Canadian LEED Projects

UBC Energy Modelling Guideline (current version)

National Emissions Inventory Report

Provincial Greenhouse Gas Factors

Electricity Emission Intensity Factors for Grid-Connected Entities

VANCOUVER GUIDANCE

New buildings are required to connect to the Academic District Energy System for thermal heat unless a variance is granted. Connectivity requirements include building heating and may include domestic hot water heating. When heat pump systems are utilized, district energy shall be used for supplemental heat.

The Academic District Energy System on the Vancouver campus is supplied by a combination of three main fuel sources that will impact the number of energy points for any project required to connect:

- The *BRDF's biomass boilers* – the existing 6 MW and a new 12 MW thermal energy boilers run on wood waste and produce thermal energy. These serve as the primary energy source to the district energy system.
- The *BRDF's cogeneration unit* – a 2 MWe combined heat and power engine is fueled by a mix of natural gas and renewable natural gas (RNG). 2.4 MW of thermal energy is recovered from the engine which is also part of the base load.
- The *Campus Energy Centre (CEC)* – consists of three 15 MW high-efficiency hot water boilers fueled by natural gas for winter peak loads.

Projects that connect to the Academic District Energy System are encouraged to consider applying LEEDv4 *Option 1, Path 2: Full accounting of DES upstream and downstream equipment* to take full advantage of the UBC Academic District Energy System efficiencies and greenhouse gas emission contribution to maximize the number of available LEED points. Until DES modeling methodology is published for LEEDv4.1, project teams are advised to confirm the approach used with GBCI Canada (via leedcoach@gbcicanada.ca) at the early stages of schematic design.

Refer to Appendix H – Vancouver Campus: District Energy System Guidance and Utility Data for energy modeling inputs including DES system efficiencies, utility costs and calculated contributions from each fuel source for electrical and thermal energy production. Note that monthly variations in the DES greenhouse gas emission profiles must be accounted for. Project teams should contact UBC Energy and Water Services at the start of the project to confirm the most recent Appendix H data to apply to the project.

OKANAGAN RESOURCES

Appendix H – Okanagan Campus: District Energy System Guidance and Utility Data

Green Building Action Plan (2018)

UBC Okanagan Climate Action Plan 2030

UBC Technical Guidelines: Section 20 00 30 Thermal Comfort Requirements

UBC Climate Ready Requirements

Okanagan Whole Systems Infrastructure Plan (2016)

UBC Energy Modelling Guideline (current version)

National Emissions Inventory Report

Provincial Greenhouse Gas Factors

Electricity Emission Intensity Factors for Grid-Connected Entities

OKANAGAN GUIDANCE

UBC Okanagan's Whole Systems Infrastructure Plan (WSIP) sets climate adaptive guidelines along with a goal for net positive performance in both energy and carbon by 2050. UBCO district energy supply optimization, expansion, and decarbonization is in support of this goal.

There are two district energy networks at UBC Okanagan:

- The Low Temperature District Energy System (LDES) and
- The Medium Temperature District Energy System (MDES).

The LDES system is an ambient closed loop campus system that serves most of the academic buildings. Projects connecting into the LDES both extract and reject heat into the loop. The heating and cooling source for the LDES includes a combination of gas fired boilers, geo-exchange through aquifer HX, cooling towers, and HX with the MDES loop. The MDES system is supplied by heat from the central heating plant (CHP) which is fueled with gas-fired boilers.

Energy utility inputs, costs, and GHG factors for district provided heating and cooling will be provided by UBCO to the project team early in the project as part of the project's Design Brief and OPR.

To take full advantage of the District Energy System efficiencies and carbon profiles *LEEDv4 Option 1, Path 2: Full accounting of DES upstream and downstream equipment* may be advantageous for some projects depending on typology, load profiles and LDES/MDES connectivity requirements. Project teams are advised to evaluate compliance paths at the early stages of Schematic Design to determine the most advantageous compliance path for the project. Until the DES modeling methodology is published for LEEDv4.1, project teams should confirm the approach used for DES modeling with GBCI Canada (via leedcoach@gbcicanada.ca) at the early stages of schematic design.

Refer to Appendix H – Okanagan Campus: District Energy System Guidance and Utility Data

EA Credit: Advanced Energy Metering

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per the requirements LEED BD+C v4.1 Reference Guide.

RESOURCES

UBC Technical Guidelines: Vancouver and Okanagan – Section 01 92 00 Monitoring Based Commissioning

VANCOUVER GUIDANCE

Project teams should reference the UBC Technical Guidelines Section 01 92 00 Monitoring Based Commissioning to inform and align the metering strategy. During the design process, project teams are urged to engage UBC Energy and Water Services or Student Housing and Community Services to develop a monitoring strategy and meaningful data reporting protocol to maximize opportunities for energy and water savings and provide operator feedback.

OKANAGAN GUIDANCE

During the design process, project teams are urged to engage UBCO Facilities Management, Energy Team and Student Housing and Hospitality Services, to develop a monitoring strategy and operational data reporting protocol to maximize opportunities for operator feedback.

Meter reading

EA Credit: Grid Harmonization

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		2
Okanagan	1		

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide.

Projects teams are required to earn at least one point as per the requirements of LEED BD+C v4.1, *Case 2: Demand Response Capable Building or Case 3: Load Flexibility and Management Strategies*. Teams should consider implementing demand response, load shedding and peak management strategies to achieve at least one point.

Case 1: Demand Response Program Participation is unavailable as demand response programs are currently not offered by the utility providers in Vancouver or Kelowna.

RESOURCES

UBC Technical Guidelines - Vancouver/ Okanagan Campuses: Section 01 92 00 Monitoring Based Commissioning

GUIDANCE

Demand response capable buildings and load flexibility and management is a priority for UBC to implement on projects for effective building operation. Project teams are encouraged to consider the requirements of this credit early in design to support future opportunities to align with a fully automated demand response program. Teams are urged to coordinate their approach with UBC Energy & Water Services (Vancouver) and Energy Management Team (Okanagan) to facilitate alignment with UBC operational requirements and for projects connected to DES system align approach with available data.

UBC is not currently participating in a demand response contract with BC Hydro or Fortis BC, making Case 1 unavailable to projects. However, both campuses are implementing strategies on the building side in new projects.

Case 2 is based on developing a plan to shed at least 10% of the annual on-peak electricity demand (based on the energy modeling done as part of the Optimized Energy Credit). The demand response system programming must be tested to effectively reduce demand as required by the LEED credit and commissioned as part of the Commissioning Authority's scope of work. Be aware that UBC is a major research university and any demand response programming must not adversely impact research, and curtailment must not target critical research equipment.

Case 3 is based on adopting at least one of listed load flexibility and management strategies:

- Peak Load Optimization
- Flexible Operating Scenarios
- On-site Thermal and/or Electricity Storage
- Grid Resilience Technologies

Note: Fossil fuel fired backup generators or co-generation is not eligible as strategy. If a portion of the fuel mix is renewable natural gas (RNG) and remaining is natural gas in co-generation, this would be not eligible.

Note: When a project is connected to the District Energy System and efficiency is claimed for the DES in the *Optimized Energy Performance* credit, the modeled DES demand must be included. Grid harmonization strategies applied to the DES may be used to document achievement at the building level. In this case, the interval recording and building automation system communications may be located in the DES and not in the building. Project teams pursuing this option are advised to contact UBC Energy & Water Services (Vancouver) or the Energy Team (Okanagan) for information.

EA Credit: Renewable Energy

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	5
Okanagan		1	

REQUIREMENTS

All projects are encouraged to earn one point where feasible. Teams should consider the credit early in the design process. If credit is pursued, projects should produce life cycle costing and demonstrate the business case as part of the UBC Integrated Sustainability Process, Appendix A.

RESOURCES

Appendix H – Okanagan Campus: District Energy System Guidance and Utility Data

UBC Climate Action Plan

Alternative Compliance Paths for Canadian LEED Projects

National Emissions Inventory Report

Provincial Greenhouse Gas Factors

Electricity Emission Intensity Factors for Grid-Connected Entities

VANCOUVER GUIDANCE

Refer to project Design Briefs for building specific renewable energy requirements.

LEED v4.1 does not define biomass as a renewable energy source unless harvested within the campus boundary. As such, the renewable energy contribution from the Academic District Energy System will not contribute. It is recommended that project teams investigate updates or pilot paths associated with biomass treatment for this credit as it applies to renewable energy systems.

OKANAGAN GUIDANCE

Refer to project Design Briefs for building specific renewable energy requirements.

LEED v4.1 does not define geothermal energy that uses a heat pump as a renewable energy source, as such, there is no renewable energy contribution from the Low Temperature District Energy System (LDES).

EA Credit: Enhanced Refrigerant Management

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide.

GUIDANCE

Projects must comply with Option 1 or Option 2.

Option 2 is the most likely compliance path for projects on both campuses, as most will have cooling or heat pump equipment. Project teams are encouraged to select preferred equipment early to confirm compatible refrigerant types. Perform calculations early in the design process to confirm the total refrigerant charge meets the credit requirements and verify calculations if different equipment is selected at later stages in the project.

If equipment is selected with a novel refrigerant, such as CO_2 heat pumps or high temperature heat pumps using R1234ze, project teams are advised to coordinate with UBC Building Operations.

Skeena Residence, UBC Okanagan Campus

Credit Guidance

Materials and Resources

Prerequisite: Storage and Collection of Recyclables

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide.

VANCOUVER RESOURCES

Recycling Infrastructure Guidelines for UBC Buildings

UBC Recycling Programs including batteries, e-waste and light bulbs

Zero Waste Action Plan (2014)

UBC Technical Guidelines: Section 11 82 00 Waste Handling Equipment

VANCOUVER GUIDANCE

Teams are required to consult the Recycling Infrastructure Guidelines for UBC Buildings to ensure waste stream receptacles are sized and placed as required. Campus collection strategies are in place for mercury containing lamps, batteries, and electronic waste through UBC Risk Management and UBC Building Operations. Refer to the UBC Technical Guidelines – Vancouver Campus Section 11 82 00 Waste Handling Equipment for waste storage and enclosure details.

OKANAGAN RESOURCES

Recycling Infrastructure Guidelines for UBC Buildings

UBC Okanagan Waste & Recycling Programs (all)

E- Waste and Battery Recycling

UBC Technical Guidelines: Section 11 82 00 Waste Handling Equipment

OKANAGAN GUIDANCE

Teams are required to follow the Recycling Infrastructure Guidelines for UBC Buildings to ensure waste storage and space provisions are met. Campus collection for small and large e-waste are provided by Health, Safety and Environment and Facilities Management. Note that academic projects on the Okanagan campus are required to include pink e-waste collection tubes for removal of battery e-waste. Refer to the UBC Technical Guidelines: Section 11 82 00 Waste Handling Equipment for waste storage and enclosure details. Project teams are encouraged to confirm the design strategy early and liaise with the Campus Planning and Facilities Management office for campus specific direction.

MR Credit: Building Life Cycle Impact Reduction

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	3	2	5
Okanagan	3	2	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide, by applying Option 2 – Path 3: Whole-Building Life-Cycle Assessment to earn at least three points. Where applicable projects are encouraged to pursue Path 4. Projects should follow the UBC Whole Building Life Cycle Assessment Guidelines included in Appendix I.

Major renovations may comply by applying Option 1 – Building and Material Reuse to earn up to 5 points. If materials forming part of the building envelope are proposed to be reused, project teams should contact UBC Building Operations to understand any maintenance implications.

RESOURCES

Appendix A – UBC Integrated Sustainability Process

Appendix I – UBC Whole Building Life Cycle Assessment Guidelines

UBC Embodied Carbon Pilot – Study of whole building life cycle assessment process at UBC (June 2021)

GUIDANCE

Project teams are encouraged to identify a specialist within the existing project team or a specialist consultant, to facilitate the LCA early in the design process and align this effort with the Integrative Process credit as applicable.

Projects should follow the UBC Whole Building Life Cycle Assessment Guidelines and the UBC LCA Step by Step guidance document included in Appendix I. An early LCA study is required before the Development Permit application, to help inform low carbon design, and a final LCA is required prior to occupancy to evaluate the final design.

MR Credit: Building Product Disclosure and Optimization (BPDO) – Environmental Product Declarations

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide, to earn at least one point. Teams are encouraged to pursue an additional point.

RESOURCES

USGBC BPDO Calculator

International Standard Organization

UBC Green Building Action Plan, Materials & Resources

GUIDANCE

UBC has prioritized materials that are third party certified for optimized life cycle impact as part of the Green Building Action Plan.

Project teams should carefully consider material attributes early in the design process and are encouraged to contact manufacturers and suppliers to request information and verification documentation for both attributes required by Option 1 and Option 2 where it is not already available, to help advocate for transparent and verified material attribute reporting.

MR Credit: Building Product Disclosure and Optimization (BPDO) – Sourcing of Raw Materials

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide, to earn at least one point. Teams are encouraged to pursue an additional point.

RESOURCES

FSC Canada

Sustainable Agriculture Network

The Rainforest Alliance

UBC Technical Guidelines: Section 09 00 10 Finishes – General Requirements

USGBC BPDO Calculator

UBC Green Building Action Plan, Materials & Resources

GUIDANCE

UBC has prioritized the following material qualities as part of the Technical Guidelines for Sustainability:

- Reused or salvaged materials or equipment
- Materials that are certified as having an optimized life cycle impact by a third party
- Materials with recycled and recyclable content
- Materials that are appropriately and responsibly sourced
- Bio-based materials
- Wood

Project teams should carefully consider material attributes early in the design process and are encouraged to contact manufacturers and suppliers to request information and verification documentation where it is not already available, to help advocate for transparent and verified material attribute reporting.

Earth Sciences Building, UBC Vancouver Campus

MR Credit: Building Product Disclosure and Optimization (BPDO) – Material Ingredients

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide, to earn at least one point. Teams are encouraged to pursue an additional point.

GUIDANCE

Supporting and advocating for healthy building materials and transparency is high priority for UBC. Project teams are encouraged to contact suppliers and manufacturers of products to request required documentation where it is not already available, to help advocate for verified material ingredient and attribute reporting.

RESOURCES

USGBC BPDO Calculator

International Standards Organization

UBC Green Building Action Plan, Materials & Resources

MR Credit: Construction and Demolition Waste Management

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide, Option 1: Diversion to earn one point. While the credit will be earned by demonstrating 50% of waste diversion, the UBC Technical Requirements require a minimum of 75% waste diversion, and the UBC Green Building Action Plan sets a goal of 100% construction waste diversion by 2035.

Projects are encouraged to pursue compliance via Option 2: Waste Prevention for an additional point.

GUIDANCE

Refer to the UBC Technical Guidelines and the UBC Waste Requirements for Green Buildings for direction on preparing a Construction Waste Management Plan. Project teams are advised to ensure the management plan includes a robust and regular ongoing reporting protocol during construction to support the most successful process and highest diversion rates.

RESOURCES

UBC Technical Guidelines: Section 01 74 19 Construction Waste Management and Disposal (Vancouver and Okanagan)

UBC Vancouver Waste Requirements for Green Buildings

UBC Okanagan Waste Requirements for Green Buildings

Zero Waste Action Plan (2014)

UBC Green Building Action Plan Materials & Resources

The Commons, UBC Okanagan Campus

Credit Guidance

Indoor Environmental Quality

Prerequisite: Minimum Indoor Air Quality Performance

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

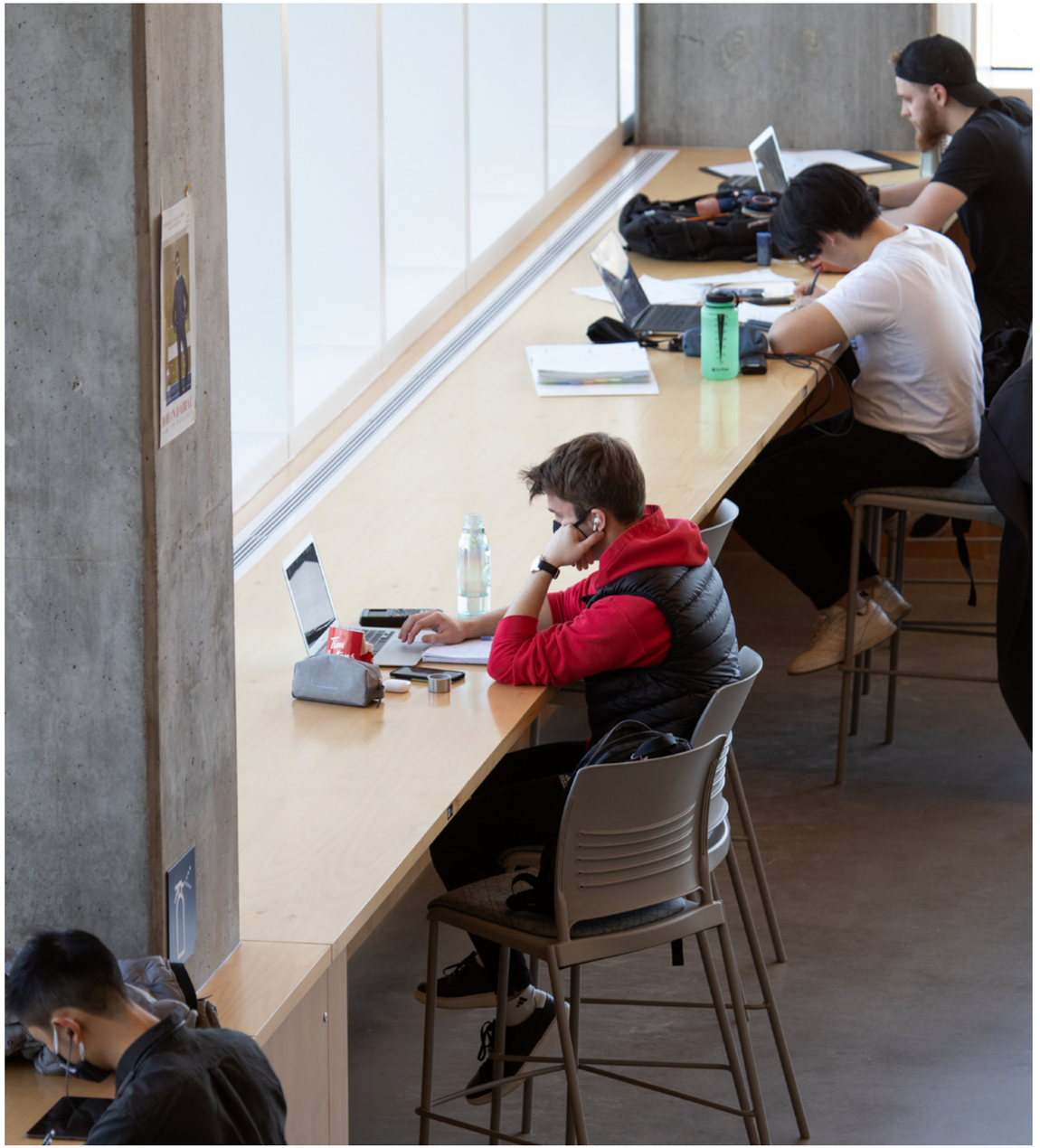
REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1.

VANCOUVER GUIDANCE

Local code (BCBC 2018) references ASHRAE 62-2001 for minimum outdoor air ventilation rates. LEEDv4.1 requires compliance with ASHRAE 62.1-2016. Project teams pursuing LEED certification are required to comply with both ventilation standards. Calculations should be completed early during the design process to confirm compliance with the most stringent ventilation rates.

The comparison should identify to what extent the total building ventilation rate will exceed either standard. This information is important to evaluate the impact on the building energy performance per Optimized Energy Credit as well as for UBC Energy targets (TEUI, TEDI, GHGI).



The Commons, UBC Okanagan Campus

Prerequisite: Environmental Tobacco Smoke Control

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver			Required
Okanagan			

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1.

RESOURCES

UBC Health & Safety

UBC Repository of Board of Governors Policies, Procedures, Rules, and Guidelines

UBC Okanagan Smoking Guidance

VANCOUVER GUIDANCE

Project teams are advised that UBC Policy No SC2 – Smoking and Vaping prohibits smoking of any kind, including vaping and cannabis, within eight meters from any doorway or building air intake, such as an openable window or air vent.

Signage indicating that smoking is not allowed within eight meters must be funded and installed as part of the project scope and budget.

OKANAGAN GUIDANCE

Project teams are advised that UBC Okanagan Policy prohibits smoking of any kind, including vaping anywhere on campus. Smoking cannabis is permitted in designated gazebos only.

Signage indicating that smoking is not allowed within eight meters must be funded and installed as part of the project scope and budget.

IEQ Credit: Enhanced Indoor Air Quality Strategies

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1, by employing at least 3 of the 10 Indoor Air Quality strategies outlined, to earn one point. Teams are encouraged to implement an additional three strategies to earn one additional point.

RESOURCES

UBC Technical Guidelines: Section 09 00 10 Finishes – General Requirements (Entry Way Systems); Section 23 30 00 Air Systems Ductwork And Equipment (Filtration Of Outdoor Air)

GUIDANCE

Applicable strategies should be prioritized according to the project context, building type, operations and maintenance needs, and occupancy.

Note that the UBC Technical Guidelines – Vancouver and Okanagan Section 23 30 00 require MERV 13 filtration on central air handling unit equipment and installation of institutional-grade entry mats in all entries to reduce cleaning, and to provide sufficient non-slip surfaces at entrances. Recessed mat systems may be considered depending on the style and maintenance requirements. Project teams are encouraged to seek approval in advance for proposed recessed entry way systems from the relevant UBC project manager.

IEQ Credit: Low Emitting Materials

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	2	1	3
Okanagan	2	1	

REQUIREMENTS

All projects must comply as per the requirements of the LEED BD+C v4.1 Reference Guide, to earn at least two points. Teams are encouraged pursue additional product categories to earn an additional point.

RESOURCES

South Coast Air Quality Management District

UBC Green Building Action Plan Materials & Resources (page 53)

UBC Technical Guidelines:
Section 09 00 10 Finishes – General Requirements;
Section 09 21 16 Gypsum Board Assemblies;
Section 09 65 00 Resilient Flooring;
Section 09 68 00 Carpet;
Section 09 90 00 Painting and Coating;
Section 07 92 00 Joint Sealants

GUIDANCE

Material health and transparency is a high priority for UBC, and project teams are urged to consider the lowest emitting materials available across all product categories, and to advocate to manufacturers and suppliers where more information is required or better performing materials are needed.

Teams may find that documenting compliance with Flooring, Ceiling, and Insulation product categories more efficient given the number of products specified and installed are typically fewer per project. Compliant products within the Paints and Coatings category are generally widely available, although where fireproofing and intumescent coatings are required, compliant products may be more difficult to source.

IEQ Credit: Construction Indoor Air Quality Management Plan

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1		1
Okanagan	1		

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1

RESOURCES

Sheet Metal and Air-Conditioning National Contractors Association IAQ Guidelines for Occupied Buildings Under Construction

GUIDANCE

Teams are encouraged to collaborate with the project general contractor to draft a Construction IAQ plan that addresses each category of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings. Teams are encouraged to include a review of each measure as part of regular site visits to ensure implementation is robust throughout the construction period.

IEQ Credit: Indoor Air Quality Assessment

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	1	1	2
Okanagan	1	1	

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1 to earn at least one point via Option 1: Flush-Out OR Option 2: Air Testing.

GUIDANCE

Project schedules may pose challenges or limitations on complying with Option 1, making Option 2 more attractive in some cases.

Note that testing costs vary depending on the size of the building, the number of samples tested, and the travel and fieldwork required of the testing agent. Teams are urged to liaise with the testing agent to determine the most applicable testing standard in advance. In the event of a discrepancy between air testing standards, the more stringent standard is to be used.

IEQ Credit: Thermal Comfort

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	1
Okanagan		1	

REQUIREMENTS

Projects employing mechanical cooling are strongly encouraged to comply as per the requirements of LEED BD+C v4.1.

RESOURCES

UBC Climate Ready Requirements

UBC Technical Guidelines – Vancouver Campus, Section 20 00 30 Indoor Thermal Environment

UBC Technical Guidelines – Okanagan Campus, Section 20 00 30 Indoor Thermal Environment

GUIDANCE

Projects are required to meet requirements for both thermal comfort design and thermal comfort control to earn this credit.

While naturally ventilated and passively cooled buildings may be unable to comply with this credit given the climate, The UBC Climate Ready Requirements require design to reflect 2050 climate conditions, making mechanical cooling a more likely solution. This should be verified and confirmed by project teams to ensure thermal comfort for the 2050's is considered.

In addition, the UBC Technical Guidelines: Section 20 00 30 Indoor Thermal Environment offer more flexibility than ASHRAE 55 in terms of allowing temperatures to exceed the limits for short periods and sets specific maximum temperatures in certain space types; if mechanical cooling is not provided, a thermal comfort model is mandatory to demonstrate compliance.

For buildings employing a mixed mode ventilation strategy project teams are urged to use the energy model to verify occupant comfort. This approach is strongly recommended to limit cooling equipment runtime and energy consumption. The costs and benefits of various control options should be analyzed to identify the optimal approach to operable windows.

IEQ Credit: **Interior Lighting**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	2
Okanagan		1	

REQUIREMENTS

All projects are encouraged to comply as per the requirements of LEED BD+C v4.1 by pursuing any available option to achieve at least one point.

RESOURCES

USGBC Interior Lighting Calculator

GUIDANCE

Option 3: Lighting control is closely aligned with ASHRAE requirements, making it a likely path for compliance for most projects.

IEQ Credit: **Daylight**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver		1	3
Okanagan		1	

REQUIREMENTS

All projects are encouraged to comply as per the requirements of LEED BD+C v4.1 by pursuing any available option to achieve at least one point.

RESOURCES

Green Building Action Plan (2018) refer to Health & Wellbeing component area (page 57)

GUIDANCE

Project teams are encouraged to consider building orientation, window to wall ratio and daylight early in the design process. While the credit is not mandatory, it is strongly aligned with UBC's Green Building Action Plan and offers good synergy with interior lighting and energy performance credits.

Teams are encouraged to use daylight simulation and analysis tools that facilitate credit achievement and help provide occupants with measurable improvements in daylighting.

Need Caption

Credit Guidance

Innovation and Design

Prerequisite: **Innovation**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	6		6
Okanagan	6		

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1 to earn the maximum of six available Innovation points. Any combination of strategies from the LEED Innovation Catalogue or Pilot Credit Library is allowed.

RESOURCES

USGBC Innovation Catalogue

USGBC Pilot Credit Library

UBC Bird Friendly Design Guidelines

Vancouver Campus Green Building Tours

Okanagan Campus Sustainability Tours

Vancouver Campus Green Cleaning Program

Okanagan Campus Green Cleaning Program

GUIDANCE

Projects on both campuses may wish to consider implementing one or both of the following strategies where applicable, to make use of existing, aligned initiatives:

- Green Building Education

  Specific program elements may be proposed at the discretion of each team. Projects may be eligible to be included as part of the Green Building Tours (educational guided tours), offered at both campuses. Tour scripts and case studies are to be developed in coordination with the Green Building Manager (Vancouver) or Associate Director Sustainability Operations (Okanagan). Teams are required to draft and develop program elements according to the requirements of the credit and generate relevant documentation for submission. Refer to Vancouver Campus Green Building Tours and Okanagan Campus Sustainability Tours pages for reference.

- O+M Starter Kit

  The relevant operations and maintenance policies for Green Cleaning and Pest Management are in place at both the Vancouver and Okanagan campuses. Project teams are encouraged to review websites and contact UBC Building Operations for guidance. Project teams are required to draft and develop program elements according to the requirements of the credit and generate relevant documentation for submission. Refer to the Vancouver Campus Green Cleaning Program and contact UBCO Facilities Management for Okanagan Campus Green Cleaning documents.

Project teams are further encouraged to pursue the following Pilot Credits which align with UBC priorities and programs:

- Bird Collision Deterrence
- Design for Enhanced Resilience
- Assess and Increase Onsite Carbon Sequestration through Plantings

Reference the USGBC Innovation Catalogue to identify other appropriate and available Innovation credits early in the design process.

Beatty Biodiversity Centre Bioswale, UBC Vancouver Campus

Credit Guidance

Regional Priority

RP Credit: **Regional Priority**

CAMPUS	MANDATORY	PRIORITY	AVAILABLE
Vancouver	4		4
Okanagan	4		

REQUIREMENTS

All projects must comply as per the requirements of LEED BD+C v4.1 to earn the maximum of four points from the four available Regional Priority Credits.

RESOURCES

USGBC Regional Priority Credits

VANCOUVER GUIDANCE

Regional Priority Credits identified in the LEED v4.1 Regional Priority Credit Library for the Vancouver Campus include:

- SS Rainwater Management (point threshold: 2)
- WE Outdoor Water Use Reduction (point threshold: 2)
- WE Indoor Water Use Reduction (point threshold: 4)
- EA Optimize Energy Performance (point threshold: 10)
- EA Enhanced Commissioning (point threshold: 5)
- MR Building Life Cycle Impact Reduction (point threshold: 3)

Based on the mandatory credit requirements for base credits, all projects can expect to earn the following:

- Regional Priority – SS Rainwater Management
- Regional Priority – EA Optimize Energy Performance
- Regional Priority – MR Building Life-Cycle Impact Reduction

At least one additional Regional Priority credit must be earned from the remaining options:

- WE Outdoor Water Use Reduction (1 point mandatory base credit)
- EA Enhanced Commissioning (4 points mandatory base credit)

OKANAGAN GUIDANCE

Regional Priority Credits identified in the LEED v4.1 Regional Priority Credit Library for the Okanagan Campus include:

- LT Surrounding Density and Diverse Uses (point threshold: 3)
- LT Access to Quality Transit (point threshold: 3)
- SS Light Pollution Reduction (point threshold:1)
- WE Indoor Water Use Reduction (point threshold: 4)
- EA Optimize Energy Performance (point threshold: 10)
- MR Building Life Cycle Impact Reduction (point threshold: 3)

Based on the mandatory credit requirements for base credits, all projects can expect to earn the following:

- Regional Priority – SS Light Pollution Reduction
- Regional Priority – EA Optimize Energy Performance
- Regional Priority – MR Building Life-Cycle Impact Reduction

At least one additional Regional Priority credit must be earned from the remaining options:

- LT Surrounding Density and Diverse Uses (2 points mandatory base credit)
- LT Access to Quality Transit (2 points mandatory base credit)
- WE Indoor Water Use Reduction (3 points mandatory base credit)

Appendix Index

Appendix A

UBC Integrated Sustainability Process (February 2022)

UBC Integrated Sustainability Process

Steps

1A Design Brief Development

Staff develops Design Brief including sustainability goals

1B Design Brief Review

Design team assesses Design Brief

2 Sustainability Workshops

Sustainability Workshop 1 IDEAS
Analyze information and explore ideas

Sustainability Workshop 2 TECHNICAL
Investigate design strategies to meet Design Brief Goals

Sustainability Workshop 3 FINAL
Interactive energy modelling

3 Sustainability Reporting

Report on sustainability goals

4 Report Performance

Post occupancy evaluation: lessons learned for future projects

UBC Development Process

UBC reviews project need and sustainability opportunities

Pre Design

Executive 1, 2 and 3 approvals

UBC Board 1 approval: Project approved in principle: site, capital and operating budget etc

Architect hired

Schematic Design

Landscape architect hired

Other consultants hired

Pre-Application Meeting

Design Development

Development permit process: Advisory Urban Design Panel preliminary, Development Review Committee, Public Open House, Advisory Urban Design Panel final

UBC Board 2 approval: Capital and operating budgets, program, schedule, DP

Development Permit

Construction Documentation

Tender process

UBC Board 3 approval: final budget, program, schedule, award of construction contract

Building Permit

Construction

Construction

Substantial Completion & Post Construction

Occupancy Permit

Occupancy

Occupancy

UBC Board 4 information: project completion

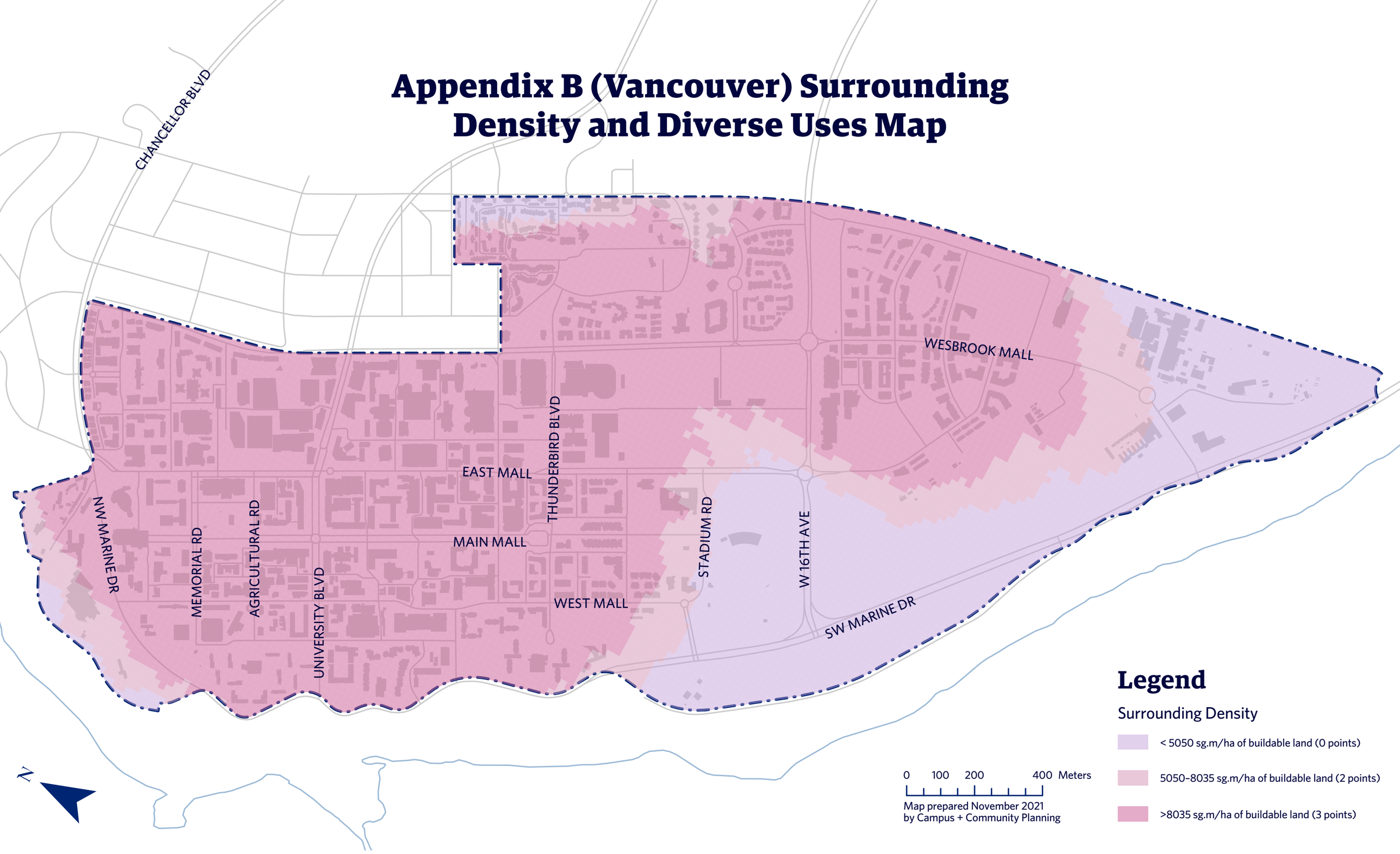
UBC INTEGRATED SUSTAINABILITY PROCESS - Major Capital Projects (updated February 2022)

Phase	Step	Responsibility	Description	Prerequisites	Deliverables	Participants
Pre-Design	**Step 1A:** **Design Brief Development**	C&CP	• Staff develops a guiding framework and a set of design goals and strategies, reflecting the particular project challenges and opportunities • Preliminary site analysis, orientation and massing study completed by staff	Stakeholder engagement	Design Brief (including: the project vision, urban design framework, green building requirements etc) reflecting the design aspirations of stakeholder groups	UBC stakeholders
	Board 1					
	Step 1B: **Design Brief Review**	Design Team	• Design Teams to assess and analyse the Design Brief and seek clarification of goals • Site visit occurs for architect and landscape architect	• Design brief prepared • Architect selected • Preliminary Owner's Project Requirements	Comprehensive understanding of the Design Brief document	UBC stakeholders and Design Team
Schematic Design	**Step 2:** **Sustainability Workshop 1** **IDEAS**	Organized by: Design Team	• The first workshop is a facilitated meeting which provides, using the design brief as a basis, a focus on site conditions, building massing & orientation, building materials, envelope attributes, sustainable energy and water systems, operational parameters and climate resiliency • Explore ideas for the project based on the Design Brief goals as well as UBC's GBAP goals, targets and vision	• **Schedule early enough in schematic design to inform massing decisions and encourage "out of the box" thinking** • Team's initial information analysis complete • Preliminary identification of dominant energy loads and indoor, outdoor, and process water demand • Owner's Project Requirements received	• With input from the entire design team, ideas are discussed which meet the Design Brief goals • Additional net positive design possibilities identified which align with UBC policies and GBAP vision • Passive design and synergies considered • Design options identified to be considered for LCA1 evaluation • LEED: preliminary scorecard, LEED certification level variance requested if applicable	• Key design team members • Key UBC stakeholders • Project Manager
	AUDP Pre-application					
	Step 2: **Sustainability Workshop 2** **TECHNICAL**	Organized by: Design Team	• The second workshop is a facilitated meeting which investigates design strategy synergies that will meet the goals set out in the Design Brief • Preliminary energy/ carbon and water budget analysis are presented to verify targets, performance benchmarks, and potential strategies to achieve project goals • Explore synergies among systems and components.	• **Schedule with AUDP pre-application meeting during schematic design** • Completed preliminary LCA1 • Preliminary energy analysis complete • Review AUDP comments on sustainable outcomes	• Agreement on specific targets for each Design Brief goal • Conceptual building envelope design defined • Design strategies to address climate readiness identified • Preliminary energy performance analysis submitted • LCA informs structural and/or envelope system selection • Low carbon energy systems options defined for life cycle costing • Approach to bird friendly design identified • LEED: updated LEED scorecard	• Key design team members • Key UBC stakeholders • Project Manager
	Development Permit Process: Advisory Urban Design Panel (AUDP), Development Review Committee (DRC), public open house					
	Board 2					
	Development Permit (DP)					
Design Development	**Step 2:** **Sustainability Workshop 3** **FINAL**	Organized by: Design Team	• The final workshop is a facilitated meeting which uses **interactive energy modeling** to evaluate the trade-offs between carbon/energy performance, life cycle cost and system complexity. • Review potential energy/carbon reduction strategies to inform and refine energy system and envelope design relative to life cycle costs.	• **Schedule at the end of design development** • Energy model complete	• Consensus on carbon reduction, energy conservation and climate ready measures • Energy model report (include GHGI for emissions factors at DP) Life cycle costing for low carbon energy system options • Energy and GHGI targets finalized • LEED: updated LEED scorecard, credit variance requests, LEED Online Project Registration number	• Key design team members • Key UBC stakeholders • Project Manager
Construction Documents	**Step 3:** **Sustainability Reporting**	Design Team	Report on the cross cutting strategies used to achieve performance and process targets for each Design Brief goal and any additional strategies identified during the design process which align with UBC policies.	Submit before BP	• Meeting minutes and presentations from workshops 1,2 and 3 • LEED score card and credit variances • Final energy model (include appendix showing GHGI using current emissions factors) **Note: Submit prior to occupancy:** • Measurement and Verification (M&V) plan • Commissioning (Cx) Plan • LCA2 report and submittals	Design Team
	Board 3					
	Building Permit (BP)					
Construction/ Occupancy	**Step 4:** **Report Performance**	ID	UBC Staff to report broad outcomes from the project for inclusion in the Board 4 meeting minutes and for consideration by the Better Building Committee. Includes LEED status and energy/carbon metrics performance.	1 year of performance records available	• Feedback to inform future projects • Selected outcomes included in Board 4 report	UBC stakeholders
	Board 4					

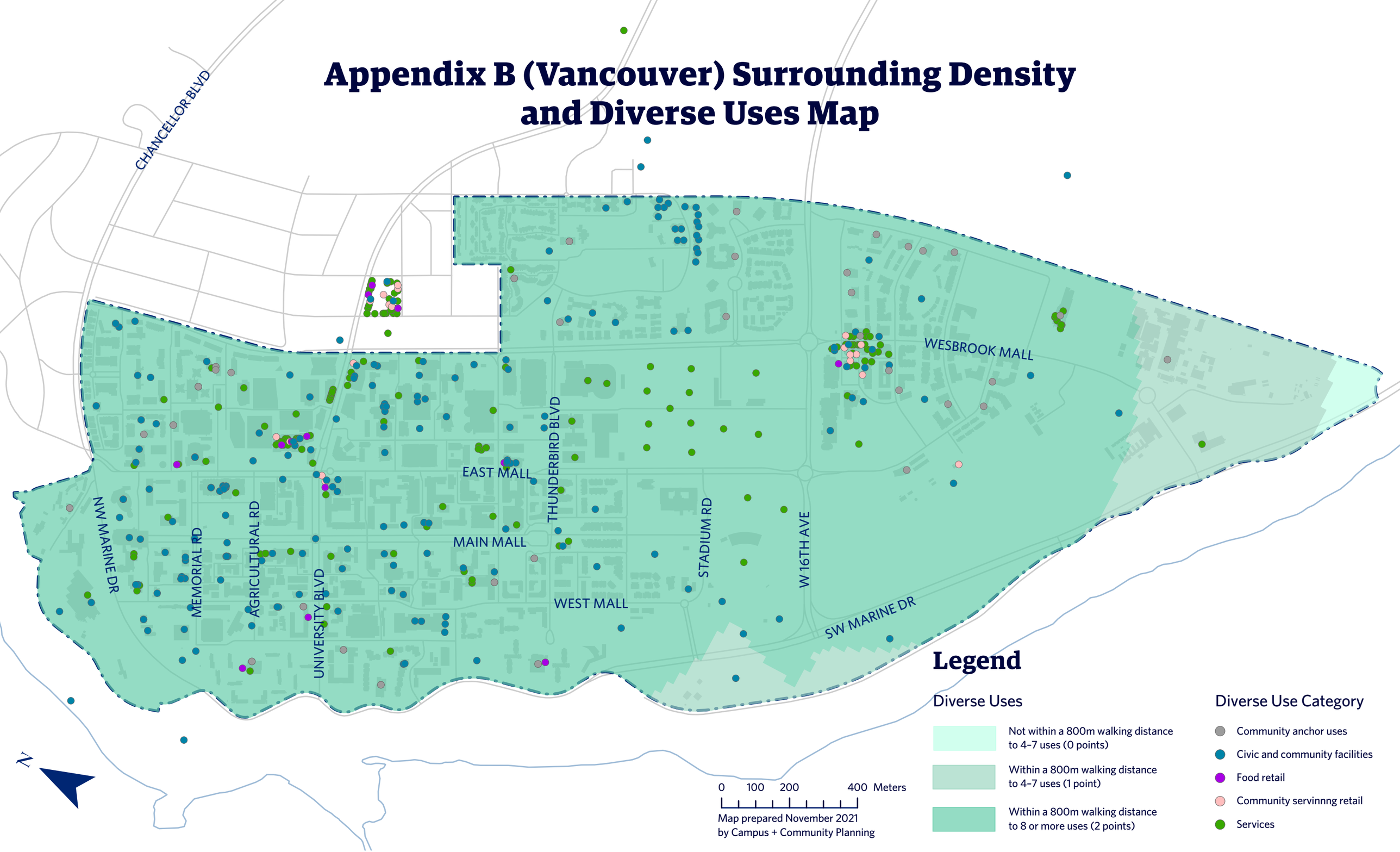
Appendix B

Surrounding Density And Diverse Uses Maps

Appendix B (Vancouver) Surrounding Density and Diverse Uses Map



Appendix B (Vancouver) Surrounding Density and Diverse Uses Map



Legend

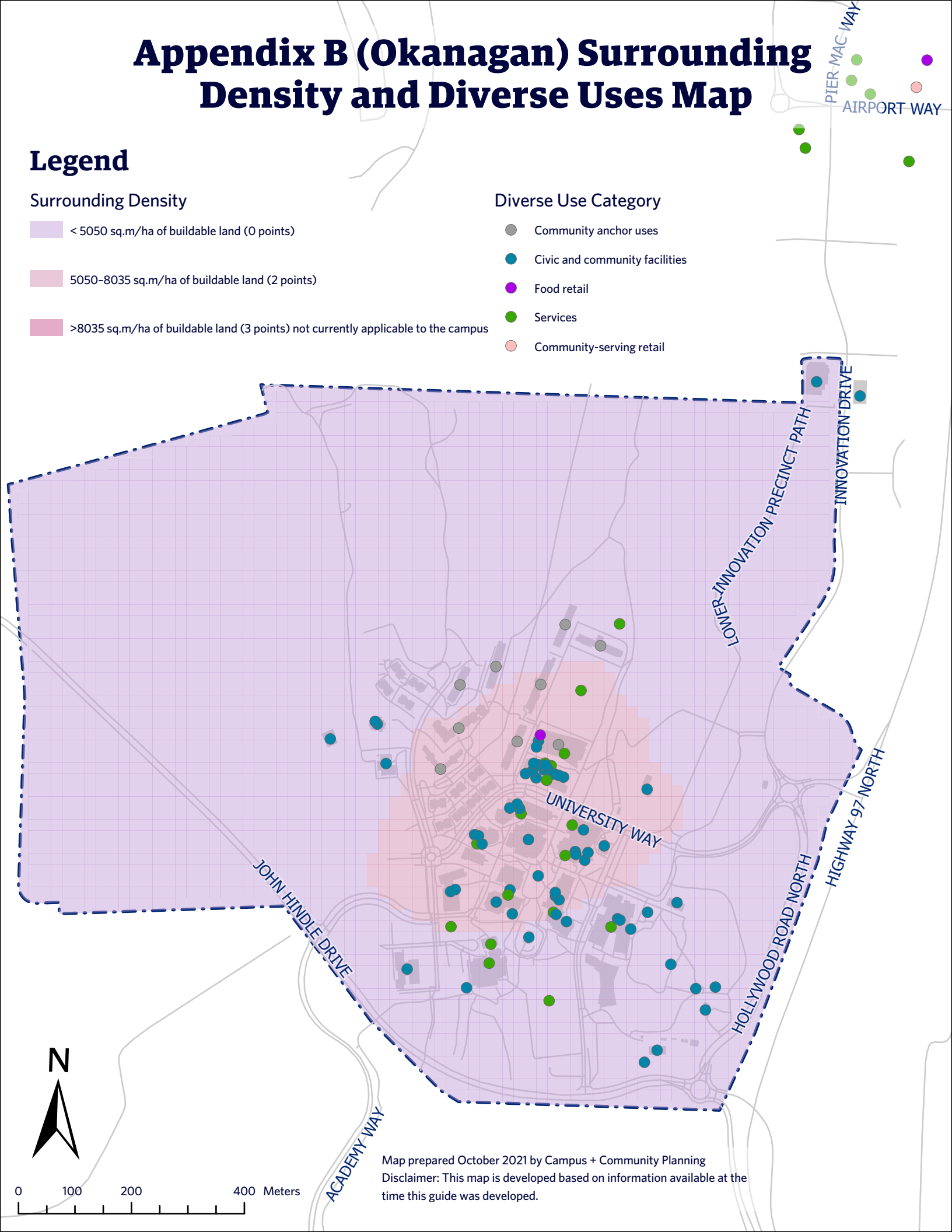
Diverse Uses

- Not within a 800m walking distance to 4–7 uses (0 points)
- Within a 800m walking distance to 4–7 uses (1 point)
- Within a 800m walking distance to 8 or more uses (2 points)

Diverse Use Category

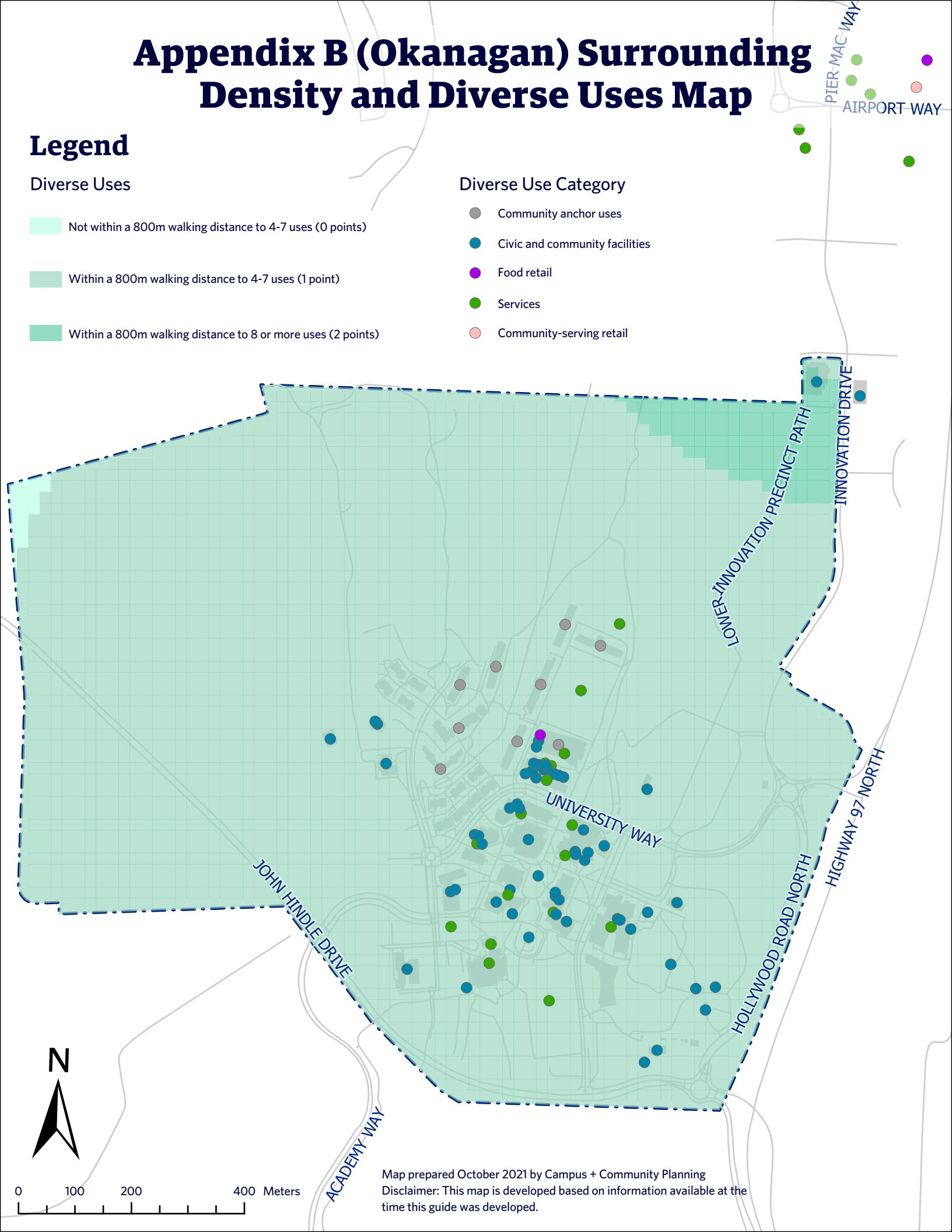
- Community anchor uses
- Civic and community facilities
- Food retail
- Community servinnng retail
- Services

Appendix B (Okanagan) Surrounding Density and Diverse Uses Map



Map prepared October 2021 by Campus + Community Planning
Disclaimer: This map is developed based on information available at the time this guide was developed.

Appendix B (Okanagan) Surrounding Density and Diverse Uses Map

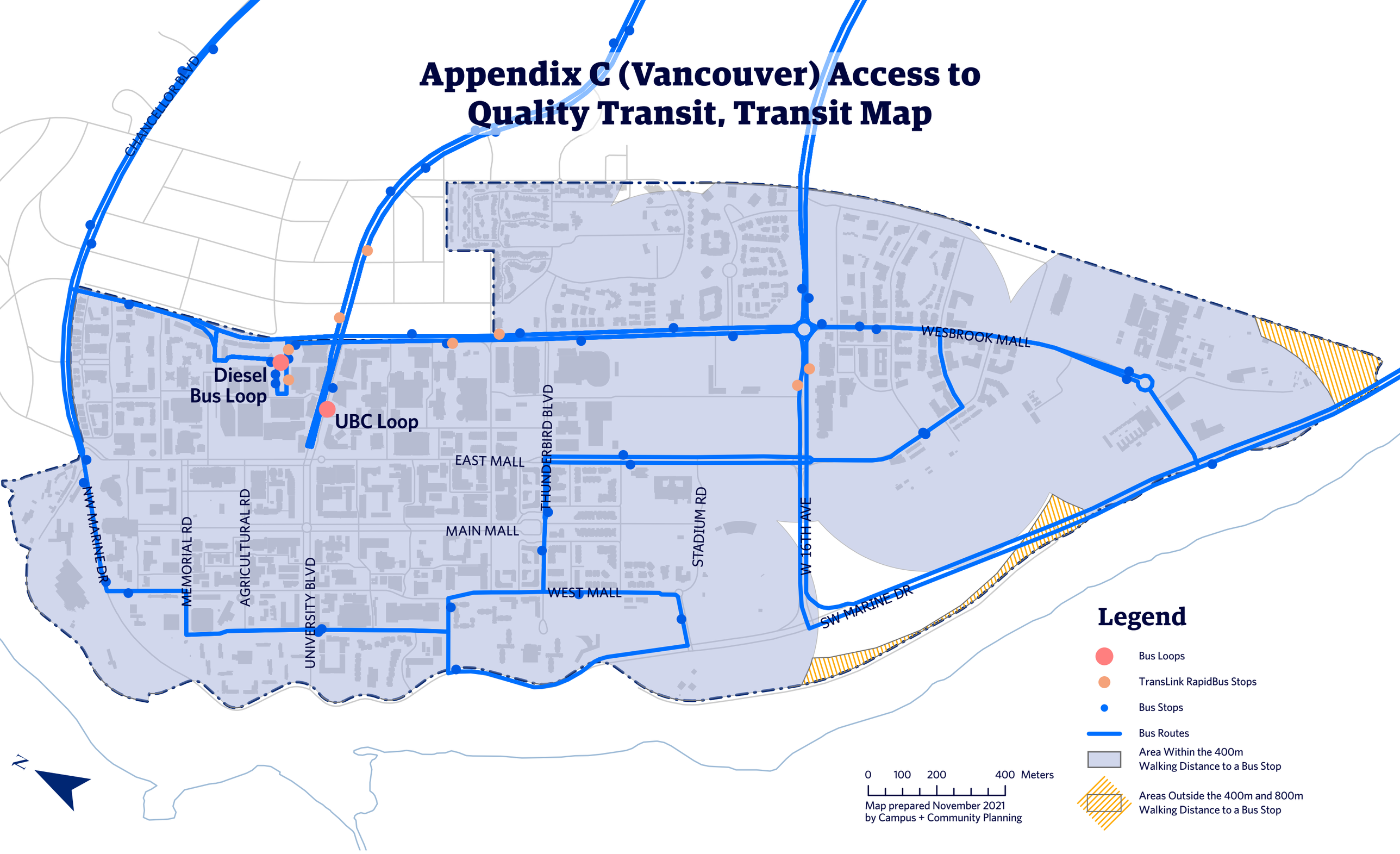


Map prepared October 2021 by Campus + Community Planning
Disclaimer: This map is developed based on information available at the time this guide was developed.

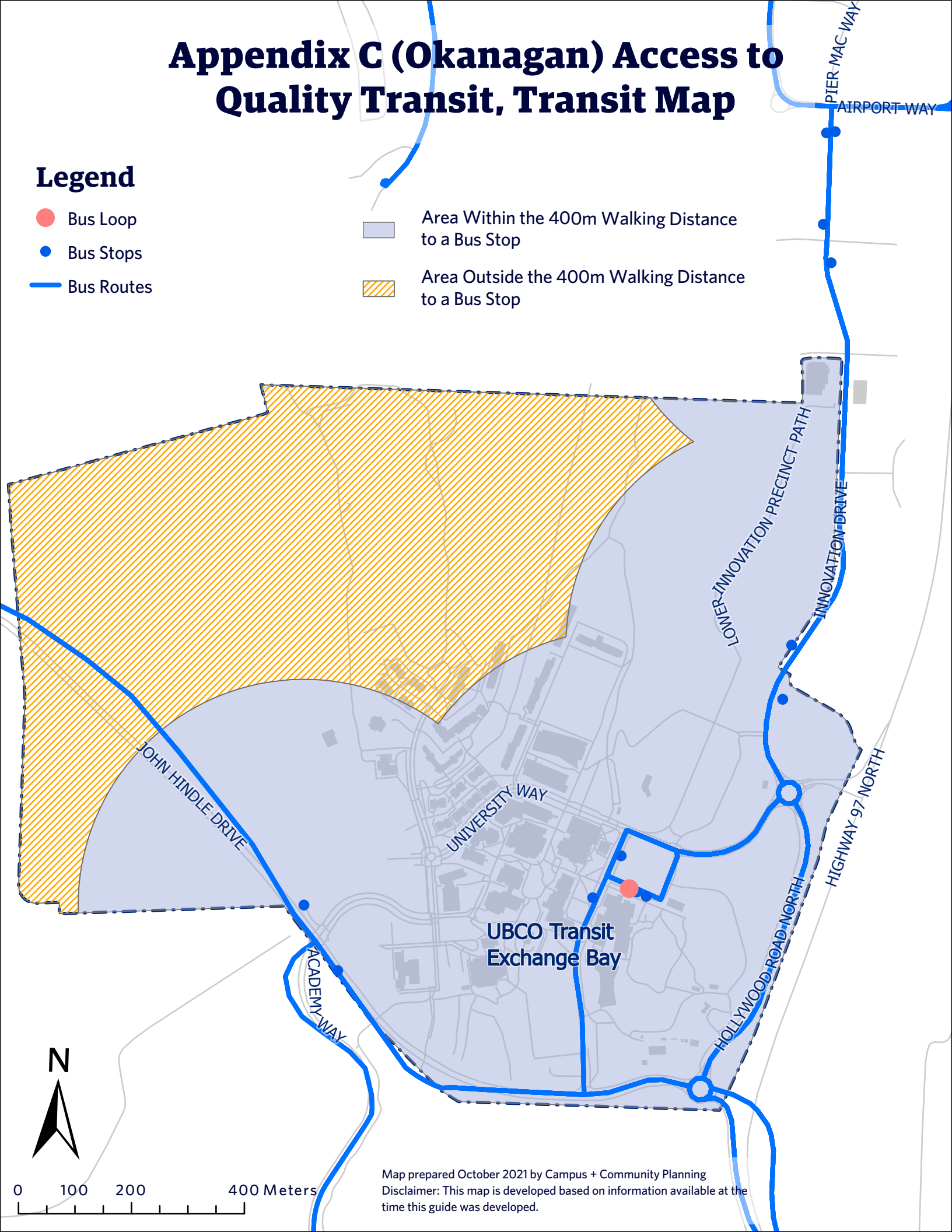
Appendix C

Transit Maps

Appendix C (Vancouver) Access to Quality Transit, Transit Map



Appendix C (Okanagan) Access to Quality Transit, Transit Map

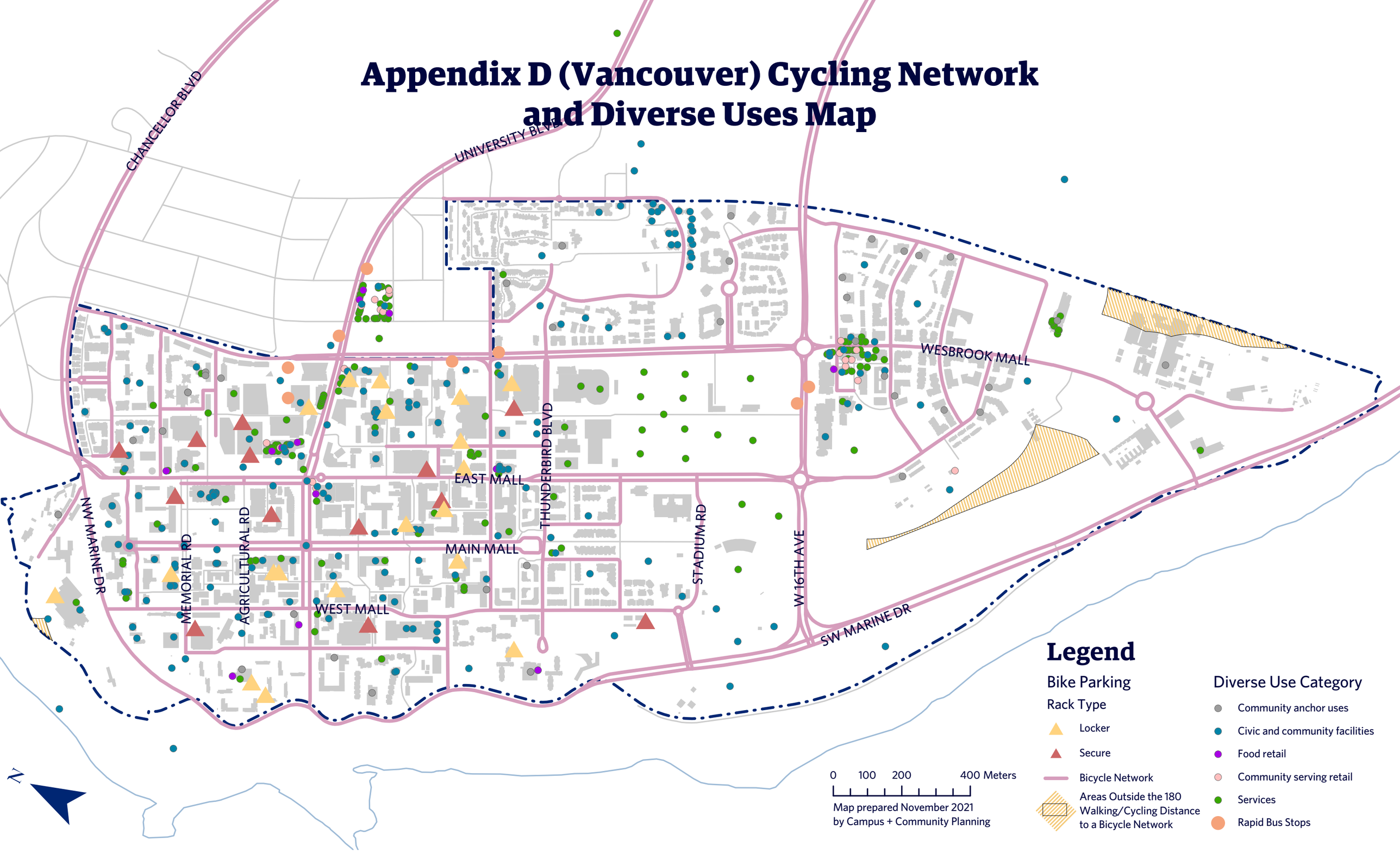


Map prepared October 2021 by Campus + Community Planning
Disclaimer: This map is developed based on information available at the time this guide was developed.

Appendix D

Cycling Networks and Diverse Uses Map

Appendix D (Vancouver) Cycling Network and Diverse Uses Map



Legend

Bike Parking

Rack Type

- Locker
- Secure

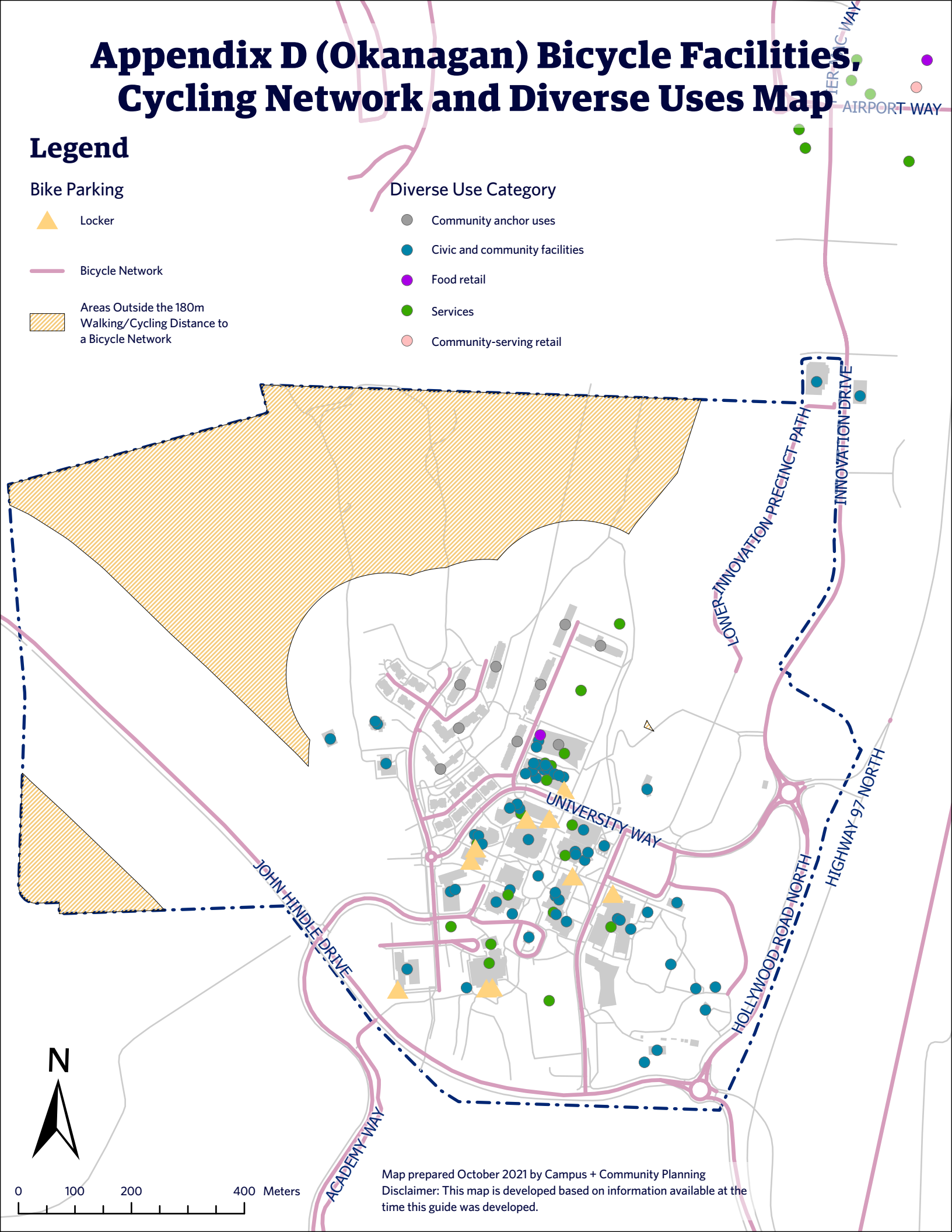
Bicycle Network

Areas Outside the 180 Walking/Cycling Distance to a Bicycle Network

Diverse Use Category

- Community anchor uses
- Civic and community facilities
- Food retail
- Community serving retail
- Services
- Rapid Bus Stops

Appendix D (Okanagan) Bicycle Facilities, Cycling Network and Diverse Uses Map

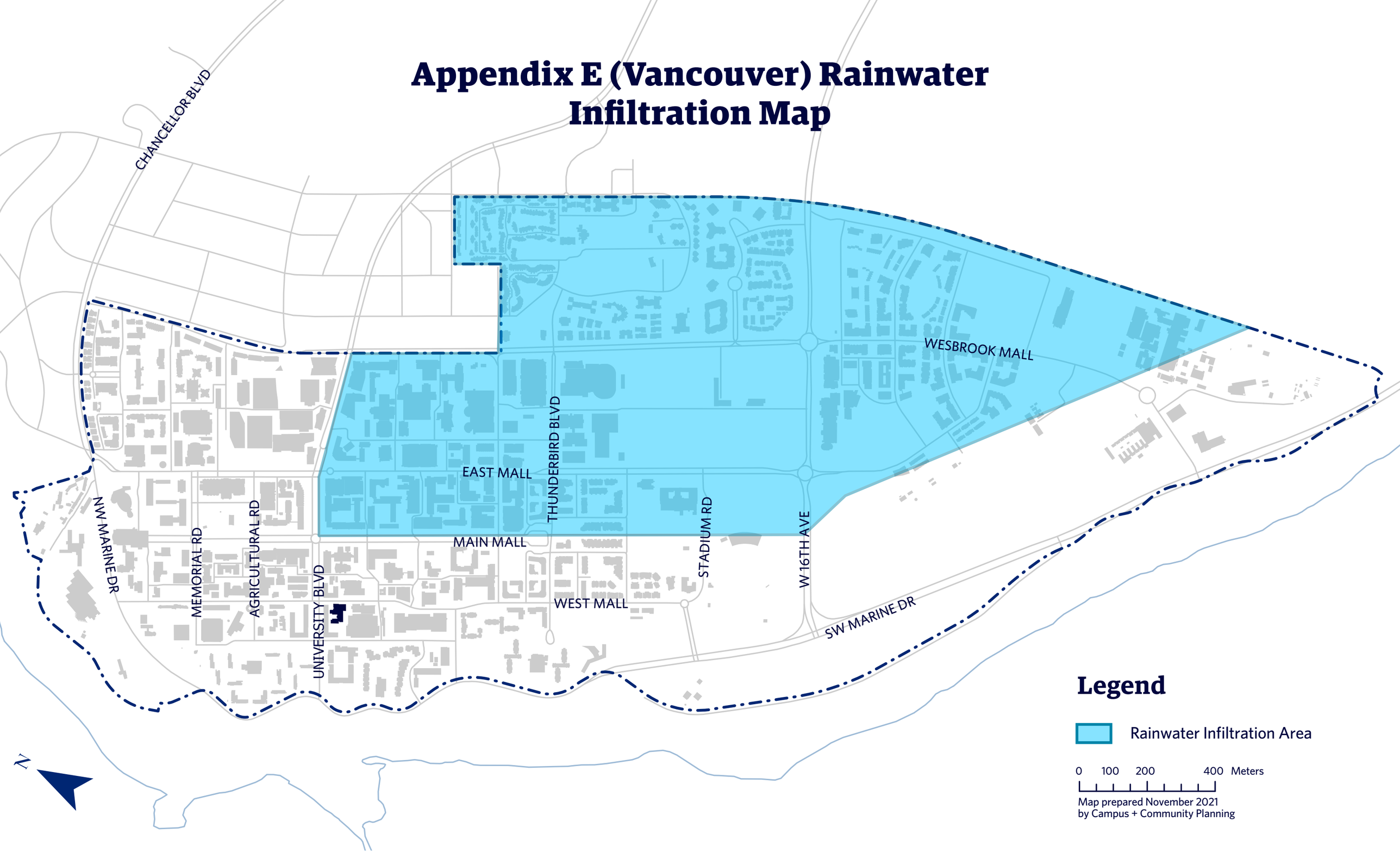


Map prepared October 2021 by Campus + Community Planning
Disclaimer: This map is developed based on information available at the time this guide was developed.

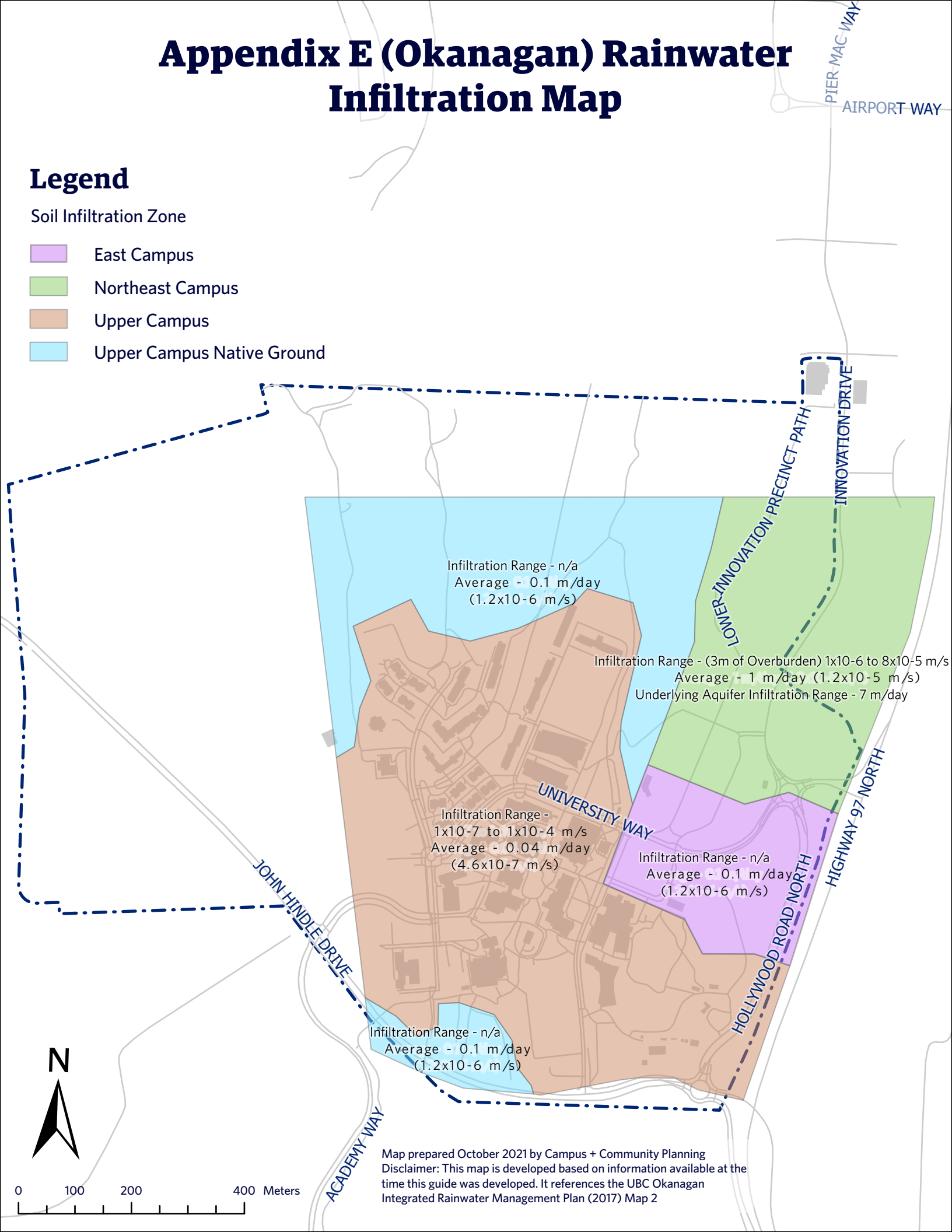
Appendix E

Rainwater Infiltration Map

Appendix E (Vancouver) Rainwater Infiltration Map



Appendix E (Okanagan) Rainwater Infiltration Map

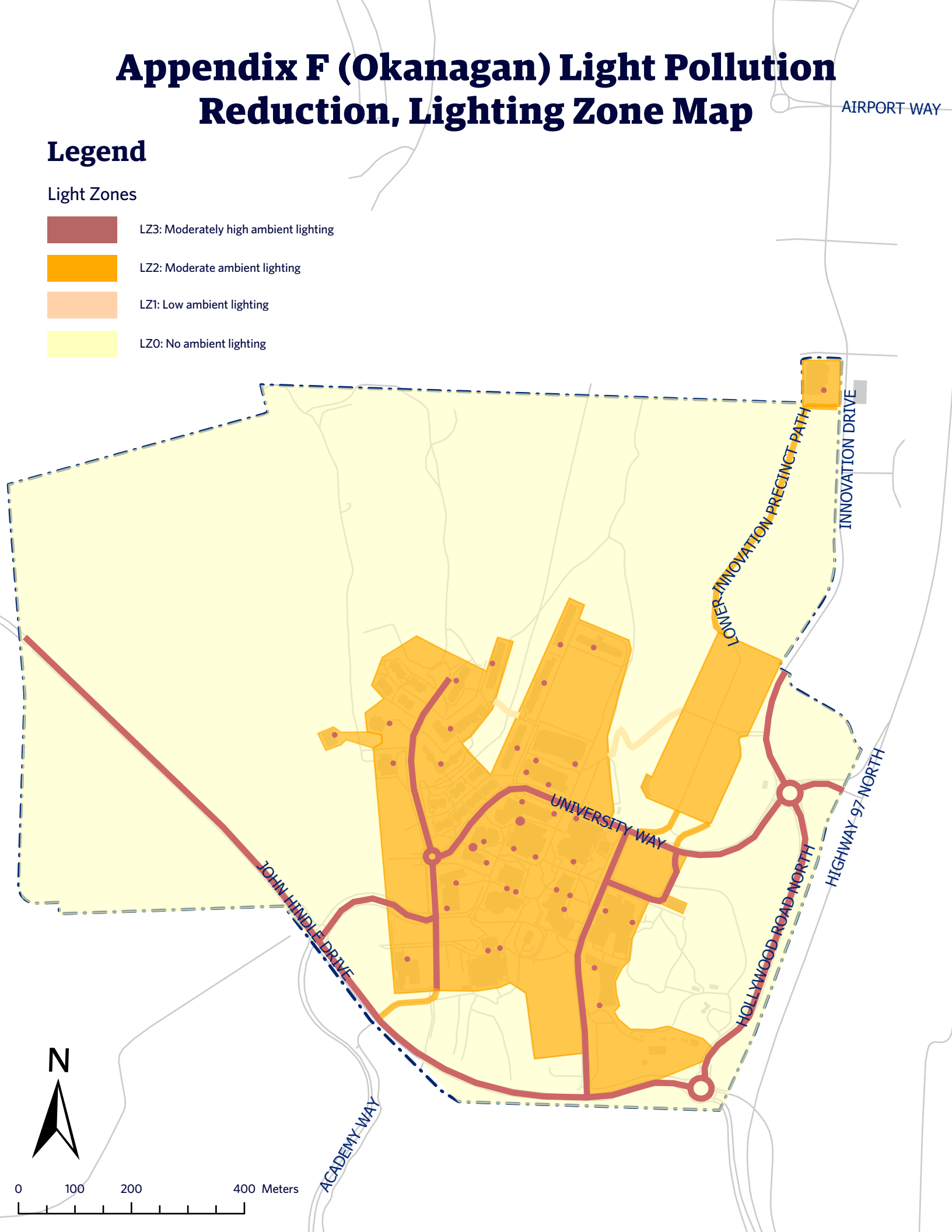


Map prepared October 2021 by Campus + Community Planning
Disclaimer: This map is developed based on information available at the time this guide was developed. It references the UBC Okanagan Integrated Rainwater Management Plan (2017) Map 2

Appendix F

Lighting Zone Map

Appendix F (Okanagan) Light Pollution Reduction, Lighting Zone Map



Appendix G

Okanagan Campus Process Water Data

UBC OKANAGAN SUEZ SERVICE REPORT

September 10, 2021

CUSTOMER: UNIVERSITY OF BRITISH COLUMBIA
SITE: OKANAGAN CAMPUS, GEO EXCHANGE, KELOWNA, BC
ATTENTION: Neil De Beyer

Comments: The Silica in the city water is 7.8 ppm and silica in Fluid Cooler is 23.6 ppm.
The Chlorides in the city waster is 7.2 ppm and Fluid Cooler #3 is 21.8 ppm.

Asset	Parameter	LCL	UCL	Jun	Jul	Aug	Sep
GENGARD GN8143	INVENTORY (LITRES)	--	--	--	--	--	300.0
	INVENTORY (KG - CALCULATED)	--	--	--	--	--	--
SPECTRUS NX1101	INVENTORY (LITRES)	--	--	--	--	--	10.0
	INVENTORY (KG - CALCULATED)	--	--	--	--	--	--
SPECTRUS NX1106	INVENTORY (LITRES)	--	--	--	--	--	10.0
	INVENTORY (KG - CALCULATED)	--	--	--	--	--	--
CORRSHIELD OR4407	INVENTORY (LITRES)	--	--	--	--	--	180.0
	INVENTORY (KG - CALCULATED)	--	--	--	--	--	--

Asset	Parameter	LCL	UCL	Jun	Jul	Aug	Sep
DES CLOSED LOOP	CONDUCTIVITY (uS)	--	--	--	--	--	1105.0
	POTASSIUM (PPM)	140	170	--	--	--	170.0
	pH	7.8	8.2	--	--	--	8.1
	MICROBIO (CFU/mL)	--	--	--	--	--	110.0

Asset	Parameter	LCL	UCL	Jun	Jul	Aug	Sep
FLUID COOLER MAKE-UP	TOTAL HARDNESS (PPM as CaCO3)	--	--	--	--	--	128.0
	CALCIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	84.0
	MAGNESIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	44.0
	M-ALKALINITY (PPM as CaCO3)	--	--	--	--	--	112.0
	pH	--	--	--	--	--	7.7
	CONDUCTIVITY (uS)	--	--	--	--	--	290.0
FLUID COOLER 1	TOTAL HARDNESS (PPM as CaCO3)	400	450	--	--	--	--
	CALCIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	--
	MAGNESIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	--
	M-ALKALINITY (PPM as CaCO3)	250	350	--	--	--	--
	pH	8.3	9	--	--	--	--

Asset	Parameter	LCL	UCL	Jun	Jul	Aug	Sep
	CONDUCTIVITY (uS)	800	900	--	--	--	--
	MOLYBDATE (PPM as MoO4)	0.65	1	--	--	--	--
	MICROBIO (CFU/mL)	--	--	--	--	--	--
	FILTERED PHOSPHATE (PPM PO4)	--	--	--	--	--	--
	UNFILTERED PHOSPHATE (PO4)	--	--	--	--	--	--
	CALCULATED CYCLES (CONDUCTIVITY)	--	--	--	--	--	3.472
	CALCULATED CYCLES (CALCIUM)	--	--	--	--	--	--
	CALCULATED CYCLES (MAGNESIUM)	--	--	--	--	--	--
FLUID COOLER 2	TOTAL HARDNESS (PPM as CaCO3)	400	450	--	--	--	--
	CALCIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	--
	MAGNESIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	--
	M-ALKALINITY (PPM as CaCO3)	250	350	--	--	--	--
	pH	8.3	9	--	--	--	--
	CONDUCTIVITY (uS)	800	900	--	--	--	--
	MOLYBDATE (PPM as MoO4)	0.65	1	--	--	--	--
	MICROBIO (CFU/mL)	--	--	--	--	--	--
	FILTERED PHOSPHATE (PPM PO4)	--	--	--	--	--	--
	UNFILTERED PHOSPHATE (PO4)	--	--	--	--	--	--
	CALCULATED CYCLES (CONDUCTIVITY)	--	--	--	--	--	2.876
	CALCULATED CYCLES (CALCIUM)	--	--	--	--	--	--
	CALCULATED CYCLES (MAGNESIUM)	--	--	--	--	--	--
FLUID COOLER 3	TOTAL HARDNESS (PPM as CaCO3)	400	450	--	--	--	392.0
	CALCIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	248.0
	MAGNESIUM HARDNESS (PPM as CaCO3)	--	--	--	--	--	144.0
	M-ALKALINITY (PPM as CaCO3)	250	350	--	--	--	340.0
	pH	8.3	9	--	--	--	8.81
	CONDUCTIVITY (uS)	800	900	--	--	--	844.0
	MOLYBDATE (PPM as MoO4)	0.65	1	--	--	--	0.91
	MICROBIO (CFU/mL)	--	--	--	--	--	120.0
	FILTERED PHOSPHATE (PPM PO4)	--	--	--	--	--	--
	UNFILTERED PHOSPHATE (PO4)	--	--	--	--	--	--
	CALCULATED CYCLES (CONDUCTIVITY)	--	--	--	--	--	2.91
	CALCULATED CYCLES (CALCIUM)	--	--	--	--	--	--
	CALCULATED CYCLES (MAGNESIUM)	--	--	--	--	--	--

Appendix H

District Energy System Guidance and Utility Data

Appendix H – Utility Data and District Energy System Guidance, Vancouver Campus

Updated February 2022

Table of Contents

Background

The University of British Columbia has recently converted its heritage steam system to a modern high-efficiency hot water district energy system. This $88 million project was completed in 2016 and replaces the existing steam system with a new hot water boiler plant, 14km of distribution piping, and 131 energy transfer stations throughout the academic core.

In November 2021, the Biomass Expansion project was completed, tripling the capacity of the existing plant; base loading UBC's district energy system with clean biomass.

New buildings must connect to the district energy system as a source of external heat where practical to reduce life cycle costs and greenhouse gas emissions (GHG) (by way of the renewable thermal energy from the Bioenergy Research and Demonstration Facility (BRDF)).

There are three main district energy sources at UBC:

- The BRDF's biomass boilers – the 6 MW and a new 12 MW thermal energy boilers which run on wood waste and produce renewable thermal energy. These will serve as the primary energy source to the district energy system.
- The BRDF's cogeneration unit – a 2 MW_e combined heat and power engine is fueled by a mix of natural gas and renewable natural gas (RNG). 2.4 MW of thermal energy is recovered from the engine which is also base loaded.
- The Campus Energy Centre (CEC) - consists of three 15 MW high-efficiency hot water boilers fueled by natural gas for winter peak loads.

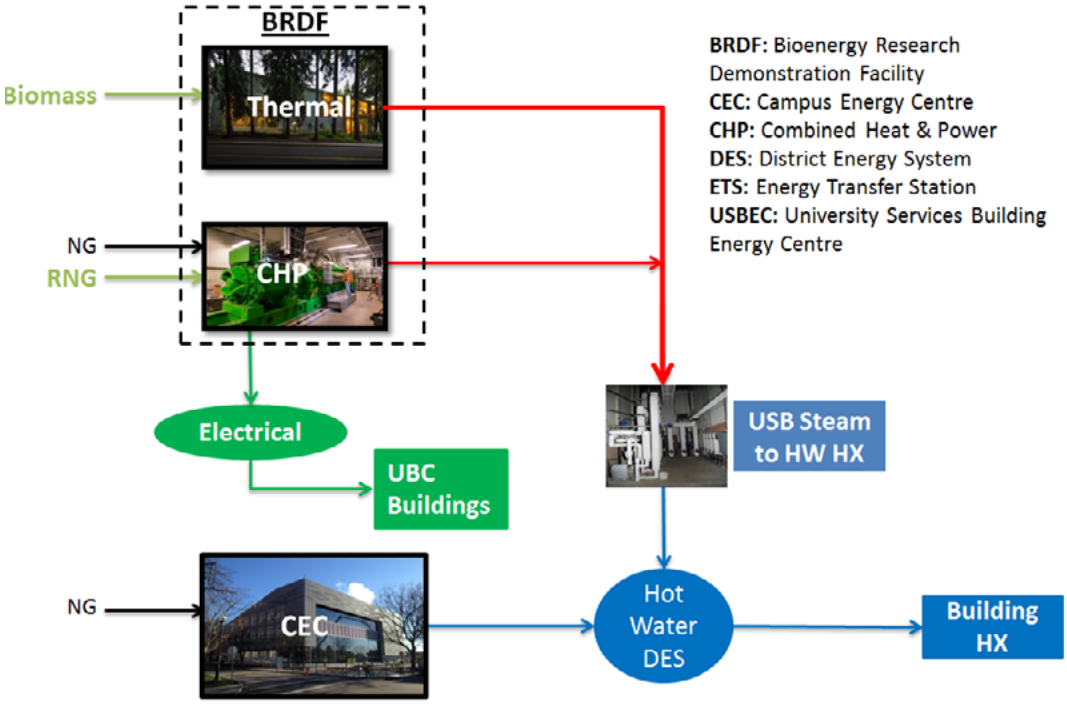


Figure 1 – UBC Thermal & Electrical Generation

UBC Utility Rates and Emissions Factors

Fiscal Year: **April 1, 2022 - Mar 31, 2023**

The following flat rate structures are to be used when a project is pursuing Option 1, Path 1 and Path 2 for the Optimize Energy Performance LEED Credit. These rates shall be adjusted to Virtual DES rates as required.

For Buildings Connected to the DES: Option 1, Path 1

Flat DES Rates	Description	Value	Units	Notes
UBC DES	UBC, DES Thermal Hot Water	$ 29.81	/MWh	Delivered Thermal Energy to Building including all upstream losses and effects.
BC Hydro	BC Hydro Electricity	$ 69.64	/MWh	Blended UBC rate, with carbon

Ancillaries Rates (for use with Athletics and Student Housing projects)

Flat DES Rates	Description	Value	Units	Notes
UBC DES	UBC, DES Thermal Hot Water	$ 90.00	/MWh	Cost of thermal energy charged to Ancillaries customers.
BC Hydro	BC Hydro Electricity	$ 87.81	/MWh	Blended UBC rate, with carbon
Natural Gas	Fortis BC gas rate	$ 14.06	/GJ	

For Buildings Connected to the DES: Option 1, Path 2

Flat DES Rates	Description	Value	Units	Notes
Biomass	Biomass Input into DES	$ 5.01	/GJ	Blended commodity rate, with carbon
Natural Gas	Interruptible Gas Input into DES	$ 10.31	/GJ	Blended commodity rate, with carbon
Renewable Natural Gas	RNG Input into DES	$ 12.75	/GJ	Blended commodity rate, with carbon
BC Hydro	BC Hydro Electricity	$ 69.64	/MWh	Blended UBC rate, with carbon
UBC DES	UBC, DES Thermal Hot Water	$ 29.81	/MWh	Based on calculated value in green table below.

For Buildings NOT Connected to the DES

Utility Energy Rates	Description	Value	Units	Notes
Fortis Rate 25	Non-DES Gas Rate (Non-Interruptible)	$ 12.18	/GJ	Blended commodity rate, with carbon
BC Hydro	BC Hydro Electricity	$ 69.64	/MWh	Blended UBC rate, with carbon

Utility Emission Factors

All new buildings are required to meet UBC's GHGI targets. Building emissions calculations are to use the emission factors of the electricity grid and the DES in the table below. Because the DES uses biomass as a base load and natural gas for peaking, the emission factor for the DES varies throughout the year as the campus heating demand fluctuates. Energy modelers should apply the emission factors below to the results of the energy model to calculate total emissions for the project.

	Emission Factor (kgCO2e/MWh)
Electricity	
	10.67*
District Energy Average Rates**	
Jan	87
Feb	67
Mar	68
Apr	35
May	12.9
Jun	11.8
Jul	9.7
Aug	8.7
Sep	47
Oct	63
Nov	73
Dec	93

* Note: BC Hydro grid emission factors fluctuate annually with the amount of energy imported from high carbon intensity grids. This value (10.67) represents the grid emission factor without considering energy imports, and is consistent with Step Code and City of Vancouver modeling practices. Updated emission factors from BC Hydro can be found here: https://www2.gov.bc.ca/gov/content/environment/climate-change/industry/reporting/quantify/electricity

** Note: DES emission factors vary year-to-year based on weather and actual operation of the DES. Values in this table are to be used for all compliance modeling, as these were the values used in establishing the GHGI targets. If needed, current actual emission factors can be obtained from UBC Energy & Water Services.

UBC DES Monitored Values

BRDF Thermal Boiler

Biomass Input	159,426	GJ
BRDF Thermal Gas Input	650	GJ
Biomass Thermal Output	32,329	MWh
Thermal Efficiency	72.7%	
Biomass Cost	$5.01	/GJ
Rate 25 NG Cost	$12.18	/GJ

BRDF Expansion Boiler

Biomass Input	280,638	GJ
BRDF Exp Gas Input	1,000	GJ
BRDF Exp Output	58,220	MWh
Thermal Efficiency	74.4%	
Biomass Cost	$5.01	/GJ
Rate 25 NG Cost	$12.18	/GJ

BRDF Cogen

Natural Gas Input	67,400	GJ
Renewable Natural Gas Input	107,207	GJ
Cogen Thermal Output/Waste Heat	14,774	MWh
Cogen Electrical Output	16,006	MWh
Thermal Efficiency	30%	
Electrical Efficiency	33%	
Total Cogen Efficiency	63%	
Natural Gas Allocated to Thermal	-	GJ
Renewable Natural Gas Allocated to Thermal	-	GJ
Natural Gas Allocated to Electrical	67,400	GJ
Renewable Natural Gas Allocated to Electrical	107,207	GJ
Cogen Gas Cost	$10.31	/GJ
Cogen RNG Cost	$12.75	/GJ

CEC Hot Water Boilers

CEC Gas Input	139,663	GJ
CEC Thermal Ouptut	33,752	MWh
CEC Efficiency	87%	
Rate 22 NG Cost	$10.31	/GJ

Parasitic Loads

BRDF Electricity Consumption	4248	MWh
CEC Electricity Consumption	856	MWh
Electrical Costs	$69.64	/MWh

Thermal Distribution Losses

Distribution System Heat Losses	4,172	MWh
% Distribution Losses from Thermal Outputs	3.0%	

All in Thermal DES Efficiency

Total Boiler Energy Input	581,377	GJ
Total Energy Produced	139,075	MWh
Total Energy Delivered to Buildings	134,903	MWh
DES Heating Plant Efficiency	86%	
District Energy Thermal Efficiency	84%	

GHG Emission Factors

Biomass GHG EF	2.24	kgCO2/GJ
NG GHG EF	49.87	kgCO2/GJ
RNG GHG EF	0.29	kgCO2/GJ
Electrical GHG EF	10.67	kgCO2/MWh

DES GHG Emissions

GHGs	GHG total	
BRDF Thermal	390	tCO2e
BRDF Expansion	678	tCO2e
CEC	6,965	tCO2e
Cogen	-	tCO2e
Parasitic	54	tCO2e
Total GHGs	8,087	tCO2e
GHG per GWh delivered	**60.0**	**tCO2e/GWh delivered**

DES Proposed Model Inputs		
District Energy Thermal Efficiency	84%	
Parasitic Electrical & Pumping Energy per Thermal Delivered	37.83	kWh electrical per MWh thermal delivered.
Weighted Average Cost per Thermal Energy Delivered	29.81	$/MWh
Weighted Average GHG	60.0	tCO2/GWh delivered

CHP equation inputs from the BRDF Cogen		
X_{heat} =	11%	
Total District Heat Provided =	134,903	MWh (used for calculating $BLDG_{HEAT}$)
CHP_ELEC_{TOTAL}	16,006	MWh
$CHP_{FUEL\ Natural\ Gas}$	67,400	GJ of NG
$CHP_{FUEL\ Renewable\ Natural\ Gas}$	107,207	GJ of RNG

UBC Renewable Energy/BRDF Submission Documentation

The Bioenergy Research Demonstration Facility (BRDF) houses two production units that provide thermal energy to UBC's district energy system:

- The BRDF's biomass boiler – a base loaded 18 MW thermal energy boiler which runs on wood waste and produces renewable thermal energy.
- The BRDF's cogeneration unit – a 2 MW_e combined heat and power engine is fueled by a mix of natural gas and renewable natural gas (RNG). 2.4 MW of thermal energy is recovered from the engine for the district energy system.

The values below reflect the most recent projected figures based on the actual measured values for the renewable energy generated by the BRDF's biomass boiler. These values are updated every few years by UBC's Energy and Water Department.

The BRDF produces the equivalent of 7.38% of UBC's annual electricity consumption; however, this portion is not yet eligible for renewable energy credit as it is produced for Fortis Renewable Natural Gas.

For Projects connected to DES:

	Thermal	
Total Thermal Delivered to Campus:	152,687	MWh
Thermal Supplied by BRDF:	101,055	MWh
% Thermal Supplied by BRDF to DES:	66.2%	

UBC hereby confirms that:

- The renewable energy reported is allocated directly to the DES and not directly to any building in particular.
- Within the DES renewable energy allocation, no renewable energy was assigned specifically to the DES central plant building, if any (in a separate LEED application), is also being counted toward the renewable energy contribution of the connected project building.
- That no renewable energy is being double-counted among any connected project buildings in separate LEED applications.
- That UBC, the DES owner and operator, maintains rights to the environmental benefits of the site-generated renewable energy.

UBC LEED v4.0 DES Modelling Approach

Optimize Energy Performance

Option 1 - Path 1 Building Stand-Alone

Option 1, Path 1 is not a recommended compliance path for UBC projects as it does not allow for DES GHG credits for Optimize Energy Performance. UBC recommends that the Energy Modeler use either the EApc95 Alternative Compliance Path; averaging the best two of three metrics, or Option 1, Path 2 for DES connected new construction projects.

If Path 1 must be used, this energy model accounts only for downstream equipment (including building DES heat exchangers), upstream DES equipment is not accounted. Proposed and Baseline are modelled using purchased energy according to the reference guide.

1. Energy Rates

   For the purposes of this Path, a flat rate structure has been calculated by UBC on a campus scale for both electricity and thermal energy. UBC's blended rate for BC Hydro electricity should be used as UBC is charged energy and demand on a campus level, not a building by building level. Please refer to the flat virtual energy rates given in*UBC Utility Rates and Emissions Factors* (page 3).

Option 1 - Path 2 Full DES Performance Accounting

Option 1, Path 2 Full DES Accounting is the recommended compliance path for UBC projects as it allows for projects to take credit for the DES' low carbon intensity. This energy model scope accounts for both downstream equipment and upstream equipment.

Full DES Accounting following LEED v4.0 Option 1, Path 2 with the EApc95 Alternative Compliance Path; averaging the best two of three metrics of energy cost, GHGs, and energy source is another preferred methodology. This allows projects to take credit for the DES' low carbon intensity while still balancing cost of source energy. This energy model scope accounts for both downstream equipment and upstream equipment.

UBC's overall DES efficiency is better than the standalone ASHRAE 90.1-2010 baseline boiler plant in terms of energy efficiency and is much better in terms greenhouse gas emissions due to the biomass component of the BRDF. Option 1 - Path 2 also allows for a significant renewable energy credit to be taken for Renewable Energy Production that cannot be taken credit for under Option 1 - Path 1.

1. Energy Rates

   UBC's DES plant operates under a specific and atypical rate structure[1] that actively takes advantage of an interruptible rate strategy (Rate 22) for load management as required by Fortis BC. For this reason the rate structure used for this path shall be the rate structure as applied to UBC's DES. Refer to *UBC Utility Rates and Emissions Factors* (page 3)

[1] Pg 364, LEED v4.0 Reference Guide for Green Building Design and Construction

2. Proposed Building, DES-equivalent plant

a. District Energy Thermal Efficiency/Heating Plant Efficiency

A virtual plant with the same efficiencies as the upstream district energy heating system shall be modelled. The entire upstream district energy system consists of a piping distribution network fed from two plants: the BRDF Biomass Boiler and the Campus Energy Centre's gas boilers. CHP is modelled separately as explained in *BRDF CHP Fuel Consumption* below. Each unit's main and auxiliary energy inputs and outputs are measured and monitored by UBC. The natural gas and electrical consumption of each plant (CEC and BRDF), the biomass consumption of the BRDF Biomass Boiler, and the thermal output of each plant is monitored. The monitored data has been combined with analytical methods that extrapolate the measured data based on heating degree days to determine total annual natural gas consumption, electrical consumption, biomass consumption and thermal output taking into consideration the output expected from the biomass expansion. The values determined from this analysis are summarized in *UBC DES Monitored Values*. *UBC DES Monitored Values* provides UBC's overall annual average District Energy Thermal Efficiency that should be used in the proposed building model plant, as well as the equivalent tCO2/GWh delivered for thermal energy should the project team pursue this credit based on GHG's instead of cost or energy efficiency. The District Energy Thermal Efficiency includes all operational effects such as standby, equipment cycling, partial load operation, internal pumping, and thermal losses.

b. Pumping Energy and other electrical parasitic loads

All electrical loads, including distribution pumping energy, for the CEC and BRDF are measured and monitored by UBC. These values are updated every few years in Appendix H. The total annual electricity consumption for the BRDF and CEC are added and divided by the annual DES thermal output to come up with a kWh per MWh thermal delivered.

This kWh/MWh number represents the parasitic electrical and pumping energy and is to be multiplied by the Proposed Building's thermal load to the DES. **The resulting total kWh's shall be added as an annual auxiliary electrical load in the Proposed Building, see *UBC DES Monitored Values*.**

c. Thermal Distribution Losses

Thermal Distribution Losses are already accounted for in the District Energy Thermal Efficiency given in *UBC DES Monitored Values*. No adjustments need to be done by the energy modeler.

At present, a number of thermal meters at the building level are not correctly reporting and collecting through UBC's ION Meter Database, this means it is not a reliable measurement of thermal distribution losses from UBC's DES.

A detailed engineering analysis was completed of the district energy distribution system to calculate thermal losses. The heat loss formula below was used to calculate total distribution losses throughout the entire UBC district energy piping network:

$$W = \frac{2\pi\,(Tm - Ta)}{3.42\ x\ 12\ \left(\frac{Ln\left(\frac{Di}{Dp}\right)}{Ki} + \frac{Ln\left(\frac{Dj}{Di}\right)}{Kj}\right)} x\ Sf$$

Where W is Watts of heat loss per foot of pipe. A detailed description of the formula and variable definitions can be found on Urecon's website[2].

A calculated distribution heat loss of 14,700 GJ/year was determined through this methodology for UBC's hot water distribution network. This is compared to the total annual thermal energy delivered to the UBC campus to get a percentage distribution loss relative to load. This percentage is found in *UBC DES Monitored Values* and is updated annually. Because the distribution heat losses are static, the percentage will change annually depending on total thermal energy distributed by the DES annually. **This percentage is already incorporated in the District Energy Thermal Efficiency provided in *UBC DES Monitored Values*.**

d. BRDF CHP Fuel Consumption

LEED v4.0 gives special guidance for cogeneration plants, so processes related to UBC's CHP system have not been included in the DES Proposed Model Inputs given in *UBC DES Monitored Values*. Instead, the fuel attributed to the LEED building by the CHP plant shall be calculated as per pg. 366 – 368 of the LEED v4.0 reference guide using the inputs to the equations as provided in *UBC DES Monitored Values*. Because there are two fuel inputs associated with the BRDF cogen, there will be two CHP_{FUEL} calculated by the energy modeler: one for natural gas, and one for renewable natural gas. The $CHP_{FUEL\ Natural\ Gas}$ and $CHP_{FUEL\ Renewable\ Natural\ Gas}$ shall then be multiplied by the utility rates as given in *UBC Utility Rates and Emissions Factors*. The same shall be done for any process added to the baseline building.

[2] http://www.urecon.com/tracing/heat_loss.html

UBC LEED v4.1 DES Modelling Approach

Optimize Energy Performance

Option 1

Energy Performance Compliance is the preferred pathway, as it aligns with UBC Green Building Action Plan and the Climate Ready Requirements for UBC Buildings. Pursuing Option 1 is required to count savings in the Renewable Energy and the Grid Harmonization credit. Project teams may choose to follow EA Pilot ACP 143 which allows either ASHRAE 90.1 or NECB to be used as the reference energy code. Note that projects applying the pilot are evaluated based on energy consumption and greenhouse gas emissions. Projects that use NECB as the reference code must still comply with certain mandatory requirements. Refer to EA ACP Pilot 143. District energy system (DES) modeling methodology, and guidance on how to account for DES carbon profiles and upstream equipment and distribution efficiencies, has not yet been published as part of the LEED v4.1 credit language. Until this direction becomes available project teams should consider using the LEED v4.0 methodology for DES modeling per Option 1, Path 2: Full accounting of DES upstream and downstream equipment. Project teams should confirm the approach used for DES modeling with GBCI Canada (via leedcoach@gbcicanada.ca) at the early stages of schematic design.

Renewable Energy

LEED v4.1 does not define biomass as a renewable energy source unless harvested within the campus boundary. As such, the renewable energy contribution from the Academic District Energy System will not contribute. It is recommended that project teams investigate updates or pilot paths associated with biomass treatment for this credit as it applies to renewable energy system.

Appendix H UBCO District Energy System

There are presently two district energy systems at UBCO. The Low Temperature District Energy System (LDES) provides ambient temperature water via a 2-pipe system over PVC pipeline. The LDES is connected to legacy buildings for heating only and provides heating and cooling to 13 newer academic buildings on campus. The Medium Temperature District Energy System (MDES) distributes 80°C (176°F) water via an insulated carbon steel pipe system to 5 Legacy buildings. None of the current residential-only buildings are presently connected to either LDES or MDES. Compared to stand alone buildings, connection to the LDES has emerged as the preferred approach on the main campus and innovation precinct to provide heating and cooling for the campus.

The long-term strategy on the UBCO campus is that all heating and cooling loads are to be met using district hot and chilled water. If district heating and cooling is not provided at the time of initial construction, the design should be compatible with the parameters of UBCO's DES to enable future connection.

Energy utility inputs, costs and GHG factors for district provided heating and cooling will be provided by UBCO to the design team early in the project as part of the project's Design Brief and OPR. Note that utility costs include both energy values and significant peak demand charges. Note that there are ongoing changes to the campus DE system and it is up to the design team to determine how to model the DES connection for LEED applications. UBCO Operations (Energy Team) can provide available historical data as needed.

UBCO energy targets are calculated based on thermal energy delivered to the building. Due to district-level heat recovery capability, energy consumption is measured based on net heating/cooling consumption using an hourly resolution. During heating dominant periods cooling is considered to be free and the heating load is considered as the net of heating less cooling. The reverse is true during cooling dominated periods.

Appendix I

UBC's Whole Building Life Cycle Assessment Guidelines

Institutional building

1 Identify building type

BASELINE
Building built to conventional materials and systems

ALTERNATIVE 1
Building built with improved envelope materials

ALTERNATIVE 2
Building structure including advanced construction systems

2 Identify potential carbon contributors

To reduce the carbon footprint by upgrading/replacing materials/systems

3 Define system boundaries

Cradle to grave (Cradle to grave + Module D*)

4 Define functional unit

FU is an institutional building operating for 60 years

5 Define LCA Scope

INCLUDE
- sub-structure (foundations)
- Superstructure
- enclosed parking
- Envelope
- Windows
- exterior doors
- interior walls and doors gypsum wall board

EXCLUDE
- Landscape
- excavation, temporary elements
- Finishes
- electrical and mechanical services/equipment
- stairs and handrails door/window hardware millwork
- furnishings

6 Inventory generation

- Prefer Canada databases and EPD's. Provide assumptions: material replacement cycles and data sources on a data quality matrix
- Data sets must be compliant with ISO 14040, ISO 14044, ISO 21930 and EN 15804.
- Data Input: Bill of materials input method or BIM-integrated input method

7 Calculate and compare the carbon footprint

- Carbon footprint is to be calculated on **ATHENA, TALLY or ONE CLICK LCA** and latest **TRACI** version
- Determine maximum project embodied carbon target achieved

8 Communicate the Results for alternative 1 and alternative 2

Report with **HOTSPOT ANALYSIS** related to building materials, life cycle stages and structural components

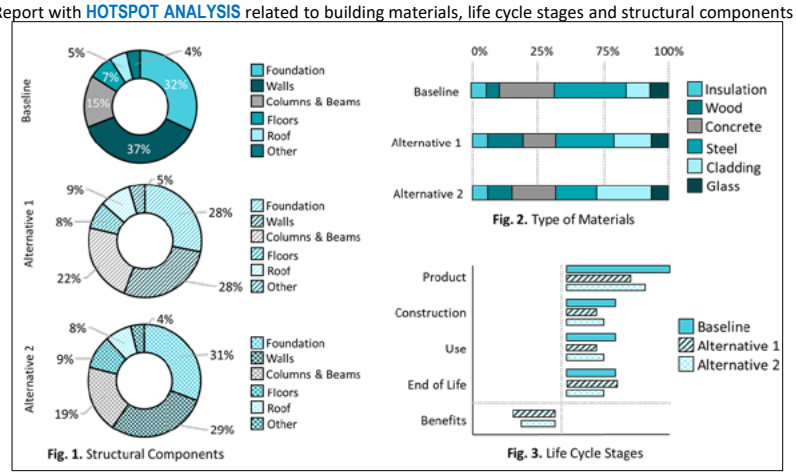


Fig. 1. Structural Components

Fig. 2. Type of Materials

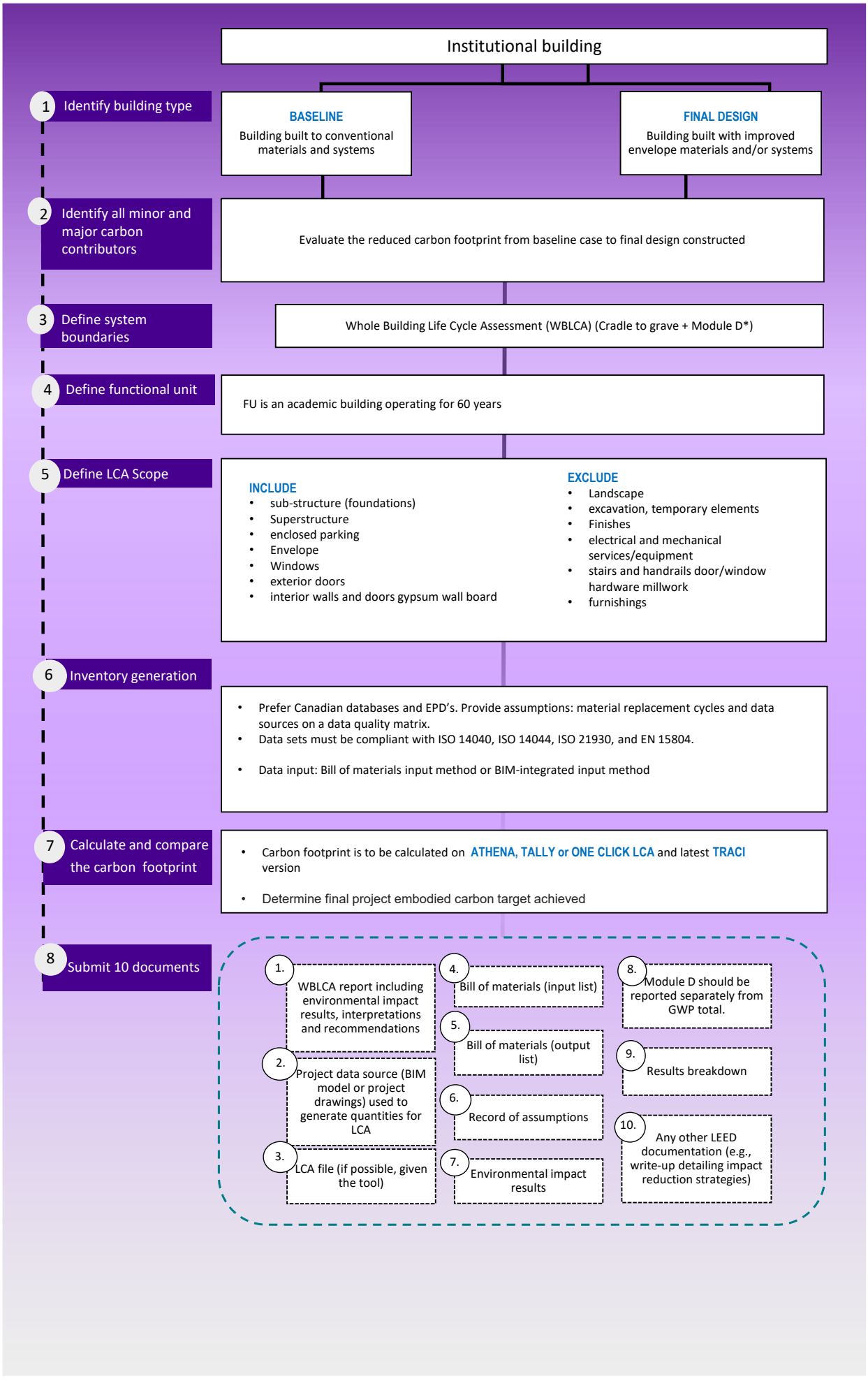
Fig. 3. Life Cycle Stages

*Sample results

9 Recommendations

From the tested alternatives recommend the most feasible option

LCA1: AT TIME OF DEVELOPMENT PERMIT



LCA2: AT TIME OF OCCUPANCY PERMIT