

UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Balancing Transportation and the Public Realm: Elevated Skytrain Integration and the Campus Experience

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University of British Columbia

PLAN 526

Themes: Transportation, Community, Land

April 5, 2019

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BALANCING TRANSPORTATION & THE PUBLIC REALM

ELEVATED SKYTRAIN INTEGRATION AND THE CAMPUS EXPERIENCE

Produced by SCARP MCRP Studio Group for UBC Campus and Community Planning

Issue Date: April 5, 2019

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Special thanks to our partners: Mathew Roddis, Adam Hyslop, Chris Fay and David Gill. As well
as our instructors: Clare Mochrie, Daniel Ross, Maged Senbel and Erick Villagomez



EXECUTIVE SUMMARY

Introduction

The University of British Columbia (UBC) has been exploring the possibility of bringing a SkyTrain extension to the Point Grey Campus. As part of the initial analysis, UBC Campus and Community Planning (C+CP) department asked the School of Community and Regional Planning (SCARP) to examine options for and evaluate approaches to accomodating an elevated SkyTrain on the Campus.

This report presents the findings of the project performed by a group of second-year Masters of Community and Regional Planning (MCRP) students as part of SCARP's Planning Studio. The report identifies station placement and alignment options and design strategies aimed at preserving or enhancing the public realm surrounding the stations and guideways. A values-based evaluation framework was developed and used to highlight challenges and possibilities associated with these options. Design strategies were developed to suggest key features for mitigating negative SkyTrain impacts and help achieve human centred design. The findings section applies the design strategies to two alignment options and evaluates their impact on the Campus experience.

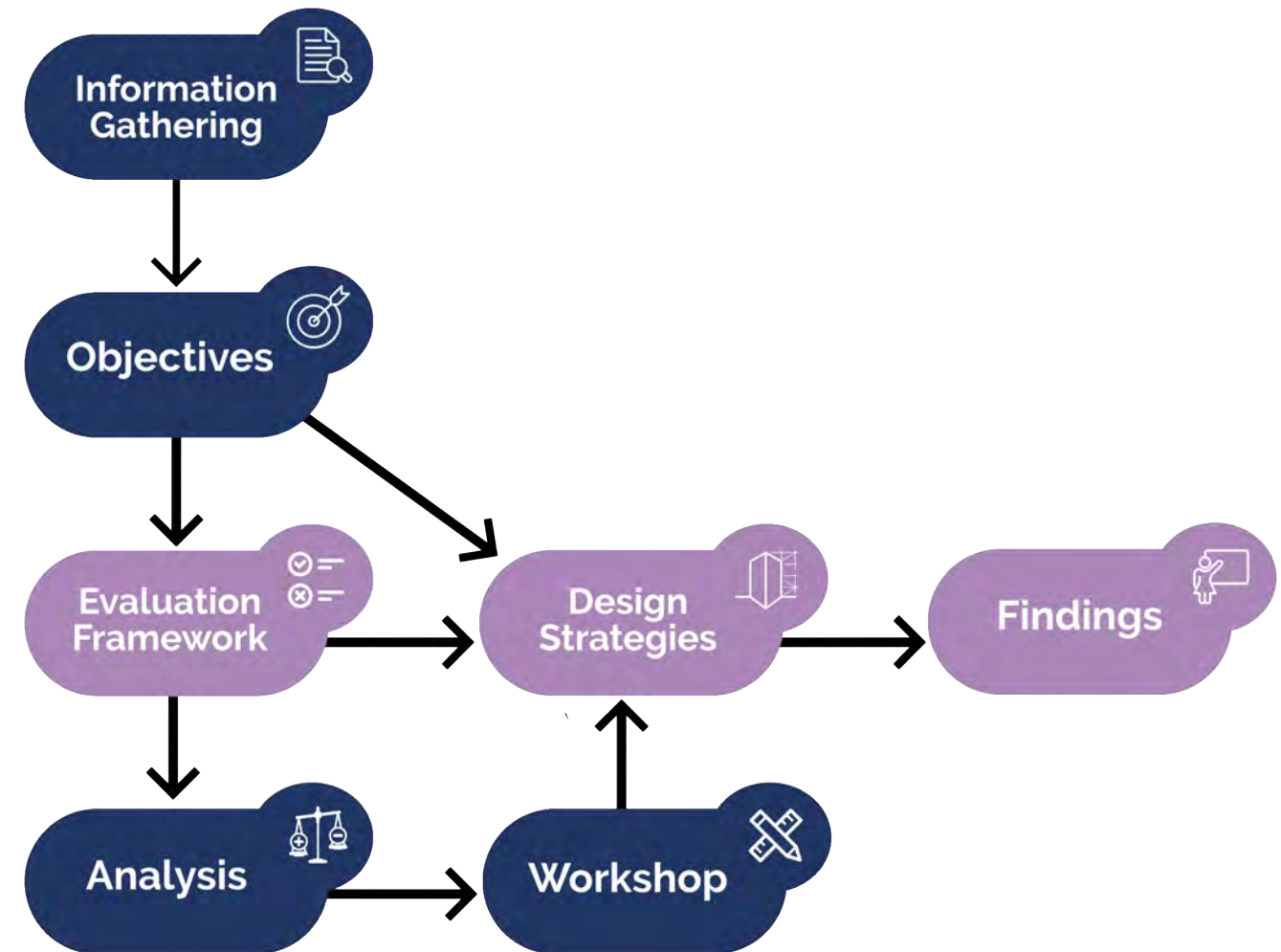
Context Purpose & Scope

SkyTrain has been approved by the Mayors' Council as the preferred technology for an extension of rapid transit to UBC. There is a strong preference from UBC and its partners for an underground guideway and station(s). However, this option is significantly more expensive than an elevated guideway, so C+CP believes it prudent to explore the implications of an elevated alternative.

The purpose of this project is to identify and evaluate approaches to accommodating an elevated SkyTrain on the UBC Point Grey Campus. The options considered include one station serving the academic core and a second station to serve the growing residential community to the south.

The analysis contained in this report does not consider alternative transportation modes such as the preferred underground guideway or improved bus services and does not include stakeholder input.

UBC is located on the traditional, unceded, and ancestral territory of the Musqueam people. It is important to note that they are a partnered governing body in the development and future direction of rapid transit to UBC. The suggestions put forth in this report will be used to inform future public engagement and should not be considered as a final or preferred choice but rather as a piece of the larger transportation network analysis.



Process and Outputs

Information Gathering

Policy Framework

Regional and local policy goals were reviewed to aid in the development of relevant and comprehensive project objectives and evaluation criteria.

SkyTrain Observations

The team observed current Metro Vancouver precedents for SkyTrain station areas to better understand the opportunities and challenges associated with elevated guideways and stations. Overall, the spaces underneath and around station areas in the Metro Vancouver region were found to be car dominated with minimal placemaking initiatives except for spaces directly adjacent to stations. None of the observations found a contextually comparable station to the UBC Campus which is pedestrian oriented and focused on public spaces for recreation and community. In contrast, the stations observed were predominantly commercial and along arterial transportation routes.

Objectives and Evaluation Criteria

The team identified five overarching objectives aimed at balancing transportation needs with livability and community wellbeing. These objectives informed the development of an evaluation framework with criteria and indicators that are consistent with goals and objectives outlined in the policy framework. The evaluation framework is a modified Multiple Account Evaluation (MAE) with values-based unweighted measures.

Project Objectives

Memorable and Accessible: Enhance the Campus Heart and balance placemaking and transportation functions.

Functional Connections : Connect the campus and UBC neighbourhoods not only to the region but to each other as well.

Lived Experience: Minimize negative impacts on existing communities and uses.

Sustainable Connections: Minimize negative impacts on species and habitats.

Access to Nature: Enhance connections to open and green space for community use.

Evaluation Framework

Connectivity: Sustainability and transportation goals should enhance transit networks, support modal integration, and limit potential barriers.

Community: Address the social benefits and impacts of the SkyTrain on campus including personal security, service to campus neighbourhoods, and campus character.

Economy: Support the financial viability of the SkyTrain extension by looking at direct and indirect costs and creating opportunities for future growth at UBC.

Environment: Maintain or enhance permeable surfaces and limit tree removal for stormwater management and protection of species and habitats.

Analysis

Site Analysis

In order to identify initial options, the team conducted a quantitative and qualitative analysis of urban systems at the campus and neighborhood scales. The site analysis outlines the existing conditions of the Campus and provides points of reference to study the effects of elevated guideways and stations.

Stage one Evaluation

The first stage evaluation resulted in a table indicating the performance of eight initial options in meeting overall project objectives. This table allowed for the comparison of advantages and drawbacks of the options. Three options along the main corridors of interest (Wesbrook Mall, East Mall, and University Boulevard) were selected for further exploration of design approaches to mitigate drawbacks and create a complete and balanced campus experience.

Workshop

Industry practitioners were invited to a design workshop to provide insight and explore opportunities for integrating an elevated SkyTrain into the Campus.

The resulting proposals were:

- A two-station alignment along Wesbrook Mall which focused on shaping future growth and enhancing multi-modal connections and passive recreation spaces.
- A two-phased option which focused on creating a memorable and welcoming experience on Campus.
 - Phase 1: A single SkyTrain station on University Boulevard with an alternate mode connecting south residential areas via East Mall.
 - Phase 2: Extension of the SkyTrain along East Mall.

The team synthesized workshop outputs by developing design strategies that could be applied regardless of which option is selected in the future.

Findings

A second stage evaluation was conducted to re-assess implications of each proposal with the design strategies applied. Most of the initial findings and assumptions were confirmed. Key features are presented with conceptual graphics and precedent examples.

The Wesbrook Mall concept preserves the character of the existing campus core and provides opportunities to shape future growth and development. The East Mall concept brings transit users to the Campus Heart and prioritizes the creation of a memorable and welcoming experience to campus and serves the upcoming Stadium Neighbourhood.

Suggestion for Further study

The team outlined suggestions for further study which could supplement the analysis presented here in assessing the impacts of an elevated SkyTrain on campus.

An in-depth study of options for guideway structure and design along the proposed alignment and the implications for the public realm.

A street-spanning station feasibility analysis to indicate both cost and opportunity for the creation of a South Campus gateway to UBC.

Options for the provision of ecosystems services within corridor redevelopment to mitigate the negative impacts on species and habitats which were indicated in all options.

Conclusion

As this is a preliminary step in the larger SkyTrain extension analysis a preferred option was not selected. The team presented an analysis and evaluation of two proposals for consideration along the main corridors of interest, and explored approaches design strategies to mitigate some of the considerable challenges associated with integrating an elevated SkyTrain on the UBC Campus. The findings from this report can be used in future SkyTrain planning processes move forward. The evaluation framework and design strategies can also be applied to underground options to create a complete and balanced campus.

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INFORMATION GATHERING



CONTEXT

The Broadway extension of the Millennium Line to Arbutus has been approved as part of the Mayors' Council vision and fully funded through TransLink's 2018-2027 Investment Plan. The 5.7 km line will extend the existing SkyTrain system from VCC-Clark Station to a new terminus station at the intersection of Arbutus Street and West Broadway (Infrastructure, 2018). The University of British Columbia (UBC) actively supports a further extension of the line to University's Point Grey campus. There is a strong preference from UBC and its partners for an underground guideway and station(s). However, this option is significantly more expensive than an elevated guideway and thus making an investment case for capital funding more difficult. Therefore, the elevated option must be considered.

The Regional Mayors' Council met in February 2019 and recommended SkyTrain as the preferred technology for extending rapid transit to UBC. This endorsement means that Translink will continue conducting technical analysis, developing extension designs, and conducting public engagement to assess support for the project (City of Vancouver Planning Department, 2019; Translink, 2019).

UBC is located on the traditional, unceded, and ancestral territory of the Musqueam people. The Musqueam people have been present in their traditional territory, including the University, adjacent University Endowment Lands (UEL) and surrounding areas, since time immemorial. Musqueam may have an interest in extending the Skytrain to UBC close to their planned developments at Jericho (in partnership with Squamish and Tsleil-waututh First Nations) and the UEL. In the planning studio group's initial meeting with C+CP, it was stated that Musqueam had expressed their preference for an underground guideway to minimize the negative impact on their land; in particular, the University Golf Club and the leləm' ("Block F") development sites (currently under construction).



Musqueam Statement of Intent (Musqueam)

PURPOSE AND SCOPE

The purpose of this project is to identify and evaluate approaches to accommodating an elevated SkyTrain on the UBC Point Grey Campus. Key stakeholders include UBC students, faculty, staff and residents, the City of Vancouver (CoV), TransLink, C+CP, Musqueam First Nation, and residents of neighbouring communities such as West Point Grey, Arbutus Ridge, and Kitsilano. As the project will traverse on the unceded territory of the Musqueam people, it is important to note that they are a partnered governing body. Though we will not be engaging with any stakeholders, this proposal will inform future engagement surrounding a possible extension of the Millennium Line to UBC as well as the upcoming Campus Plan update in 2020.

The UEL is a distinct jurisdiction from UBC or the City of Vancouver as it is governed by the Province of British Columbia (Chong, 2005). Areas in the UEL were considered beyond the scope of this project. However, residential, commercial, and recreational properties in the UEL are considered demand forces that draw people to and from proposed station areas.



University Endowment Lands Context Plan Map. (Chong, 2005, p.31)

RISKS AND ASSUMPTIONS

The risks involved in this project are primarily rooted in the possibility that the design will counteract the engagement conducted to date by TransLink which has indicated a strong preference for an underground alignment and stations.

The stakeholders mentioned previously could also misinterpret this report as C+CP moving forward with elevated SkyTrain plans without consultation. It is important to reiterate that this analysis does not consider alternative transportation options such as the preferred underground guideway or improved bus service. TransLink has considered some of these alternatives in their initial 2010 UBC Line Rapid Transit Study (Steer Davies Gleave, 2012) and further technical analysis conducted as part of the Rail to UBC Rapid Transit Study (Translink, 2019). The short-listed options put forth in this proposal should be used to inform ongoing project development and public engagement and should not be considered as a final or preferred choice but rather as a piece of the planning process.

The team was given specific parameters from Campus and Community Planning on which to base our analysis. These are working assumptions for the purpose of this SCARP study and may not reflect actual project development assumptions:

- A horizontal alignment of the SkyTrain along University Boulevard, westbound from the City of Vancouver boundary to UBC;
- A vertical alignment of an elevated SkyTrain from approximately Blanca street westbound to UBC;
- Two above-ground SkyTrain station locations and associated guideway alignments to serve UBC along either East Mall or Wesbrook Mall with;
 - One station to serve the academic core of campus, generally in the area of University Boulevard west of Wesbrook Mall; and
 - The second station to serve the growing South campus residential community, generally between Thunderbird Boulevard and the Wesbrook Place Neighbourhood.

Technical specifications and assumptions about ridership and capacity requirements were also provided and can be found in **Appendix E**.

POLICY FRAMEWORK

UBC is the largest educational institution and a major employment destination in the region. As UBC continues to grow, regional accessibility will become a more pressing issue. The Regional Growth Strategy (RGS) outlines the need to create strong urban centers located in strategic areas along TransLink's Frequent Transit Network (**Appendix B**).

A SkyTrain extension to campus would improve regional connections to education and employment opportunities (Metro Vancouver, 2011). It is important that the SkyTrain extension helps to achieve the goals and targets identified in the plans and policies outlined here.

The Musqueam Comprehensive Community Plan (CCP) is a high-level, holistic plan that encompasses the key planning areas for the Musqueam community and establishes important values and recommendations (Musqueam First Nation, 2011). Goals and objectives identified in Musqueam's CCP were considered in the development of evaluation principles and criteria (**Appendix C**). Current and future developments near campus, such as leləm' located on University Boulevard within the UEL, were considered as part of the campus scale analysis.

Site specific plans that will inform opportunities for integration of a SkyTrain into the UBC campus include: the ongoing Stadium Neighbourhood planning processes, planned upgrades to Wesbrook Mall, the University Boulevard Precinct Plan and Design Guidelines, the Transit-Oriented Design Guidelines and the Transit Passenger Facility Design Guidelines (Campus and Community Planning, 2017a, 2019; PFS Studio & Public: Architecture + Communication, 2015; TransLink, 2011, 2012).

This policy framework informed the development of the project objectives as well as the Evaluation Framework presented in the following section.

Regional



Metro Vancouver 2040 Regional Growth Strategy

- Sustainable transportation choices contributing to the development of compact urban areas and complete communities along the Frequent Transit Network
- Environmental protection strategies aimed at responding to climate change impacts

Regional Transportation Strategy

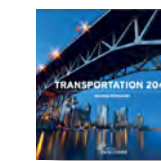
- Make transportation decisions that: provide sustainable transportation choices; support a compact urban area; foster safe, healthy and complete communities; enable a sustainable economy; and protect the environment
- Design our communities and transportation system in a way that: allows for half of all trips to be made by walking, cycling and transit; and to reduce the distances people drive by one-third



Neighbouring Community Plans

Musqueam Comprehensive Community Plan

- Provision for essential public transportation services to Musqueam members
- Fostering cultural and community pride and facilitating connections to build understanding with other communities
- Protection of environmental, natural, and cultural resources
- Increasing investment in economic development



Transportation 2040

Sustainable mode share targets:

- 1/2 of all trips by 2020
- 2/3 of all trips by 2040



Housing Vancouver Strategy

- Landing social and supportive housing near rapid transit investments will be key to meeting the 10-year targets



Renewable City Strategy

Greenhouse gas emissions reductions depend on Millennium Line extension to UBC

UBC Plans



Vancouver Campus Plan

Sustainable, safe, interesting, and vibrant campus strategies:

- More capacity for student housing
- Public realm designed with nature
- Compact campus



UBC Land Use Plans

Vision for a complete integrated university community:

- Opportunity to meet ecological, economic, and community objectives.
- Respectful of the adjacent communities and Pacific Spirit Regional Park
- Places to live, work, and learn



Transportation Plan

Sustainable Travel targets:

- Two-thirds of all trips to and from UBC by walking, cycling or transit (at least 50% by transit)
- Reduce Single Occupant Vehicle (SOV) travel to and from UBC by 20% from 1996 levels (30% reduction in SOV trips per person)
- Maintain daily private automobile traffic at or less than 1997 levels



Public realm plan

Improvements to existing public spaces to communicate visually a sense of cohesiveness and direction on the campus:

- Supports mental and physical health
- Instills a strong sense of place for all



Integrated Stormwater Management Plan

Stormwater flow mitigation strategies:

- Reduce the flow of water and impacts of stormwater flows off campus
- Maintain or enhance water quality at campus boundaries



Climate Action Plan

Transportation targets:

- 100% reduction in GHG by 2050
- Improving cycling infrastructure on Campus

Site Specific Policies



University Boulevard Plan + Precinct Design Guidelines

Visions for a university gateway, vibrant academic and social hub, and complete community



Wesbrook Mall Upgrades

Wesbrook Mall design visions between University Boulevard and 16th Avenue:

- Continuous southbound bike lane along Wesbrook Mall
- Dedicated bus lane southbound along Wesbrook Mall
- Improved pedestrian connections



Stadium Neighbourhood Planning Process

Phase one themes from public engagement processes:

- Locally serving commercial use and amenities
- Transportation connections
- Protection of natural assets



Transit Passenger Facility Design Guidelines

- Integrated design process
- Transit passenger facility typologies and design principles



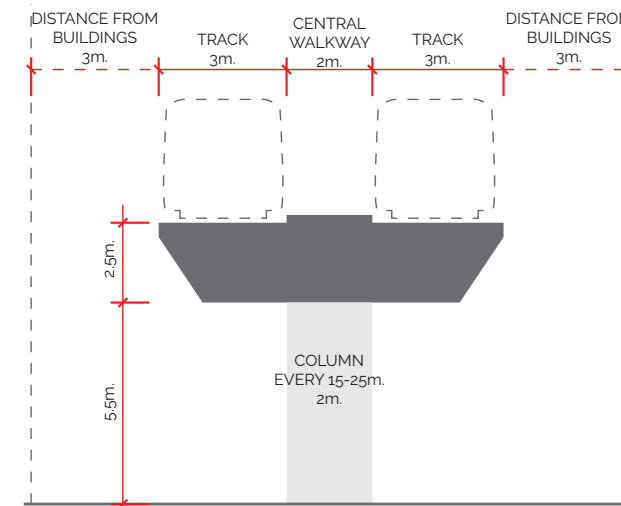
Translink Transit-Oriented Communities

Design Guidelines

- Livability, sustainability, and resiliency goals and indicators

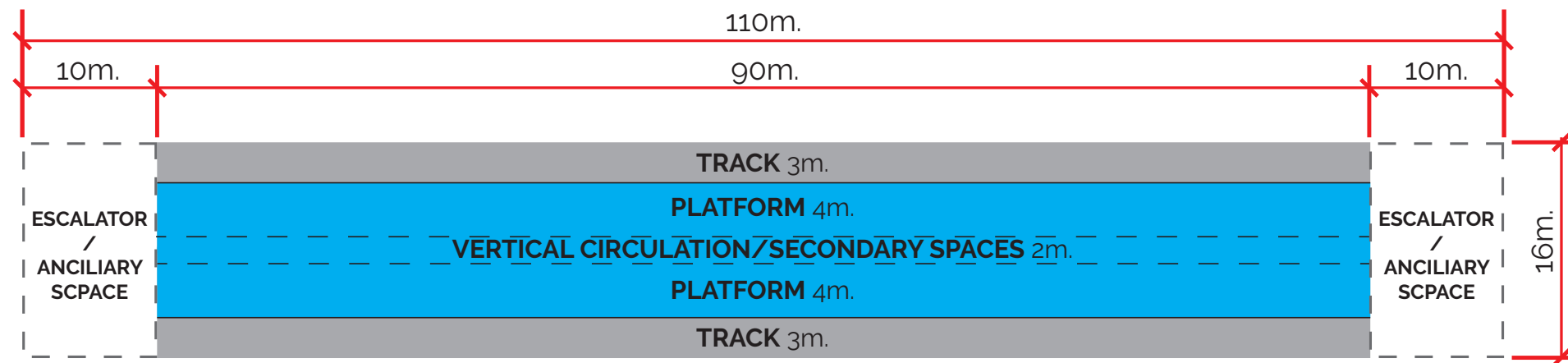
STATION AND GUIDEWAY TECHNICAL ASSUMPTIONS

Technical assumptions were given to the team by Translink and C+CP. These assumptions helped guide the site analysis in the following sections.



Guideway

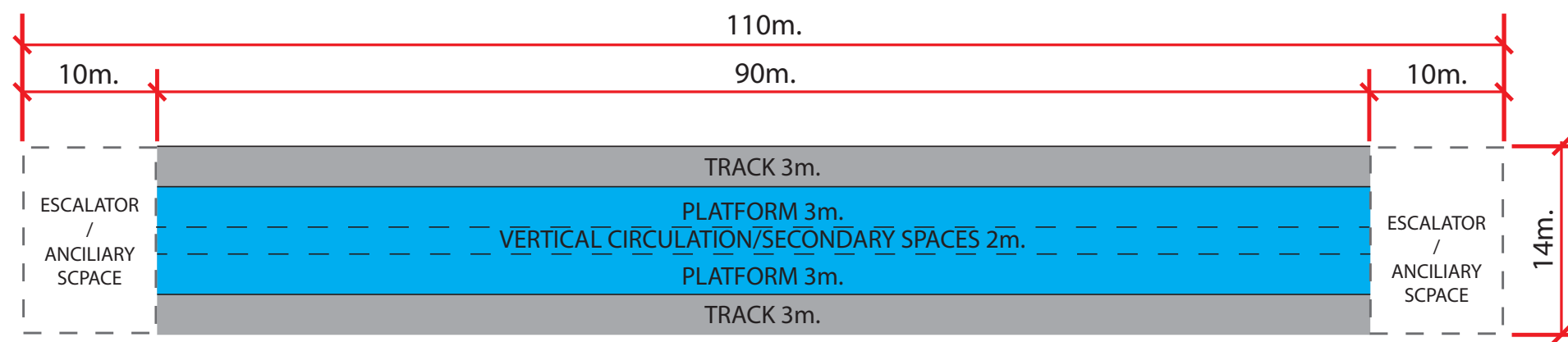
- Width: Two 3m tracks with a 2m central walkway
- Columns and Offsets at Grade: 2m x 2m columns, with a minimum column spacing of 15m
- Depth: 2.5m
- Minimum Height: 5.5m
- Turning Radius: 80m
- 20m of tangent track on either side of any curve



CENTRAL CAMPUS STATION

Central Campus

- Peak hour assumption: 24 trains/hour x 400 passengers/train (96000 people per hour)
- Multiple entrances to distribute flow



SOUTH CAMPUS STATION

South Campus

- A single main entrance
- No peak hour assumptions given

VANCOUVER PRECEDENTS: SKYTRAIN OBSERVATIONS

An experiential analysis of the physical and functional characteristics of elevated SkyTrain stations and guideways in the Metro Vancouver area was conducted to inform the development of project challenges and objectives for evaluation of station areas and guideway routes on Campus.

Stations

Surrounding Land Use

- Commercial areas and corridors are found around the busiest stations such as Metrotown and Commercial Broadway.
- Large flows of potential customers make this area attractive for retail and office space.

Public Space Design

Stations tend to be next to:

- Main vehicular corridors highways or arterial roads
- Urban open spaces
- Parking lots or service roads

Large amounts of open space for pedestrian and cyclist flow and way finding were observed.

Terminus Station

- Terminus stations that we visited incorporate a tail extension beyond the station that tends to be an imposing structure into the space.
- This "tail" extends approximately 70m at the Lafarge Lake-Douglas Station. Tail tracks are often included to provide operational flexibility (e.g. to facilitate turn-around and serve as storage space for out-of-service trains). They may not be required in all cases, however. Specific operational needs of a UBC terminus station are not yet known.



Commercial area around Metrotown Station



Metrotown Station



Landscape around King George Station

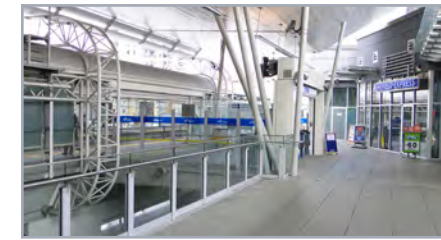
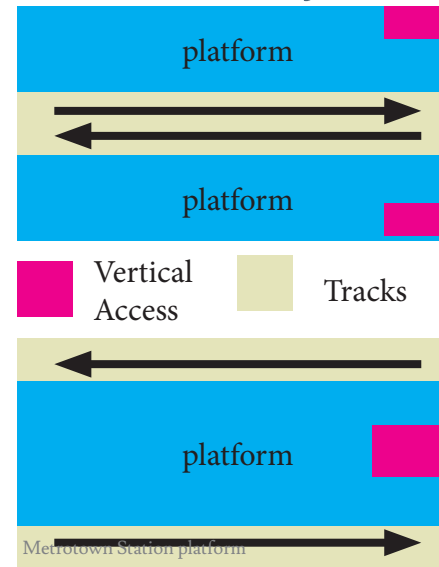


New Westminster Station within the mall



Lafarge Lake-Douglas Station tail

Platform Layout



New Westminster Station platform



Metrotown Station platform

Side Platforms

Two separate platforms with rails in-between them.

- Independent set of vertical circulation
- Boarding is more orderly since cross circulation is avoided, especially during rush hour.
- Incoming rails can maintain their dimensions outside of the station since they do not need to slit to accommodate a central platform.

Central Platform

A single platform space for both directions with the rails on each side.

- Common set of vertical access and entrances
- Passengers who want to immediately take a train going to the opposite direction do not need to go to a different platform.
- During peak hours, with heavy demand towards a single direction, passengers can occupy a larger area.

Stand-Alone

Stand-alone stations are independent structures usually located at the middle of major roads.

- They are often located at the middle of wide roads or other open spaces.
- They require touch down pedestrian access.
- These can be less disruptive of neighbouring uses as there are often large spaces (usually highways) between the station and other buildings.
- As they are independent from other uses, its planning and construction is more flexible since it is not tied to additional programming.

Integrated

Integrated stations are part of another building's structure

- Can reduce the visual, shadowing, and noise impact in cases where the street cross-section is narrow.
- Uses within stations are primarily commercial for the floors directly adjacent to guideways and station platforms such as the Vancity office building at the Main Street Science World station. They can also include mixed-uses with residential and office components.
- Sound and vibration impact on the building are notable but can be mitigated with construction techniques over station, guideways, and on adjacent buildings.
- Shared services and/or circulation with other uses imply potential maintenance and operational cost savings.

Materials

The columns and guideways in Vancouver are mostly made with concrete with no special finishes.



Lafarge-Lake Douglas guideways



Urban spaces under guideway by to Lafarge-Lake Douglas Station

Turning Radius

Areas adjacent to sharp turns are mainly over open spaces and arterial roads.

- Curvature radius of 80-100m were found.



Lafarge-Lake Douglas guideways



Conventional Vancouver guideways support structure vs. dual column structure for provision of public space.

Noise

Buildings directly adjacent to the tracks do not open onto the tracks or have substantial soundproofing or barriers.

- Noise appears to increase in pronounced curved segments of the guideways
- Most stations are adjacent to busy arterial roadways whose noise is often more or equally disruptive than that produced by the Sky Train.



Curve guideway segment next to Science World Station

Elevated-Underground Transition

Visual and physical barriers for a considerable length creates placemaking and security problems.

Experiential impact of streetscape surrounding this transition is primarily negative at New Westminster station.

- Businesses with entrances to this space are primarily those aimed at under-served and marginalized groups.



Guideway transition close to New Westminster Station

Placemaking Opportunities

- The quality of space underneath the tracks is minimal. It is usually underutilized or used for parking.
- Pedestrian/Bicycle pathways below tracks are mainly hardscaped.
- Areas under the curve are generally large open spaces.
- There are potential place-making opportunities to use them for active and passive recreation.
- Dual column structures can also provide opportunities where space is more limited.

In general, we found spaces underneath and around station areas in the metro Vancouver region to be car dominated with minimal placemaking initiatives except when directly adjacent to stations. Guideways and stations were mostly next to arterial roadways and commercial spaces, with residential land uses being separated from guideways and stations by large urban open spaces.

In contrast, the UBC Campus is dominated by pedestrian movement and focused on public spaces for recreation and community use. As none of the observed stations closely resembled the UBC campus context, the implementation of a SkyTrain on campus poses a greater challenge as the current Metro Vancouver precedents may not be applicable.



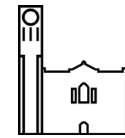
The Underline in Miami (James Corner Field Operations) represents an opportunity for placemaking underneath the guideway.

OBJECTIVES AND EVALUATION FRAMEWORK



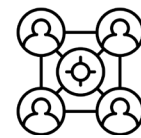
OBJECTIVES

The planning studio team identified five objectives that aligned with objectives, goals, and strategies identified in the Vancouver Campus Plan, Land Use Plan, Transportation Plan, the Regional Transportation Strategy, and Musqueam's CCP. These objectives are aimed at balancing transportation needs with livability and community wellbeing. They are informed by the policy research and SkyTrain observations that have been conducted by the team and consider the observations of current Vancouver SkyTrain station areas and guideway implications. These goals informed the development of an evaluation framework which was used to assess a set of initial options and identify a shortlist to be further developed in later stages of the project.



Memorable and Accessible

Enhance the Campus Heart and balance placemaking and transportation functions.



Functional Connections

Connect the campus and UBC neighbourhoods not only to the region but to each other as well.



Lived Experience

Minimize negative impacts on existing communities and uses.



Sustainable Connections

Minimize negative impacts on species and habitats on UBC's Vancouver Campus.



Access to Nature

Enhance connections to open and green space for community use.

EVALUATION FRAMEWORK

The evaluation criteria were identified through a review of existing documents (**Appendix D**) including:

- Existing plans and policies from Canadian cities related to transit network analysis transit-oriented development (TOD), and transit technology option evaluations
- Social policy related to TOD
- Sustainability measures relevant to the UBC Campus

The evaluation principles and indicators were used to assess how well options and proposals met the overall objectives listed above. The criteria are listed in categories to help maintain a consistent evaluation process. The principles and indicators have been listed separately but it should be noted that they are fundamentally interconnected. Therefore, their implications cannot truly be isolated from one another.

This is a Multiple Account Evaluation (MAE) framework with qualitative, unweighted measures. The evaluation framework was used to create a shortlist of options (Highway Planning, 2015). With this framework, we estimated a positive, negative, or neutral impact on criteria.

This framework can be applied in future analysis and is not limited to elevated stations and guideways.

Community

The community principle addresses social benefits and impacts of the SkyTrain on campus including personal security, service to campus neighbourhoods, and campus character. This category focused on the smart growth principles identified in the Vancouver Campus Plan by providing connections to a complete range of academic and community needs within compact and strategic development patterns. Linkages to adjacent neighbourhoods, parks, and open space are considered key objectives in this category. The community principle also aims to minimize negative sensory impacts caused by the noise, light obstruction, and vibration from the SkyTrain (OHM Planning, 2018; Pendakur & McLean, 1989; TransLink, 2009). Station plazas and entrance areas are the introduction to the TransLink customer environment and a gateway to the neighbourhood. Station area landscaping should reflect this quality (Sas-Bojarska & Rembeza, 2016).

ENHANCE URBAN OPEN SPACE

- Maintain or enhance open/green space networks
- Potential to utilize space underneath and adjacent to guideway/station

SUPPORT MIXED-USE HUBS

- Proximity to existing mixed-use nodes
- Proximity to trip generators and destinations
- Connects communities within campus
- Supports safe movement throughout the day

EMPHASIZE CAMPUS HEART

- Emphasize the heart, gateways, and pathways
- Integration with existing academic communities and neighbourhoods

MINIMIZE NEGATIVE SENSORY IMPACTS

- Proximity to residential and academic buildings
- Visual, noise, light intrusion, vibration during construction
- Visual, noise, light intrusion, vibration after construction

OPPORTUNITY TO SHAPE COMMUNITY GROWTH

- Proximity to vacant or developable sites
- Proximity to underutilized space

Connectivity

The objectives identified in the connectivity principle focus on sustainability and transportation goals outlined in the Vancouver Campus Plan. Bringing together students, staff, faculty, and local neighborhood residents and integration with pedestrian and cyclist networks were the main considerations in our analysis. Psychological and physical barriers were also considered as they can limit access by fragmenting spaces. Barriers are typically components such as wide, busy streets, walls, train tracks, or inadequate crossing (Sas-Bojarska & Rembeza, 2016). Connections to regional and local transit options were also considered as measures of connectivity.

ENHANCE TRANSIT NETWORKS

- Proximity to transportation networks
- Disruption to flow during construction

SUPPORT MODAL INTEGRATION

- Pedestrian network connectivity
- Cycling network connectivity

LIMIT POTENTIAL BARRIERS

- Number of potential borders
- Potential for design interventions to reduce impact of borders
- Enhancement or preservation of east-west and north-south connections

Economy

The Economy principle aims to support the financial viability of the SkyTrain extension. The approval of the SkyTrain extension is largely influenced by cost. Therefore, minimizing cost where possible is a primary objective. The direct cost of the SkyTrain extension is impacted by guideway and station construction. The indirect cost is impacted by the degree of infrastructural improvements needed to accommodate the increase in pedestrian flow or mitigate sound, vibration, and light intrusion. Apart from minimizing direct and indirect costs of the project, this category seeks to identify opportunity for economic growth at UBC. Alignment and proximity to current and future key residential and commercial areas was a factor in this analysis as an indicator of potential land value capture (CPCS, n.d.).

MINIMIZE DIRECT SKYTRAIN COSTS

- Route Length
- Design Complexity

MINIMIZE INDIRECT INFRASTRUCTURE COST

- Increasing capacity of services/infrastructure for pedestrian flow
- Limit disruption to service roads
- Adapting buildings to SkyTrain related disruptions

POTENTIAL FOR LAND VALUE CAPTURE

- Proximity to existing and planned development
- Proximity to key residential areas

ALLOW FOR FLEXIBILITY

- Proximity to vacant, developable sites
- Proximity to sites identified for redevelopment or replacement
- Proximity to surface or above ground parking lots with potential to be removed or relocated
- Consideration of special design guideline areas

POSSIBILITY FOR FUTURE EXPANSION ¹

- Option to extend the system in the future

Environment

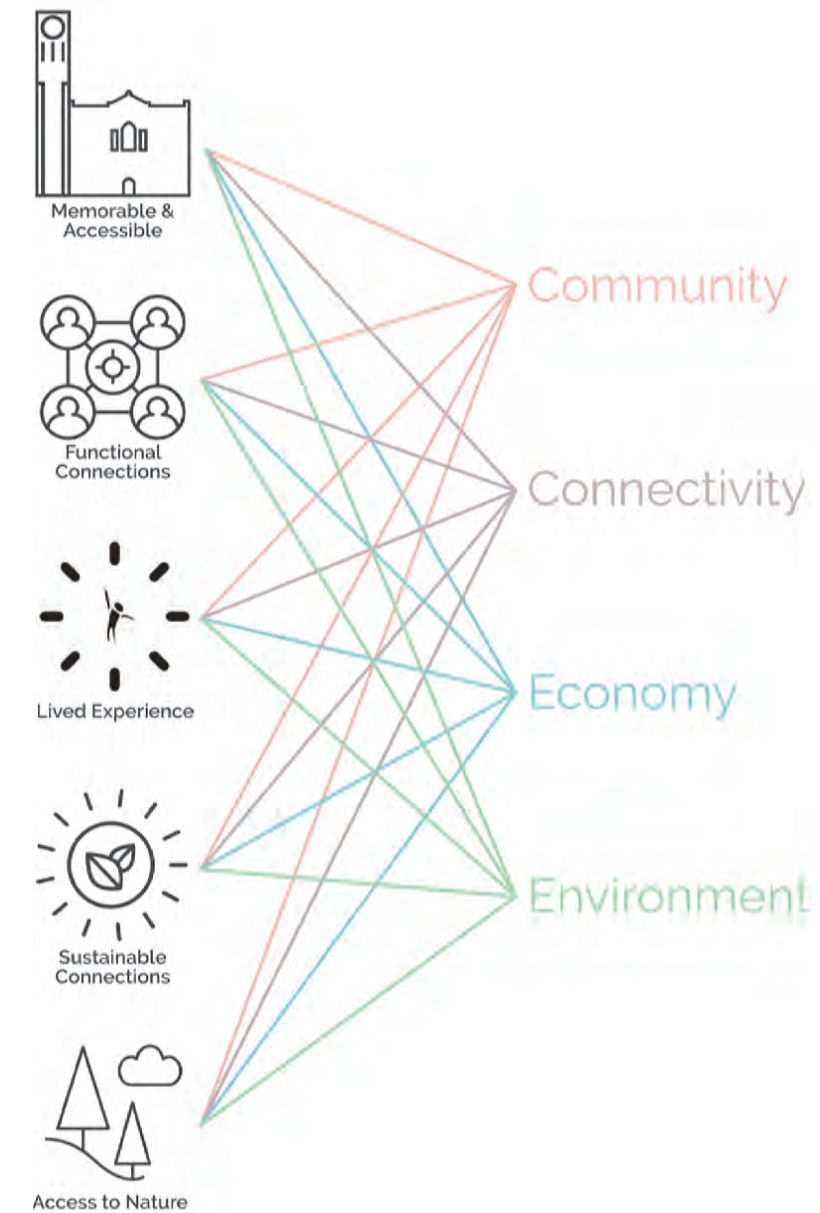
The Environment principle aims to maintain or enhance permeable surfaces and limit tree removal for stormwater management and preservation of habitat and habitat connections. UBC campus is home to a variety of species and habitats, all of which will be impacted by an elevated guideway (Dyck, 2016). Construction will also reduce permeable surfaces which can generate increased runoff during rainfall and increase stormwater peak flows (Campus and Community Planning, 2017b). Natural settings throughout Campus are also highly valued by the UBC community (Campus and Community Planning, 2017a). A comprehensive environmental impact assessment will be required in the future for the suggested station and guideway locations.

MINIMIZE DEGRADATION OF SPECIES AND HABITATS

- Proximity to sensitive habitats
- Tree and habitat displacement
- Corridor and linear connection of green spaces

MAXIMIZE RAINWATER MANAGEMENT

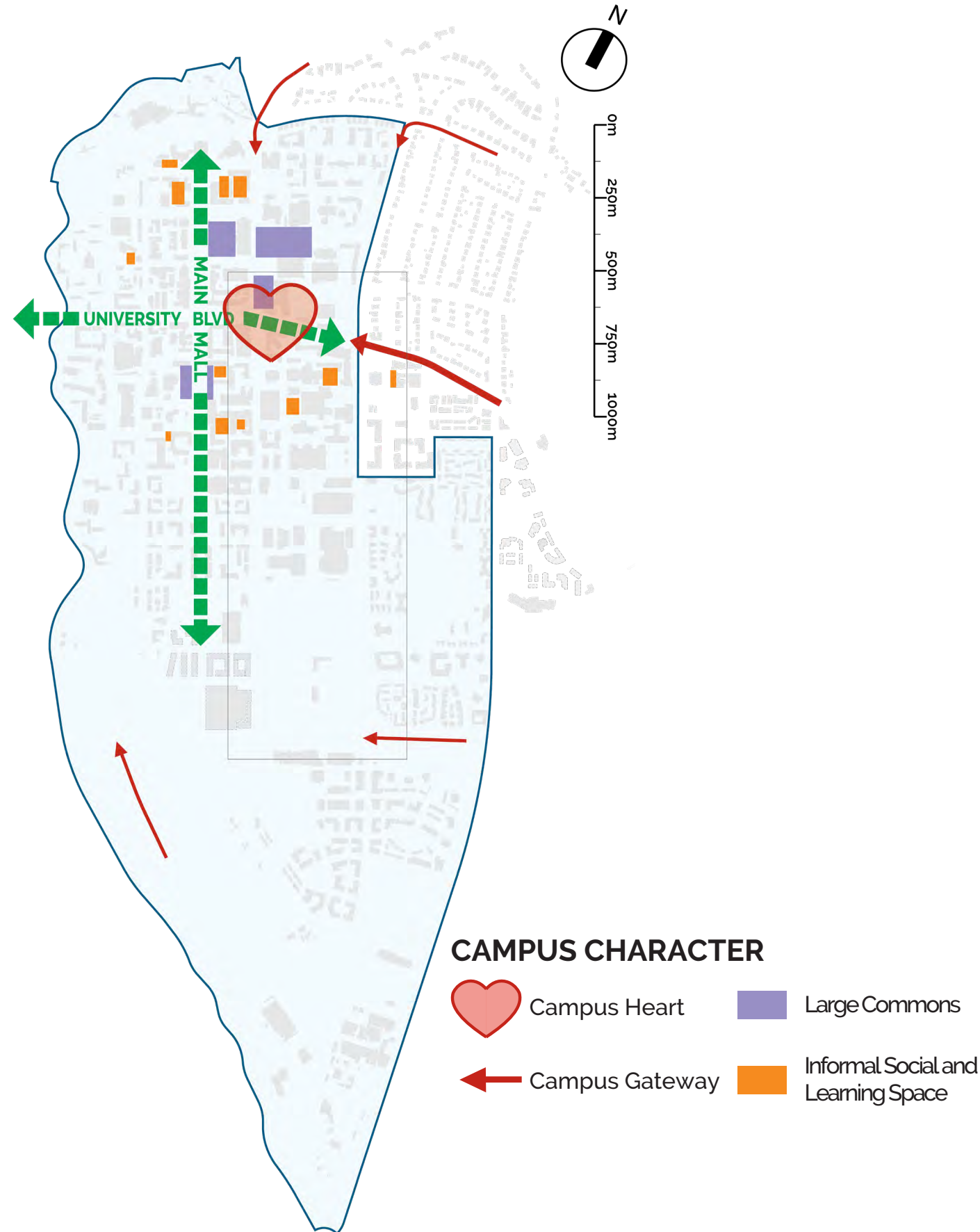
- Minimize removal of permeable surfaces
- Slope runoff/ direction
- Removal of trees



¹ Possibility for future expansion was added to the evaluation framework after the workshop and was used as an indicator in the evaluation of the final two proposals.

ANALYSIS





SITE ANALYSIS

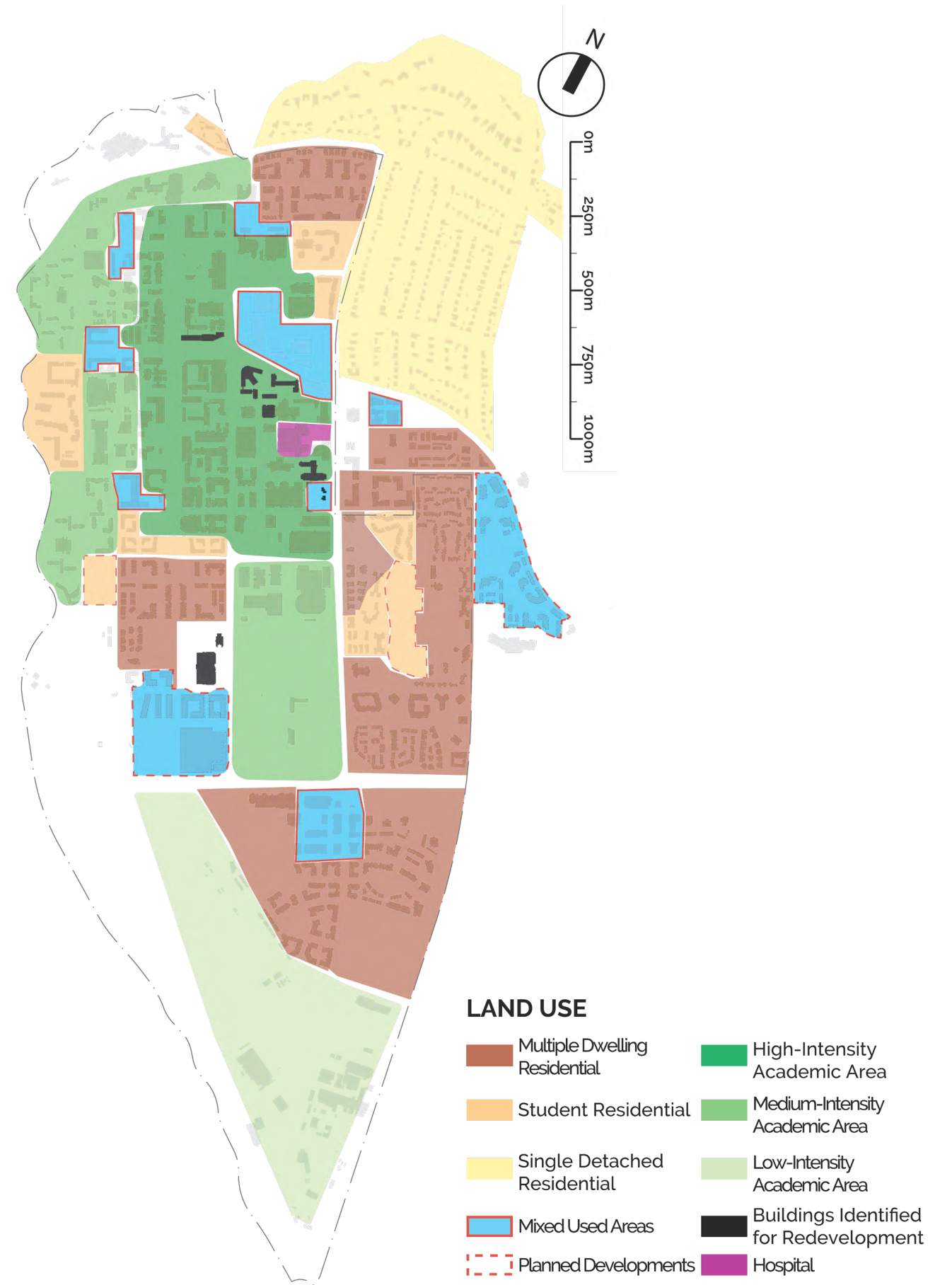
Campus Scale

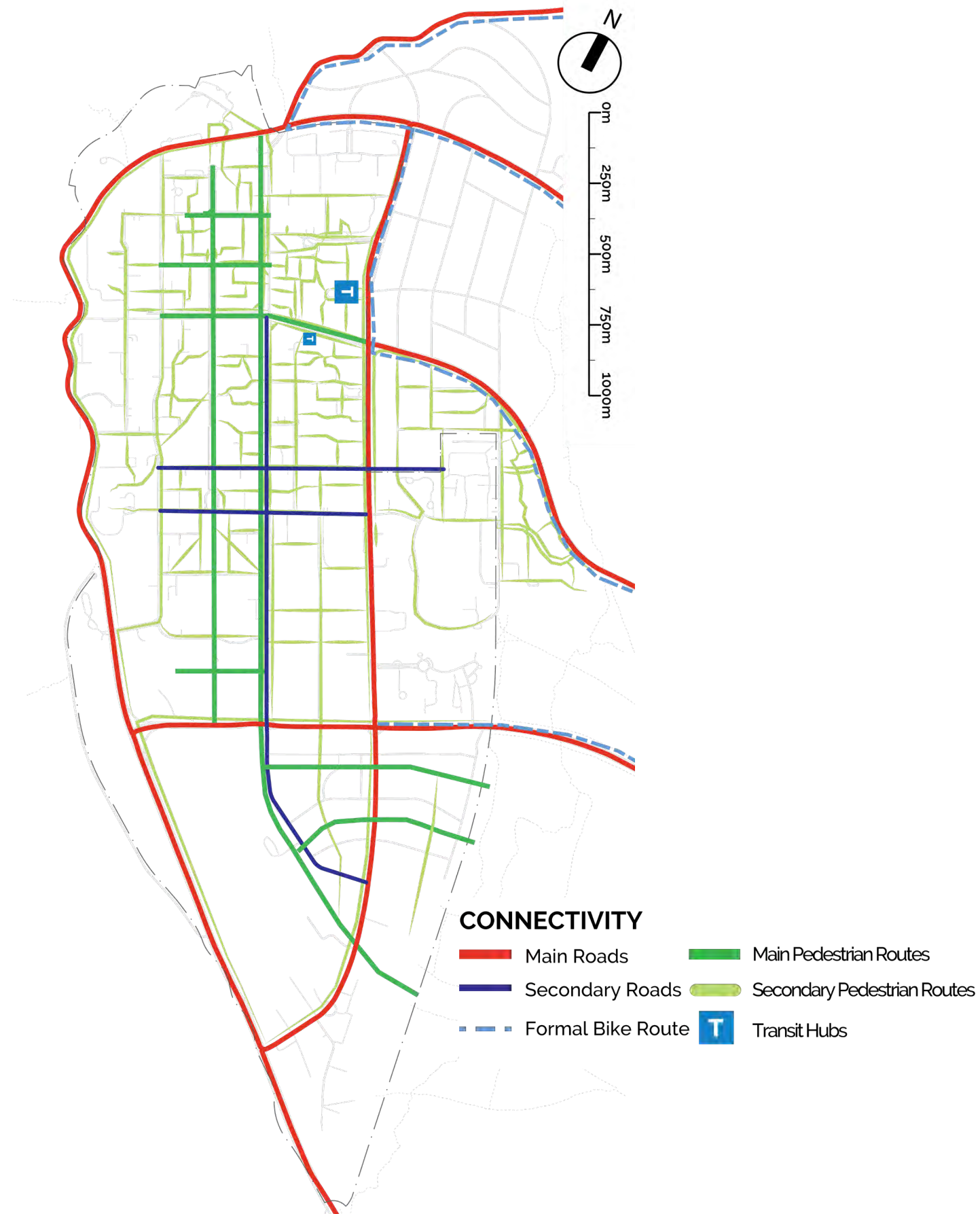
Campus Character

The campus is articulated through two organizational spines: Main Mall and University Boulevard. These are historically and geographically significant to the campus and provide viewpoints toward Howe Sound and the Coastal Mountains. A number of important urban open spaces are located along these paths. At the intersection of University Boulevard and East Mall, the Campus Heart represents the symbolic academic and social centre of campus. The Alma Mater Society (AMS) Student Nest and Alumni Centre are prominent landmarks of this location. Important university and public events are held in this area. The campus gateways are the main access points to UBC. They are located along University Boulevard, Chancellor Boulevard, West 16th Avenue, and South West Marine Drive. The University Boulevard gateway, within the Campus Heart, is considered by C+CP to be the most significant entry point to the campus .

Campus Land Use

UBC's academic population is more than 55,000 students and 15,000 faculty and staff. The academic area occupies most of the campus, with higher concentrations of buildings along Main Mall, East Mall, and University Boulevard. There are more than 11,000 people living in the residential neighbourhoods and nearly 12,000 students living in on-campus student housing. Residential areas are concentrated at the outer edges of the academic core with mostly high and medium-density buildings. Mixed-use hubs are shown as indicators of community use and important trip generators. There is a high density of academic, recreational, and mixed-use buildings around the Campus Heart and along University Boulevard. Other hubs are located within residential areas and Wesbrook Village to the south. Outside the Campus boundaries, the University Village is an important commercial and residential area along University Boulevard. The future Stadium Neighbourhood at the intersection of East Mall and West 16th Avenue is expected to become an important mixed-use hub. The Ielam' development project will also incorporate a considerable number of high-density residential units and commercial activities outside the campus boundaries.





Campus Connectivity

The Campus is surrounded by the following major roads: University Boulevard, Chancellor Boulevard, West 16th, and Southwest Marine Drive. University Boulevard and Main Mall are the major pedestrian paths on campus. The Campus Heart is an important convergence of multiple transportation modes with diesel and trolley bus exchanges within a 5-minute walking radius.

Neighbourhood Scale

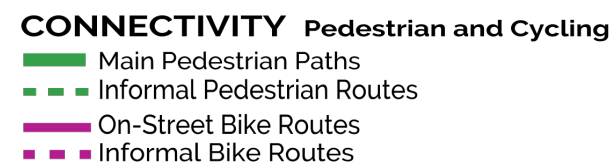
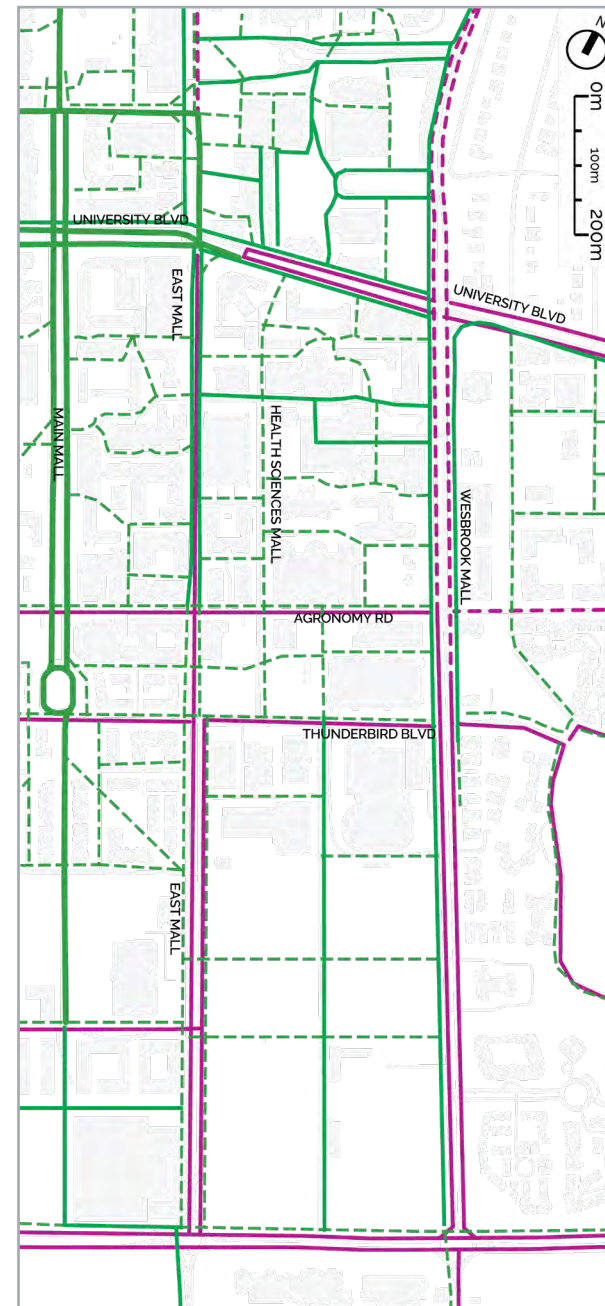
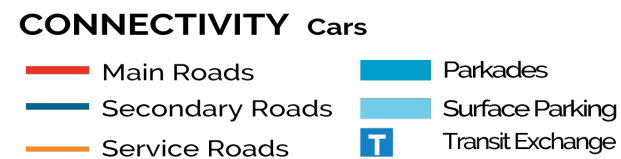
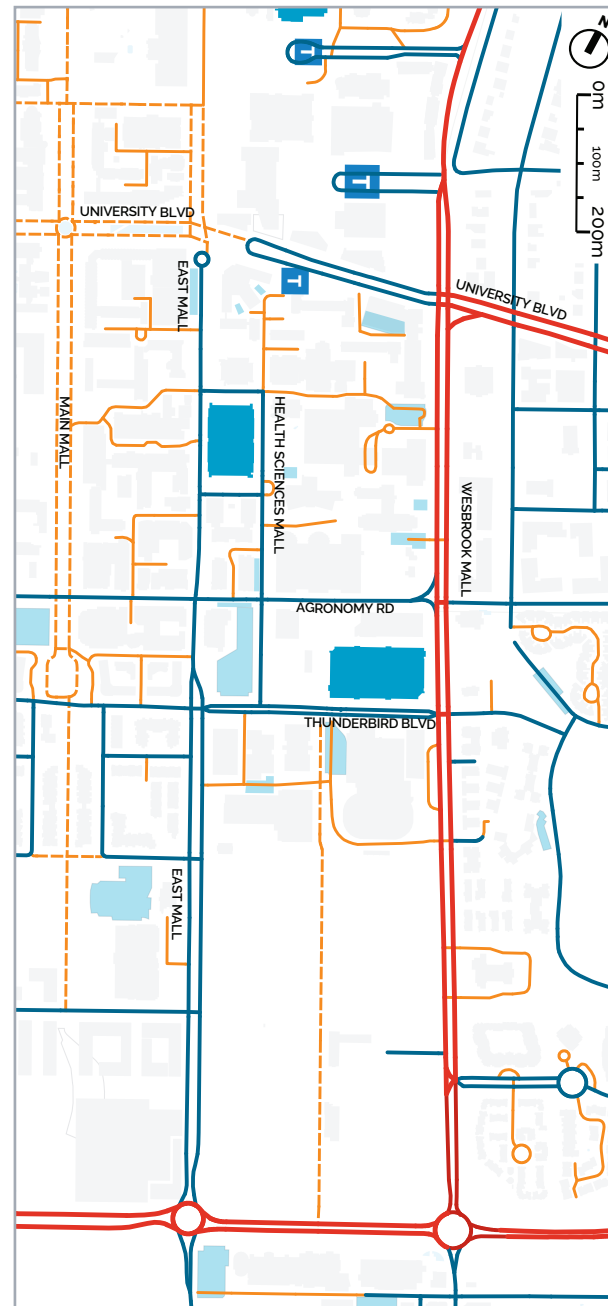
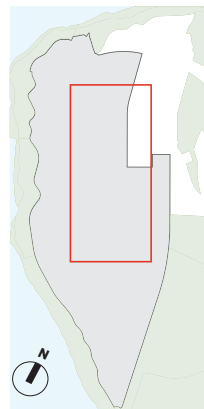
Corridor Connectivity

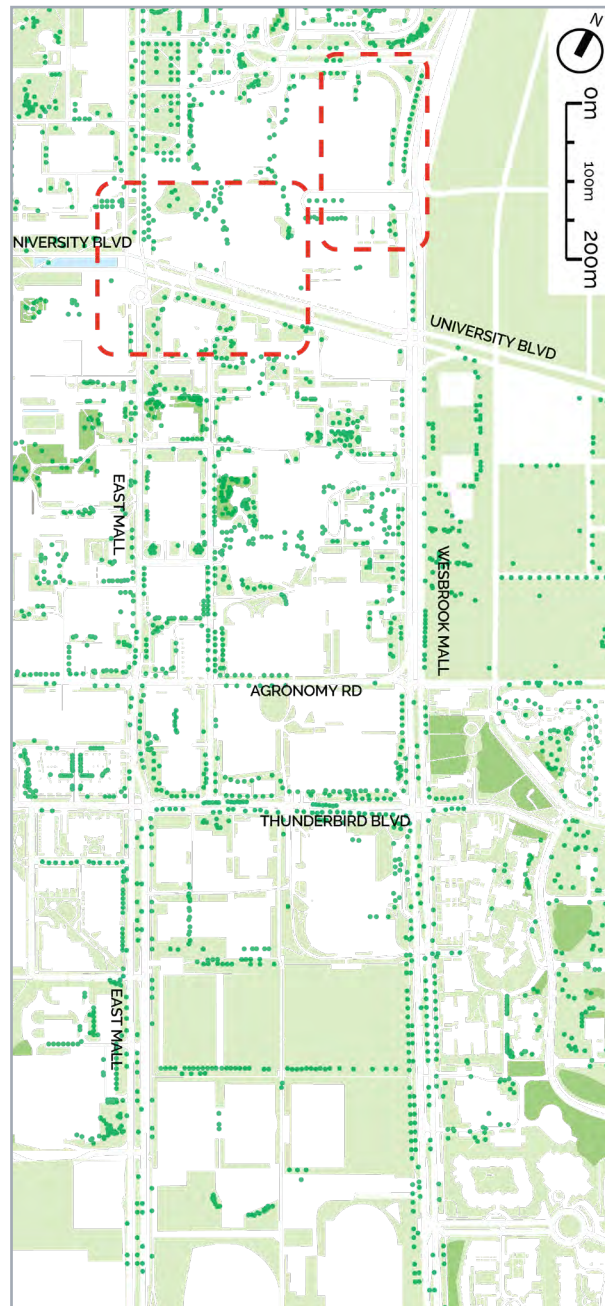
Wesbrook Mall is designed to accommodate high volumes of vehicle traffic including the majority of bus routes terminating at UBC and is not currently a very pedestrian-friendly environment. Service vehicle roads accessed from East Mall and Wesbrook Mall will require consideration with any modifications of roadways.

The intersection of University Boulevard and East Mall is a major connector for both pedestrian and cycling routes. Formal bike paths circumvent the campus core except for routes along Wesbrook Mall and East Mall, south of Agronomy Road.

Opportunity Areas

The Vancouver Campus Plan predicts that a 33 percent increase in floor space will be needed to accommodate projected growth. Rapid transit stations will influence where this density is added. Sites planned for redevelopment allow for potential densification and reimagining of the space. Parkades and surface parking lots along East Mall and Wesbrook Mall were also identified as areas of opportunity. These spaces could be utilized to enhance gateways and multimodal connections to the campus core and UBC neighbourhoods.





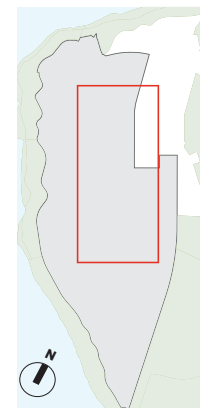
ENVIRONMENT

- Permeable Surfaces
- Forested Area
- Trees
- Potential Flood Risk



BUILDING SENSITIVITY

- High
- Medium
- Low



Environment

Considerable permeable surfaces are located on the sides of East Mall and along the center and sides of University Boulevard and Wesbrook Mall. These areas have varied proportions of grass with shrub and small tree cover. An abundance of trees is found along University Boulevard, Wesbrook Mall, and East Mall corridors. Forest fragments can be found along Wesbrook Mall and at the South end of East Mall; species in these areas may susceptible to disruption. The intersection of University Boulevard and East Mall as well as the Stadium Area are identified as susceptible to stormwater flooding by the UBC Integrated Stormwater Management Plan.

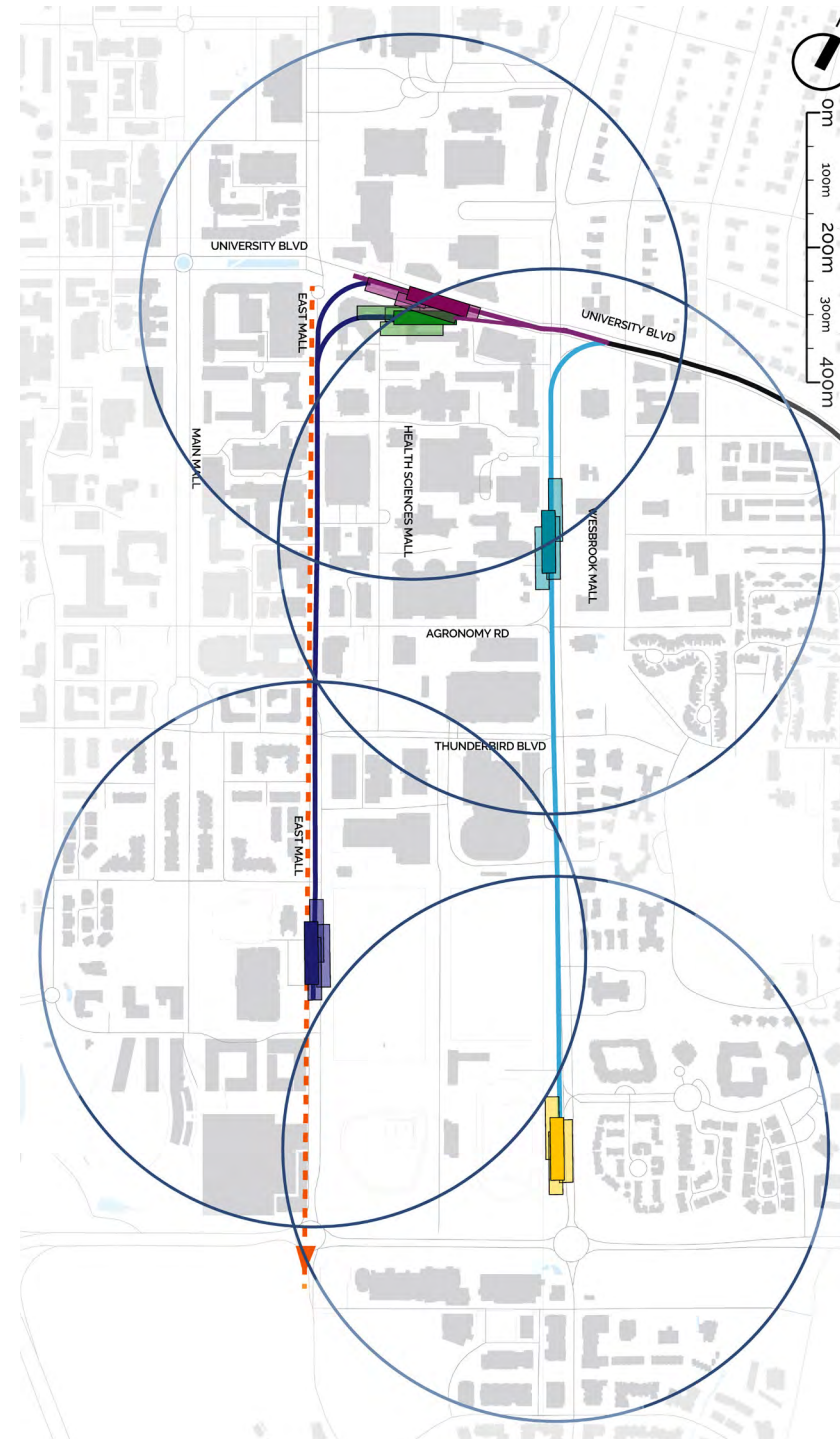
Sensitive Areas

Buildings along East Mall would be more affected by sensory impacts such as noise and vibration due to the narrow right-of-way, concentration of research uses, and the presence sensitive research equipment. University Boulevard's right-of-way is wider, but new residential buildings would be also be affected by the noise and vibration of a guideway. The wider right-of-way of Wesbrook Mall allows for a greater degree of separation from residential buildings to the east.

Initial Options

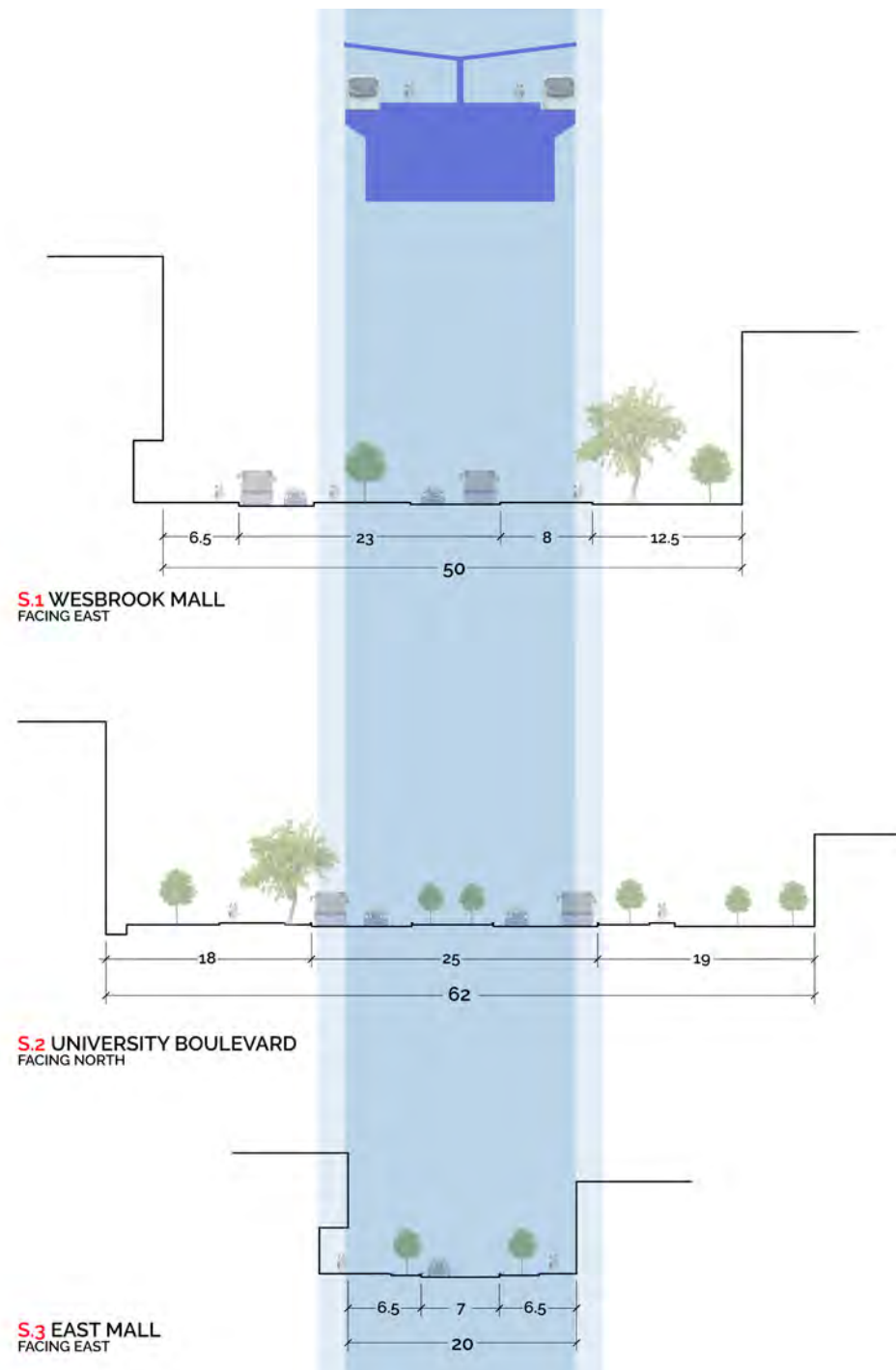
Based on the site analysis and assumptions provided, the team drafted eight alignments along University Boulevard, Wesbrook Mall, and East Mall. At this stage, station areas were identified but did not include the exact station footprints.

After identifying these initial options based on the above site analysis, the team explored corridor and station area challenges and possibilities. This zoomed in analysis helped to inform the first phase of evaluation which was intended to narrow the scope of options to continue developing in the design stage.

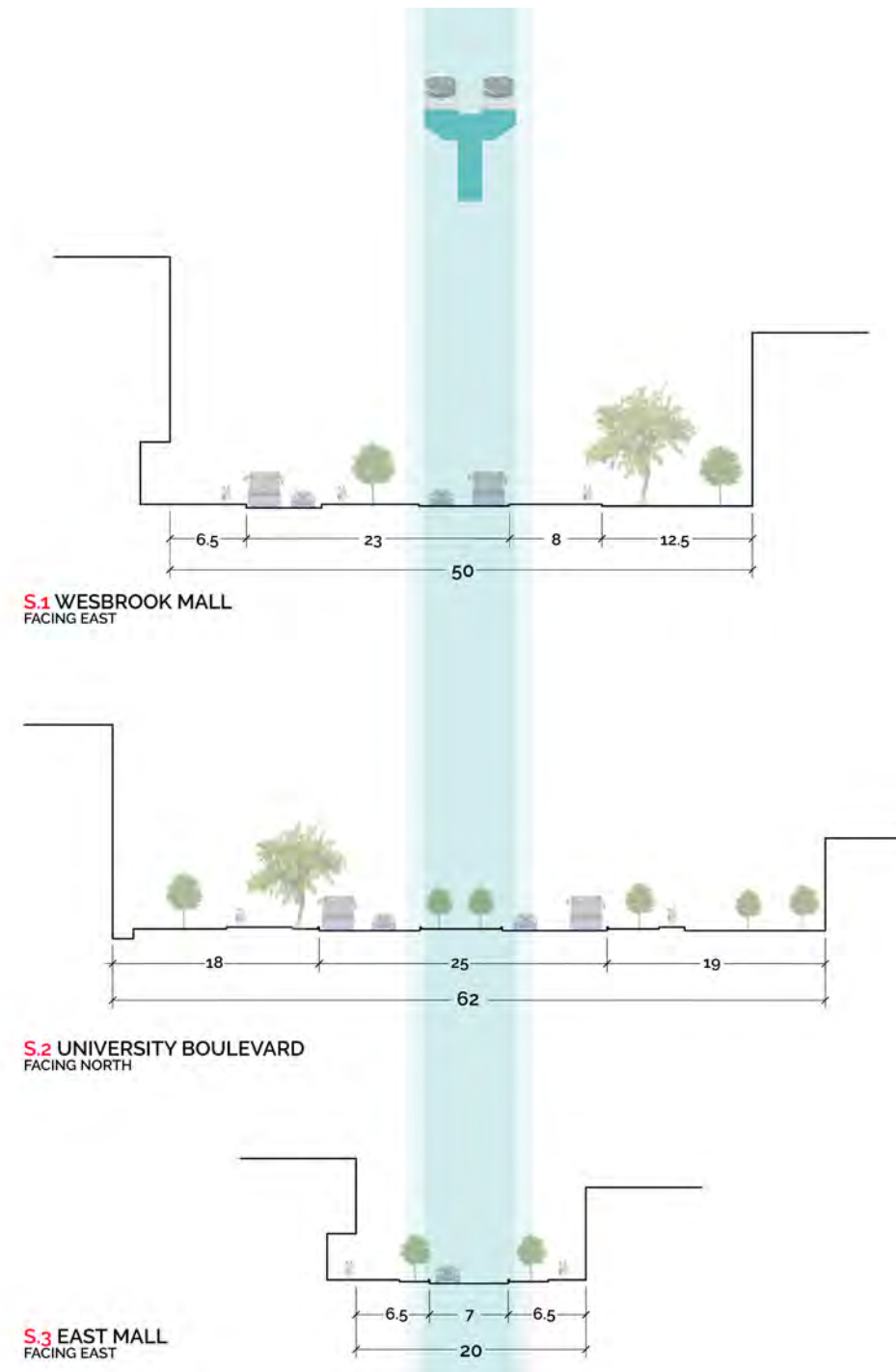


- Option 1 (A1)
- Option 2 (AB1+4)
- Option 3 (A1+Alternate Mode)
- Option 4 (A2)
- Option 5 (AB2+4)
- Option 6 (AB2+Alternate Mode)
- Option 7 (C3)
- Option 8 (C3+5)

Routes	Stations
— Common	■ Station 1
— Route A	■ Station 2
— Route B	■ Station 3
— Route C	■ Station 4
- - - Street Car	■ Station 5



Corridor sections indicate the space requirements of a standard 20 metre central station with a central platform. These technical specifications help identify station location possibilities and space requirements.



Corridor sections indicate the space requirements of a standard 8 metre guideway between buildings with a 3 metre buffer for construction.

Corridor Challenges and Possibilities

The cross-sections along the main corridors allowed us to visualize the proportions of the guideways and stations in relation to the available physical space. These sections indicate implications such as proximity to buildings and disruption of the existing streetscape including road networks, pedestrian paths, green spaces, and permeable surfaces.

This helped to classify an area's sensitivity to shadowing, noise, and vibration. Areas with more narrow street sections are considered to have higher sensitivity and require more intervention to accommodate both guideways and stations.

This analysis also indicates potential impacts on streetscape and public realm experience beneath these structures. Corridors with wider sections provide greater opportunity to maintain or enhance pedestrian and cycling networks.

Station Area Key Challenges and Possibilities

Pedestrian Shed

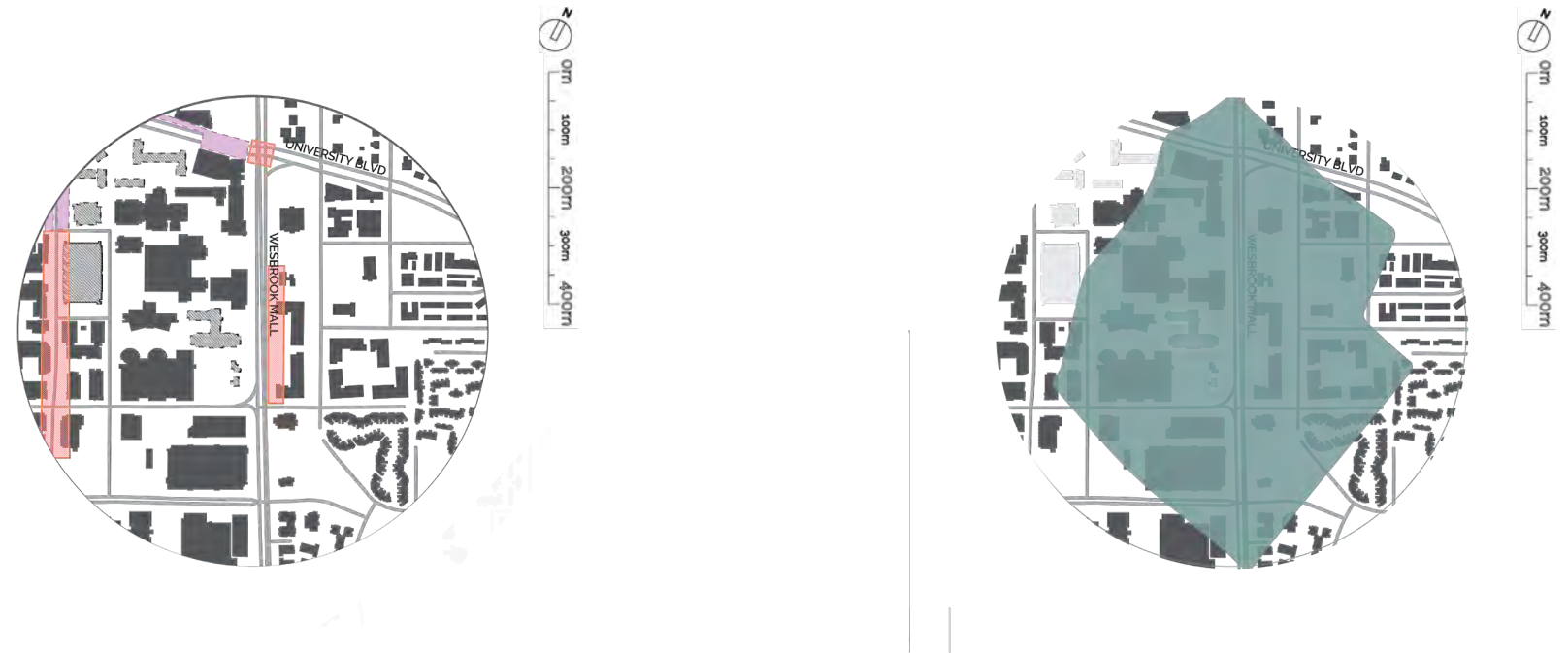
The "pedestrian shed" is considered to be the distance people are willing to walk before opting to drive. Based on the average walking speed, a five-minute walk is represented by a radius of 400 meters.

Wesbrook Mall North

Wesbrook Mall is a primary connector of the academic and south campus neighbourhoods and a regional connector to UBC.

This site is well connected to residential, academic, and commercial uses. However, Wesbrook Mall creates a barrier from East to West. Currently, it is a car-dominated street and not intended as a major pedestrian or public realm route.

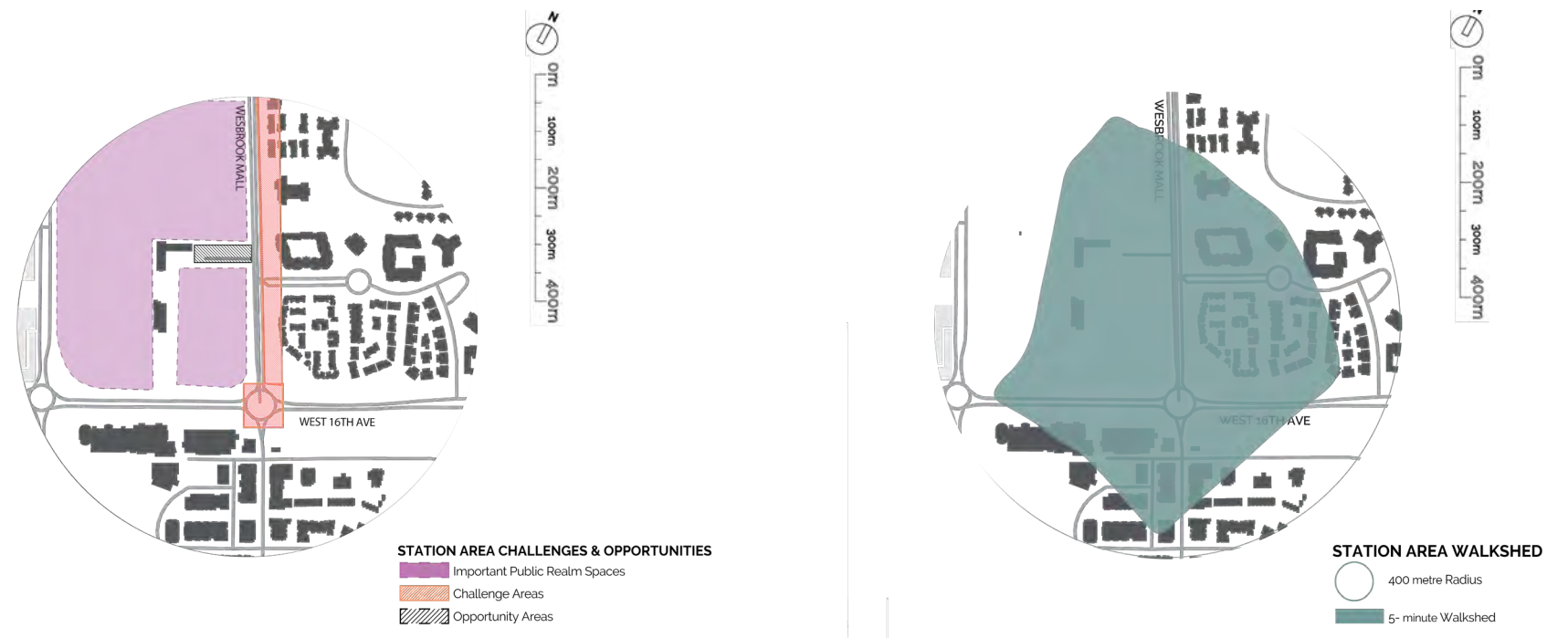
The main challenge of this site is connecting the station to both the Campus Core to the West and residential areas to the East. Buildings identified for redevelopment create spaces of opportunity for the enhancement of the public realm around this location. Residential buildings facing Wesbrook Mall may be disrupted by noise, light, and vibration.

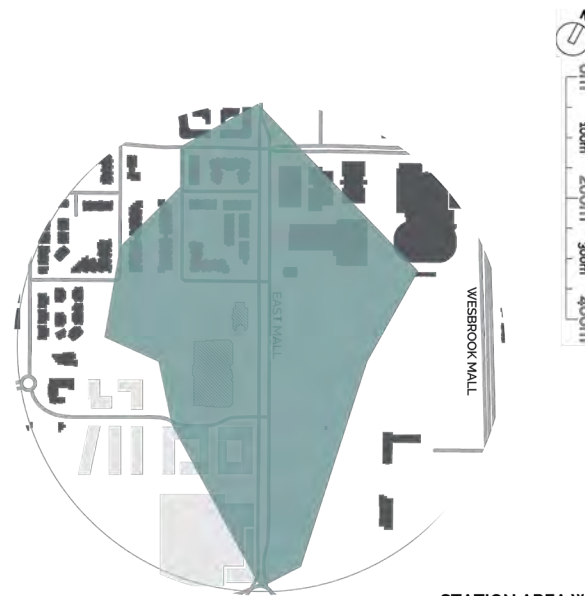
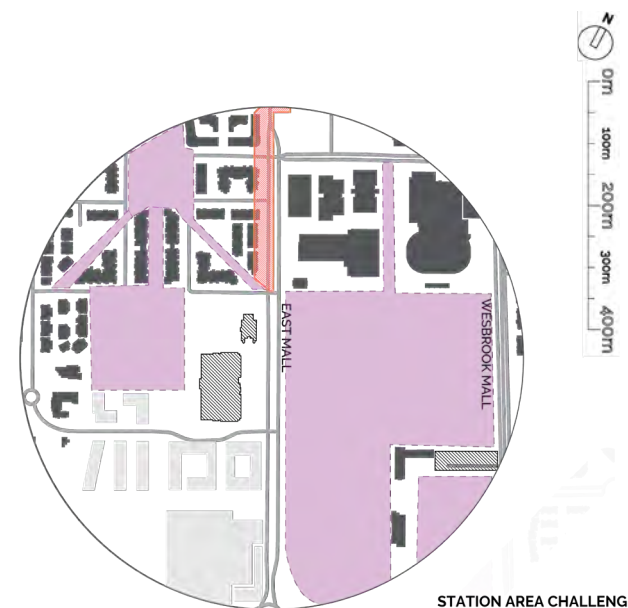
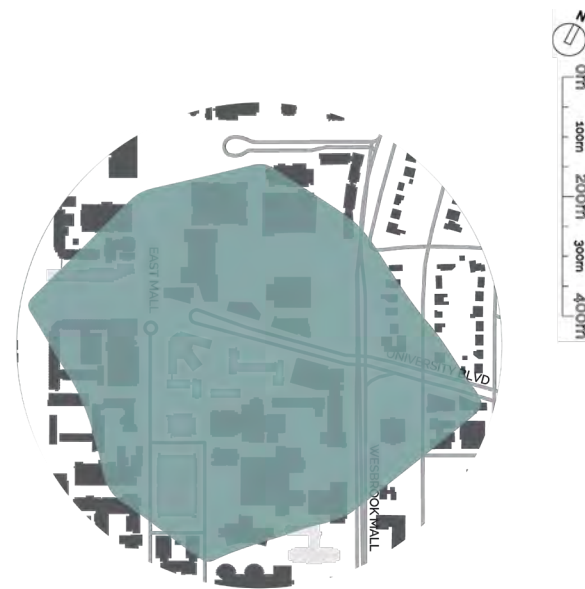


Wesbrook Mall South

This area has historically been one of the main gateways to UBC. Wesbrook Mall and 16th Avenue is a major intersection of residential neighbourhoods and the academic and athletic areas of Campus. 16th Avenue is a major regional connector for cars and buses.

The site is characterized by athletic fields to the West and residential neighbourhoods to the South and East. The main challenges of this site are minimizing the impact of the guideway and station on residential buildings on the east side of Wesbrook Mall and the experience on the playing fields. The streetscape is car-dominated and there are minimal placemaking initiatives along this route. Pedestrian access across both Wesbrook Mall and 16th Avenue is a challenge in this area.





STATION AREA CHALLENGES & OPPORTUNITIES
 ■ Important Public Realm Spaces
 ■ Challenge Areas
 ■ Opportunity Areas

STATION AREA WALKSHED
 ○ 400 metre Radius
 ■ 5- minute Walkshed

University Boulevard

University Boulevard is one of the main gateways to Campus with residential, commercial, and recreational uses. Historically, the gateway was designed for cars. As the campus changes pedestrians and the public realm are being prioritized.

Currently, this is a shared roadway with cars, cyclists, buses, and pedestrians. The northern side of University Boulevard has recently been redeveloped and provides access to cafes as well as recreation facilities, residences, and student services. However, the south side has yet to be updated and buildings identified for redevelopment provide spaces of opportunity in this area.

The main constraints of this site are the many vibrant public pathways and plazas adjacent to it that may be negatively impacted by an elevated guideway and station. The pedestrian infrastructure at the intersection of University Boulevard and Wesbrook Mall is insufficient for increased pedestrian flow which would be inevitable with the placement of a station along University Boulevard.

East Mall South

East Mall was historically a significant roadway for cars into the central campus. Recently the north section has been altered to limit vehicle access and focus on pedestrians and cyclists.

The site is surrounded by residential buildings and playing fields. The planned development of the Stadium Neighbourhood will add density and mixed-use commercial areas. Previous analysis has suggested the need for a form of inter-campus transit along East Mall to better connect Stadium and Wesbrook Place Neighbourhoods to the rest of campus (Mah, Aono, Stavel, 2018).

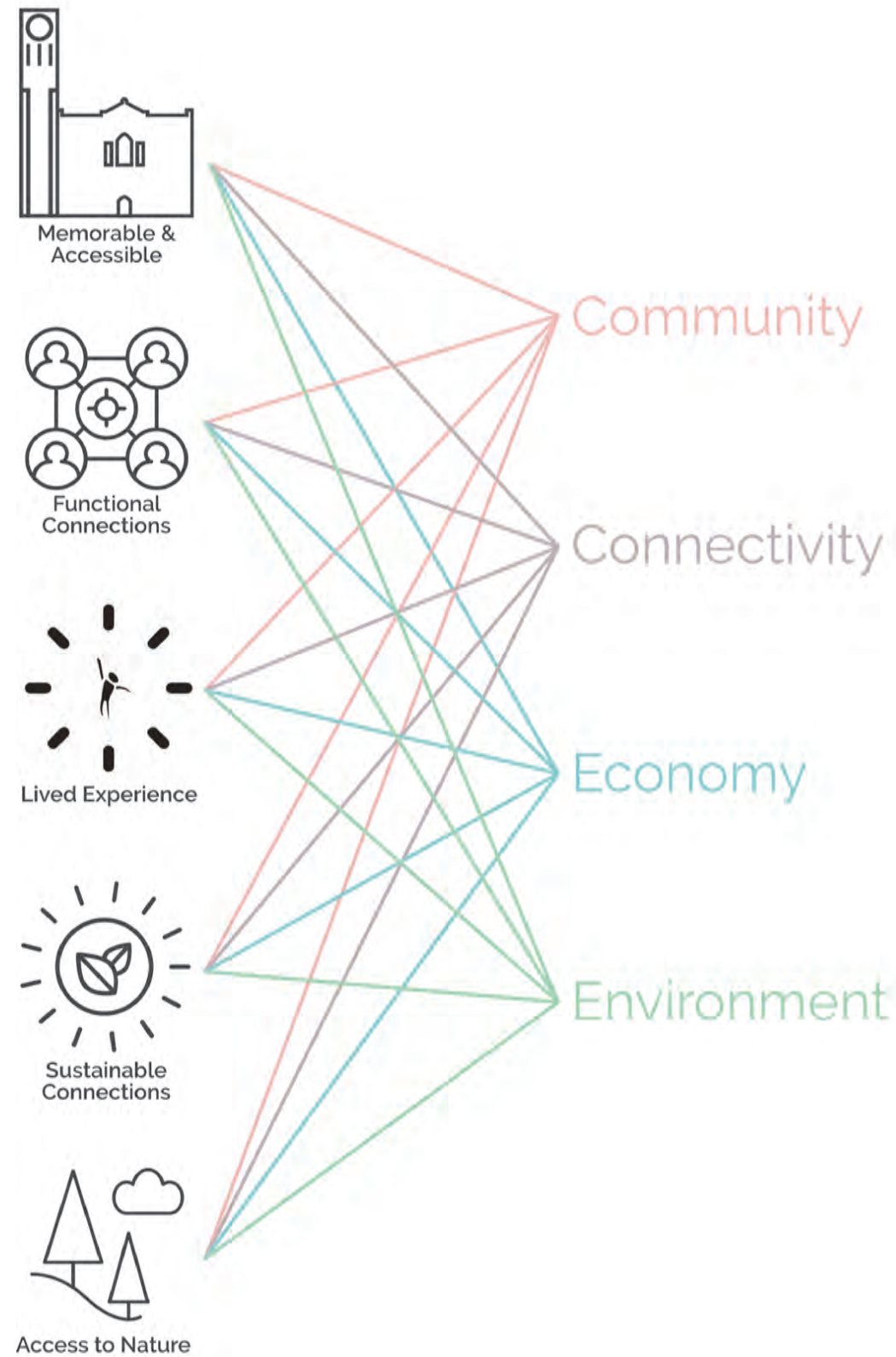
Residential areas and public spaces adjacent to the site are of primary concern. Significant public pathways, parks, and forested areas can be found on the western side of East Mall.

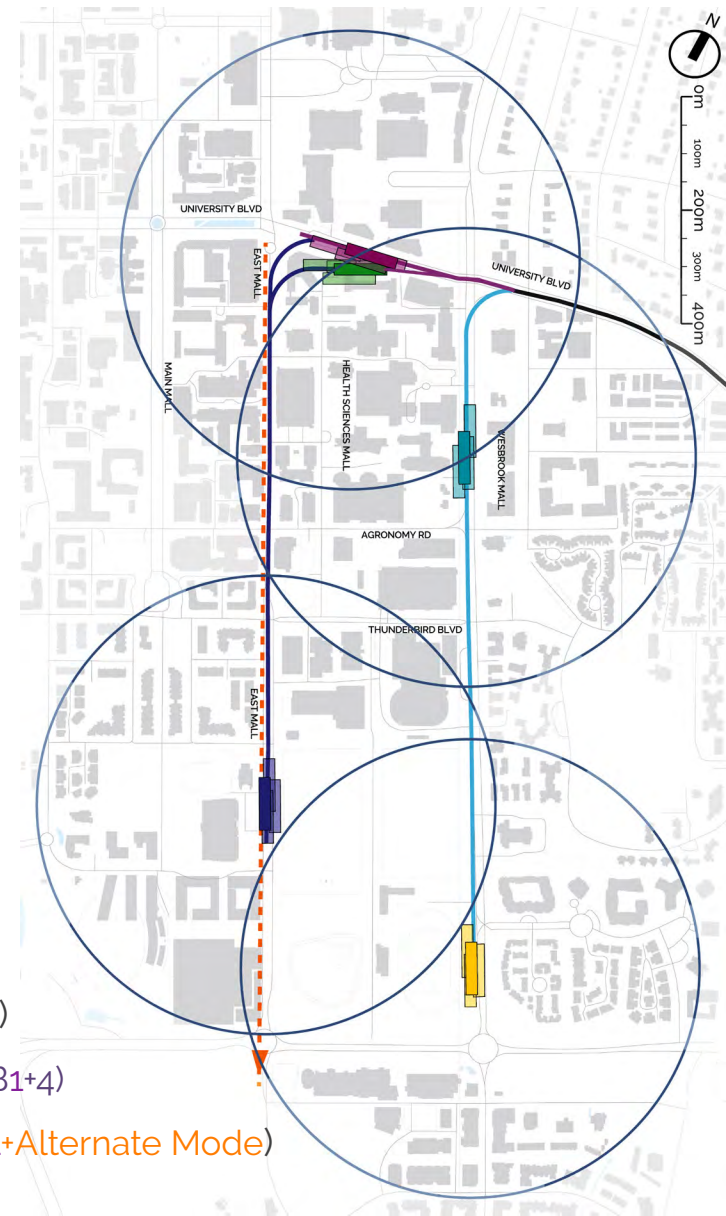
STAGE ONE EVALUATION

Eight initial options were assessed using the evaluation framework developed by the team. This was used to create a shortlist of options to move forward with in the design stage of the project.

As mentioned in the previous section these evaluation criteria and indicators were developed to assess how well each of the options meets the overall project objectives. With this framework, we estimated a positive, negative or neutral impact with the addition of a SkyTrain.

This method is values-based and assumes individual biases. In the future, this method could be used to gain a better understanding of community priorities for a SkyTrain to UBC. The pros and cons for each option are detailed in the following pages.





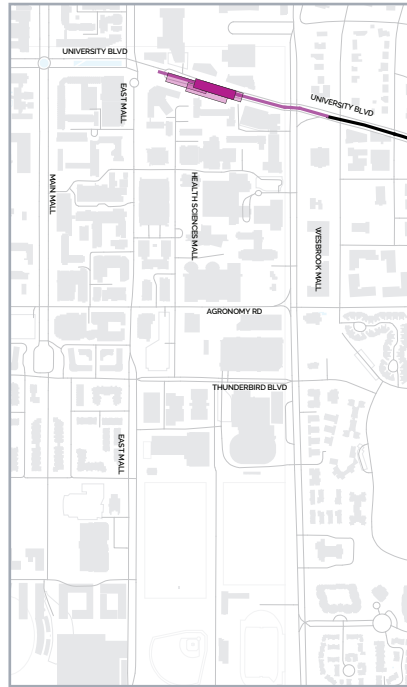
- Option 1 (A1)
- Option 2 (AB1+4)
- Option 3 (A1+Alternate Mode)
- Option 4 (A2)
- Option 5 (AB2+4)
- Option 6 (AB2+Alternate Mode)
- Option 7 (C3)
- Option 8 (C3+5)

- Common
- Route A
- Route B
- Route C
- Street Car

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Connectivity								
Enhance Network	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive
Modal Integration	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive
Limit Barriers	Neutral	Very Negative	Neutral	Positive	Negative	Positive	Negative	Negative
Community								
Enhance Passive Use	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive
Support Mixed-Use Hubs	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive
Emphasize Campus Heart	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive	Very Positive
Minimize Negative Sensory Impacts	Negative	Very Negative	Negative	Neutral	Negative	Negative	Negative	Negative
Opportunity to Shape Community Growth	Neutral	Neutral	Very Positive	Neutral	Positive	Very Positive	Positive	Positive
Economy								
Direct Costs	Very Positive	Very Negative	Positive	Positive	Very Negative	Positive	Positive	Neutral
Indirect Costs	Neutral	Very Negative	Negative	Negative	Very Negative	Negative	Negative	Negative
Land Value Capture	Positive	Very Positive	Very Positive	Positive	Very Positive	Very Positive	Very Positive	Very Positive
Flexibility	Neutral	Positive	Neutral	Positive	Positive	Very Positive	Positive	Positive
Environment								
Stormwater Management	Negative	Very Negative	Neutral	Negative	Neutral	Neutral	Neutral	Neutral
Protection of Species & Habitats	Neutral	Negative	Very Negative	Neutral	Negative	Negative	Negative	Very Negative

■ Very Negative
 ■ Negative
 ■ Neutral
 ■ Positive
 ■ Very Positive
 Shortlisted Options

Option 1 (A1)



This option is a single terminus station located in the Campus Heart above University Boulevard between East Mall and Wesbrook Mall. It is close to academic and residential uses as well as existing and planned development. This station provides opportunities to enhance and modify existing pathways. However, it would require significant and radical design interventions to accommodate flow into and out of.

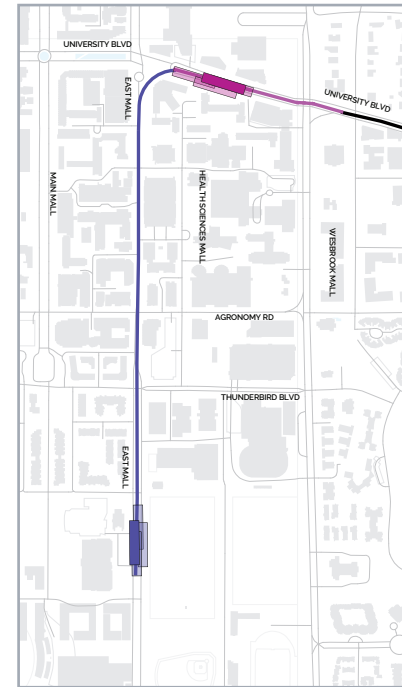
PROS

- Multimodal connections and transit network integration
- Brings passengers to the Campus Heart and supports mixed-use hubs
- Guideway length, single station design, and potential for land value capture

CONS

- No connection to southern part of campus
- Visual and psychological barrier between the North and South sides of University Boulevard
- Negative sensory impact for residential buildings and adjacent academic and office buildings
- Permeable surface and tree removal in a high-risk flood zone

Option 2 (AB1+4)



This option has two stations located in the campus core. One is above University boulevard and the second is on East Mall between Eagle Drive and Stadium Road. Given the narrow corridor, the turn down East Mall would have significant implications for the lived experience underneath and adjacent to the guideway. A pedestrian priority zone and significant redesign of East Mall would be required. Noise, light, and vibration disruption to the plaza at the intersection of University Boulevard and East Mall is a concern.

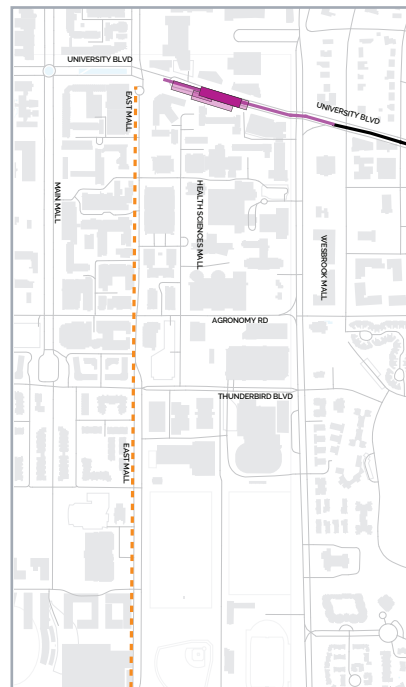
PROS

- Multimodal connections
- Supports both existing and planned mixed-use areas
- Potential for land value capture

CONS

- Permeable surface and tree removal in a high-risk flood zone
- Guideway length and complex curve
- Negative sensory impacts

Option 3 (A1+Alternate Mode)



This is a multimodal option with a single terminus station over top of University Boulevard and an alternate mode of transit connecting the campus core to southern neighbourhoods. This option provides opportunity for flexible and incremental change to inter-campus transportation. Less infrastructure requirements along East Mall would mitigate negative impacts on the public realm while still enhancing connectivity between the academic core and south campus neighbourhoods.

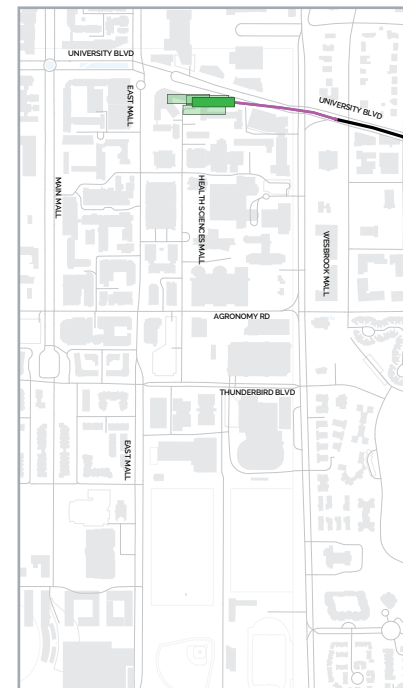
PROS

- Multimodal and transit network connections
- Supports mixed-use hubs and emphasizes the Campus Heart
- Opportunity to shape character and development along East Mall as well as south campus areas
- Allows for flexibility and may contribute to land value capture
- Adaptation of sensitive buildings and streetscapes to mitigate sensory impacts
- Potential disruption of Rhododendron woods and Main Mall gateway habitat areas

CONS

This option is a single terminus station

Option 4 (A2)



located on the south side of University Boulevard between East Mall and Wesbrook Mall. This station would require extensive demolition and redevelopment of buildings, pathways, and greenway. However, this option would allow the existing bus loop to continue as is after construction. This station provides significant opportunity to enhance and redesign the gateway and Campus Heart.

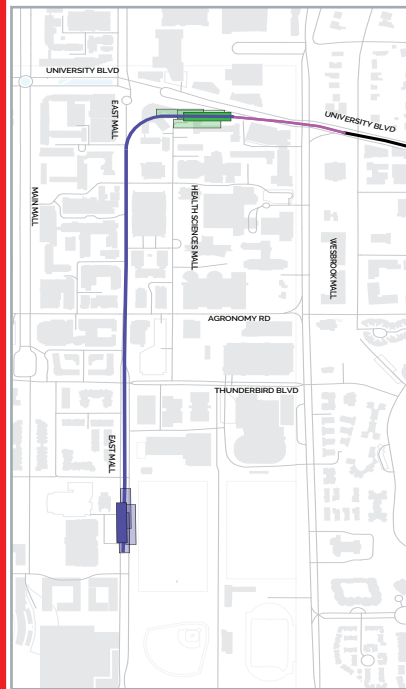
PROS

- Multimodal connections
- Allows for flexibility and enhancement of urban open spaces surrounding the station
- Brings passengers to the Campus Heart and supports mixed-use hubs
- Guideway length

CONS

- No connection to southern part of campus
- Disruption of service roads and informal pathways
- Building demolition and redevelopment
- Permeable surface and tree removal in a high-risk flood zone

Option 5 (AB2+4)



This option has two stations located in the campus core. One is located on the southern side of University Boulevard and the second on East Mall between Eagle Drive and Stadium Road. East Mall poses a significant challenge because of its narrow section and sensitive buildings. However, the demolition of COPP and Wesbrook buildings allows for the station and guideway to be placed away from open space and buildings to alleviate some of the negative sensory impacts around the Campus Heart.

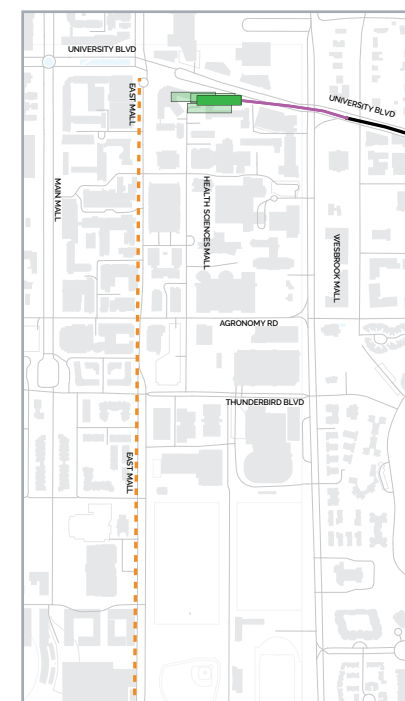
PROS

- Multimodal connections
- Potential for land value capture
- Opportunity to re-shape and enhance campus gateway

CONS

- Guideway length and complex curve
- Adaptation of sensitive buildings and streetscapes to mitigate sensory impacts
- Potential disruption of Rhododendron woods, Main Mall gateway habitat areas, and permeable surfaces

Option 6 (AB2+Alternate Mode)



This is a multimodal option with a single terminus station over top of University Boulevard and an alternate mode of transit connecting the campus core to southern neighbourhoods. This option provides opportunity for flexible and incremental change to inter-campus transportation. The integration of the SkyTrain station into the site of the COPP and Wesbrook buildings can mitigate some of the disruption from noise, light and vibration. Potential redevelopment also provides an opportunity to emphasize University Boulevard as a major gateway.

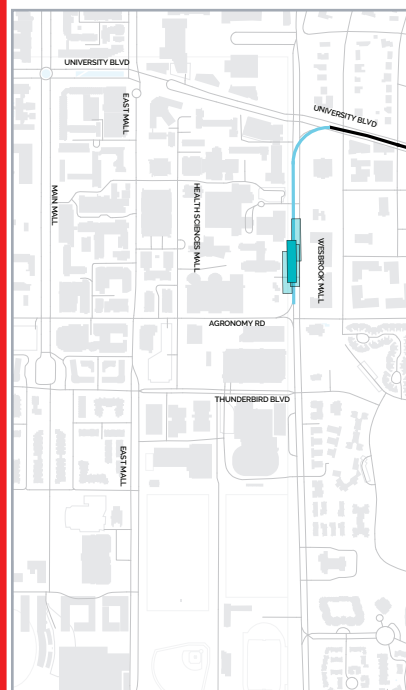
PROS

- Multimodal connections
- Emphasizes the Campus Heart and mixed-use hubs
- Opportunity to shape community character and growth
- Flexibility for incremental changes to East Mall and South Campus areas with potential for land value capture

CONS

- Potential disruption of Rhododendron woods and Main Mall gateway habitat areas

Option 7 (C3)



This option is a single terminus station located on the edge of Campus on Wesbrook Mall between Agronomy Road and University Boulevard. This location is close to both academic and residential areas but would create the need for a new gateway to campus and extensive pathway redesign to connect to the academic core. As it is on the edge, this option would be less disruptive to the existing campus fabric.

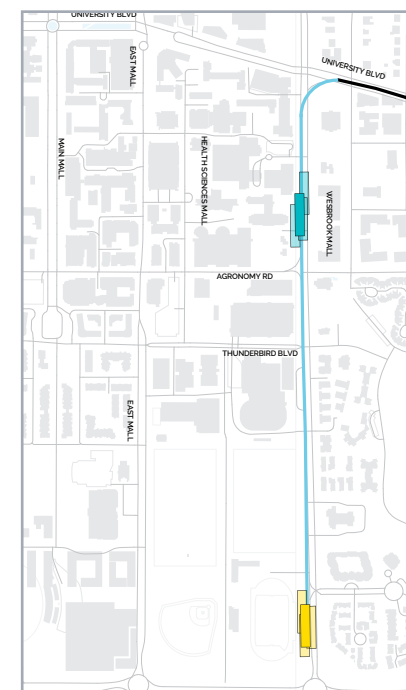
PROS

- Multimodal connections
- Potential to enhance use of adjacent urban open space
- Opportunity to shape communities of Acadia and University Village
- Guideway length and flexibility

CONS

- Indirect access to major transit routes
- Access to the current Campus Heart would require significant redesign
- Proximity to forest fragments along western parkway and disruption of trees and permeable surfaces

Option 8 (C3+5)



This option has two stations along Wesbrook Mall connecting the campus core to athletic areas and neighbourhoods to the south of Campus. With the guideway along Wesbrook Mall, an existing major roadway, there would be less disruption of public realm spaces. However, it would potentially intensify the feeling of Wesbrook Mall as a 'barrier' between the campus and the neighborhoods east of Wesbrook Mall. The redesign of a campus gateway and pedestrian pathways would be required to connect both stations to the academic core.

PROS

- Multimodal connections
- Potential to enhance urban open spaces and supports mixed-use hubs
- Opportunity to shape community growth in East Campus and South Campus areas

CONS

- Proximity to forest fragments along western parkway as well as 16th Avenue, as well as tree and permeable surface disruption
- Increases barrier between East Campus neighbourhoods and academic core
- Infrastructure upgrades to pedestrian connections required
- Disruption of residential areas along the east side of Wesbrook mall.

Shortlisted Options

SHORTLISTED OPTIONS

We selected three options to continue exploring in the design phase of this project. They were selected based on the results of the evaluation framework in the previous stage. The shortlisted options are located along corridors of interest expressed by our partners at C+CP. They consist of two stations, which would provide more opportunities for more comprehensive assessment in the design stage. Each one has different strengths and weaknesses and further development of them will inform the viability of a SkyTrain along these corridors.

Connectivity

The two options with stations on University Boulevard would connect people with other transit networks and major pedestrian and cycling routes. The main drawback of the East Mall guideway is the creation of a barrier through the academic core. An alternate mode of transit for this corridor, such as a streetcar shuttle or other forms of surface transit, would be less disruptive. With its location on the edge of campus, the Wesbrook Mall option would be the least disruptive but does not serve the academic core or connect to pedestrian routes as directly.

Community

The shortlisted stations support mixed-use areas, critical residential neighbourhoods, and critical public spaces. The station locations all provide an opportunity to shape the future development of the campus, with proximity to residential areas and areas identified for redevelopment. The Wesbrook Mall option has the most space between buildings so may be less disruptive to the on-campus experience, whereas the other two options place a guideway next to significant public spaces and are very close to academic and residential buildings.

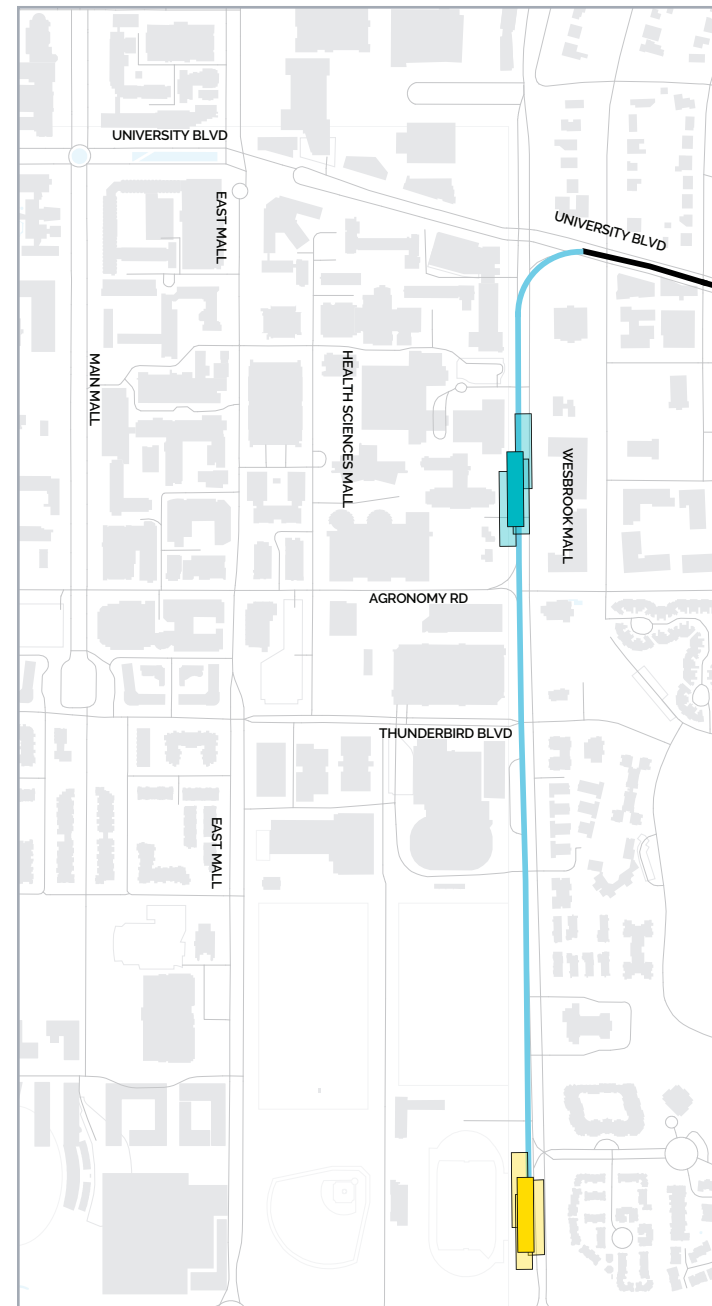
Economy

Buildings identified for redevelopment provide opportunities for enhancement of the Campus Heart and the creation of more significant gateways and pedestrian corridors. The East Mall SkyTrain option would likely cost the most due to the tight curve at East Mall and the demolition of the COPP and Wesbrook buildings along University Boulevard. As this is a sensitive area, major upgrades will be required to buildings such as the newly built Stewart Blusson Quantum Matter Institute to mitigate noise and vibration impacts.

Environment

All of these options will negatively impact environmental measures. Construction would remove trees and permeable surfaces. The options along Wesbrook Mall are only a short distance from forested areas. These factors have implications for stormwater management and habitat connections across campus.

Wesbrook Mall (Option 8 C3+5)



This option has two stations along Wesbrook Mall connecting the Academic Core to Wesbrook Place, Hampton Place, athletic facilities, and south campus areas. With the guideway along Wesbrook Mall, an existing major roadway, there would be less disruption to the public realm. The guideway would increase the barrier between the campus and the neighborhoods east of Wesbrook Mall. The redesign of a campus gateway and pedestrian pathways to the west of both stations would be required to connect to the Campus Heart and other academic areas.

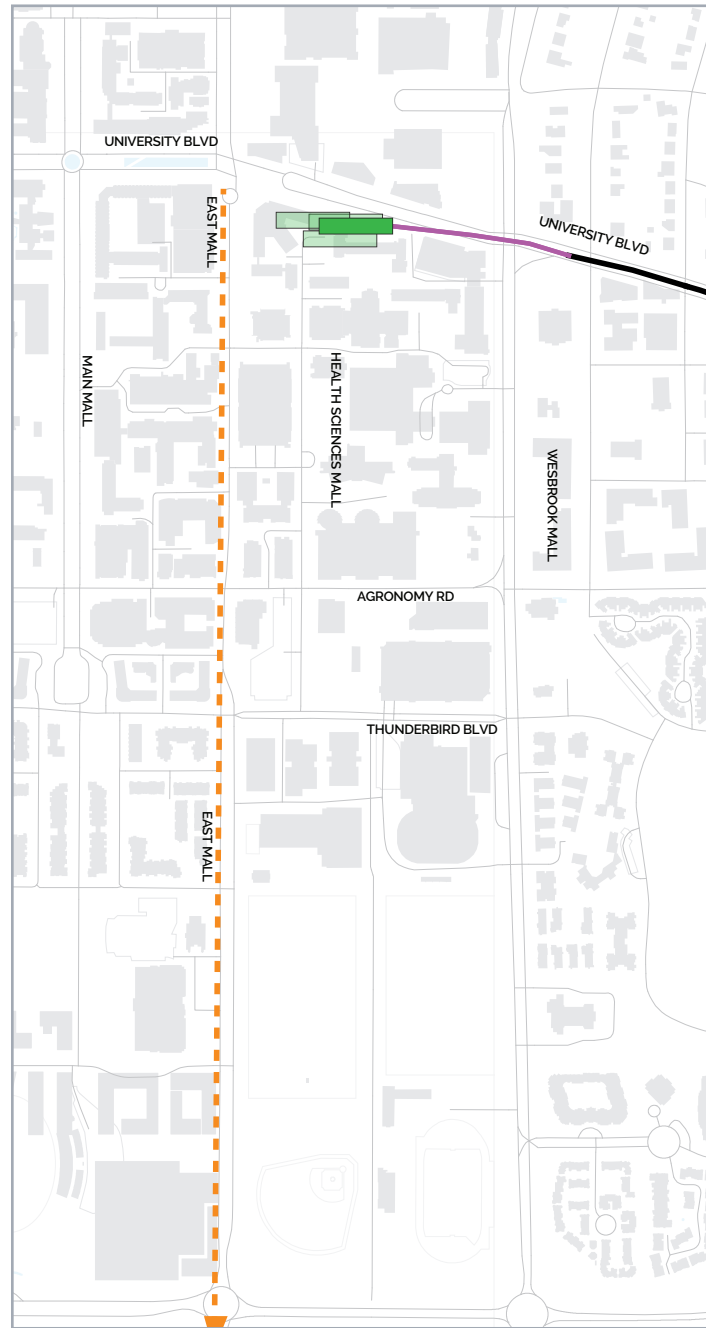


3D View Wesbrook North Station Area

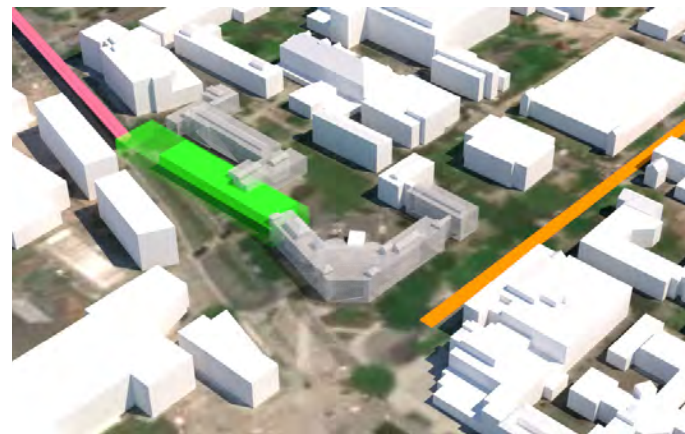


3D View Wesbrook South Station Area

University Boulevard (Option 6 AB2+Alternate Mode)

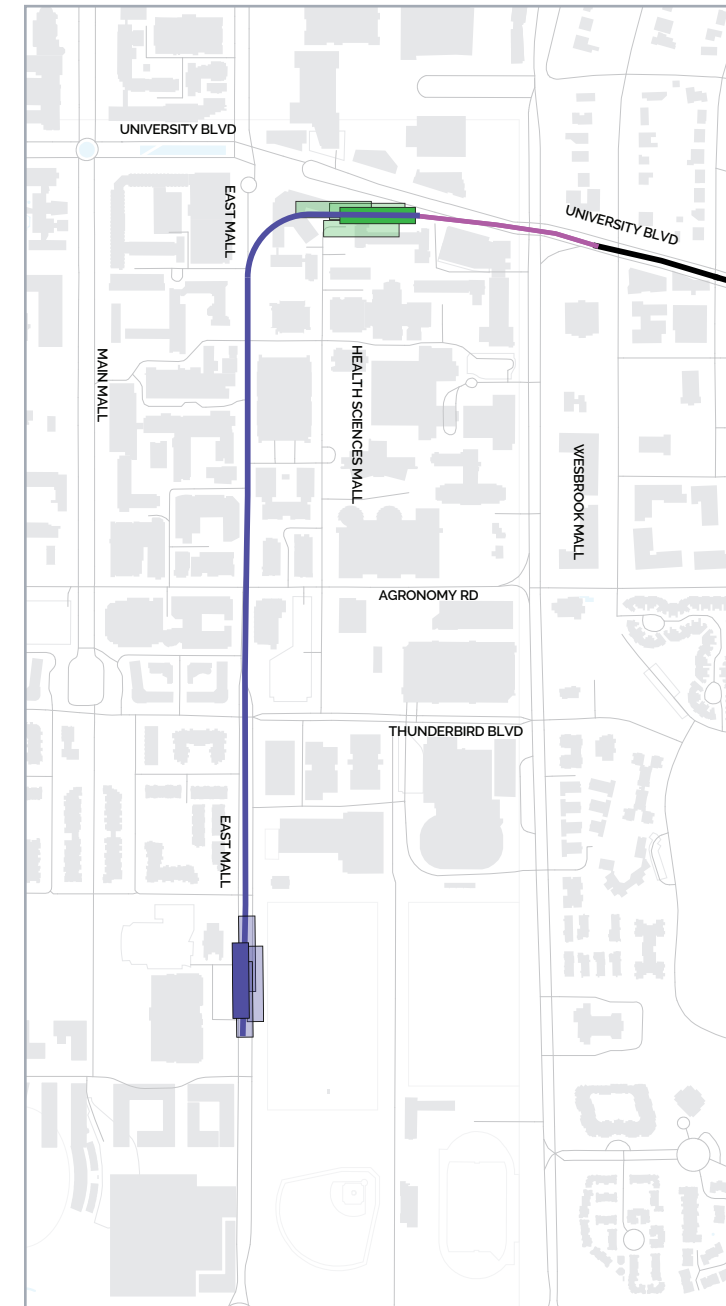


This is a multimodal option with a single terminus station at the Campus Heart and an alternate mode of transit (i.e. streetcar or shuttle) connecting the academic core to southern neighbourhoods. This can provide for flexible and incremental change to inter-campus transportation. Less infrastructure requirements would mitigate negative impacts on the public realm while still enhancing connectivity between the academic core and south campus neighbourhoods.



3D View Ublvd Station Area with alternate mode along East Mall

East Mall (Option 5 AB2+4)



This is an extension of the University Boulevard proposal replacing the alternate mode of transit with a second SkyTrain station. The second station would aim to serve the south campus neighbourhoods. The proposed East Mall South station would be a stand-alone, street jump station. The guideway and station would be biased to one side of the street to mitigate the challenge that the narrow street width of East Mall poses. The areas adjacent to the station would allow for active edges along with higher-density developments.



3D View Ublvd Station Area



3D View East Mall South Station Area

WORKSHOP



GOALS

Develop a shared vision for the future of the campus and its surrounding area, including the integration of green spaces, pedestrian-friendly infrastructure, and sustainable practices. This vision will guide the design and implementation of the campus master plan, ensuring that the campus is a vibrant, accessible, and sustainable community.

- Memorable and Accessible**
Enhance the campus identity and history, preserving and integrating historic architecture.
- Functional Connectors**
Connect the campus and its neighborhoods, ensuring that the campus is a vibrant, accessible, and sustainable community.
- Lived Experience**
Maximize opportunities for social interaction, community building, and a sense of place.
- Sustainable Connections**
Maximize opportunities for sustainable transportation, including walking, biking, and public transit.
- Access to Water**
Integrate water features and green spaces into the campus design, enhancing the campus's sustainability and aesthetic appeal.

How can UBC accommodate an elevated SkyTrain while preserving or enhancing the public realm and campus character?

WORKSHOP OVERVIEW

The team organized a design workshop in partnership with C+CP. Building upon the three shortlisted options identified through the stage one analysis, the aim of this workshop was to further explore opportunities for integrating an elevated SkyTrain into the public realm. Industry practitioners with experience in rapid transit and community planning were invited to provide insight on how to utilize spaces of opportunity and protect the campus experience and character.

Participants were put into three groups with an attempt to evenly distribute various expertise and knowledge. Each group was tasked with exploring ideas for one of the three options. In light of the current Vancouver station precedents presented in "Information Gathering". The team was interested primarily in the effects of stations and guideways on the user experience in the public realm. Participants were asked not to focus on the station design at this stage in the process. This workshop was not intended to explore alternative station areas beyond the four presented. The ideas and concepts from the workshop were used to develop five design strategies that focus on preserving and enhancing the public realm and campus character.

To see all raw workshop outputs see **Appendix F**.

Requested Outputs

To facilitate consistent outcomes, each table was given the following guidelines:

Station Placement Plan:

Drawing showing the placement of the stations considering the context.

Public Realm Plan:

Diagrams showing public space features in the areas adjacent to the stations and along the guideways (increased sidewalk width, open urban spaces, bicycle parking, etc.).

Sections:

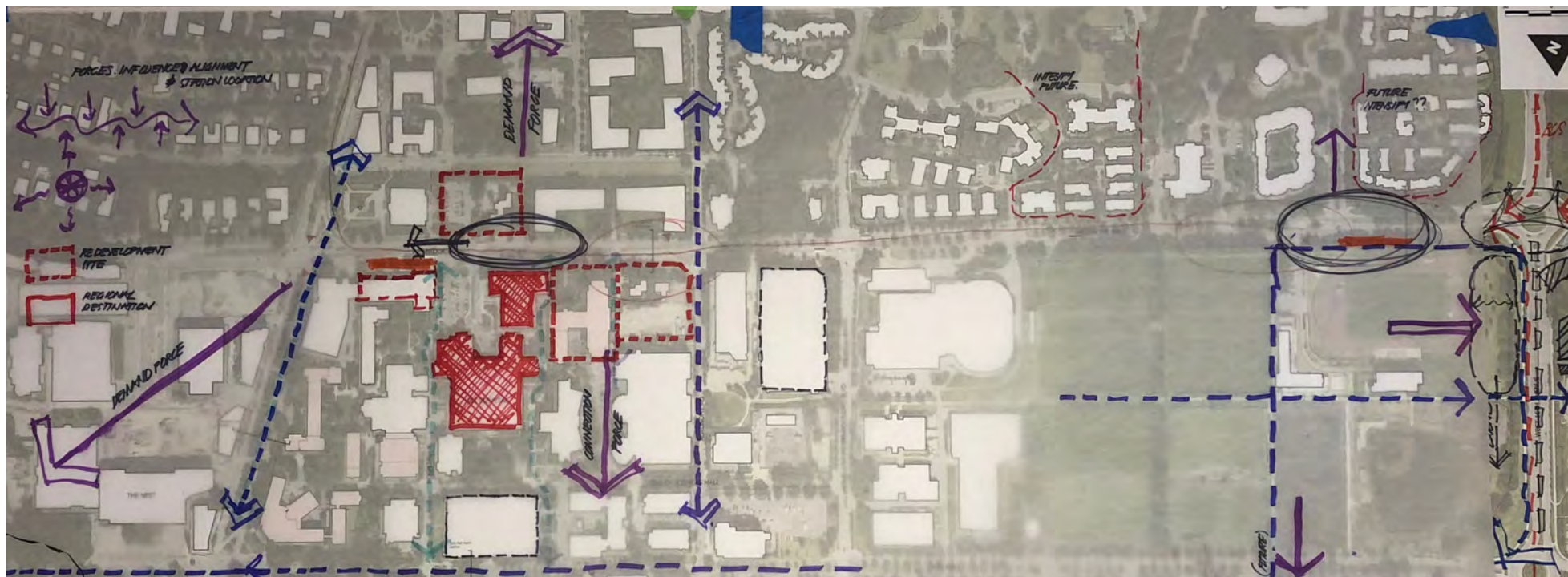
Sections showing the placement of the stations and guideways considering the built environment and road realignment. Public realm features under and next to the guideways and/or through important public realm areas.

Perspectives:

Any 3D view that best represents the vision for the stations, guideways and the public realm.



Workshop participants included planners, architects, landscape architects, and urban designers from Campus and Community Planning; McElhanney, Edward LeFlufy Urban Design & Architecture, PFS Studio, VIA Architecture; DIALOG and HCMA; and Students in the Urban Design Concentration at the School of Community and Regional Planning.



Raw workshop outputs from the Wesbrook Mall Option

WORKSHOP OUTPUTS

Wesbrook Mall

This option incorporates a central station on Wesbrook Mall close to the University Boulevard intersection serving the campus core; and a second station close to West 16th Avenue serving current and future developments in the southern area of the campus. Participants presented this option as having the potential to become a "seam" bridging the Wesbrook Mall and West 16th Avenue barriers. Connecting not only the northern and southern areas of the Campus, but also the residential and mixed-use areas to the east.

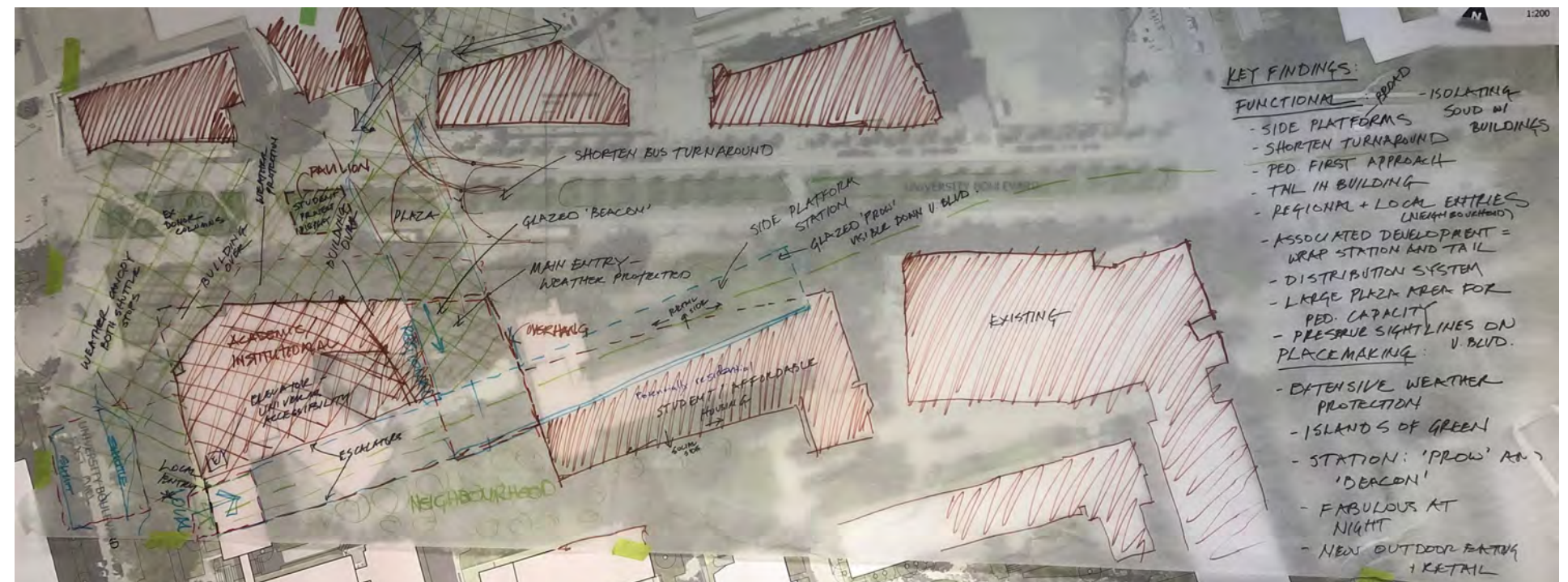
A street-spanning gateway station was proposed at the second station as a way to give South Campus an iconic and memorable "entrance", and improvements to the attractiveness of medium- and long-term TOD opportunities in the Acadia neighbourhood along the Wesbrook Mall would provide housing and community amenities surrounding the station areas.

The potential externalities would be reduced by the wide right-of-way along Wesbrook Mall. The Wesbrook Mall Upgrade plan, expected to be finished by the end of 2019, would allow this corridor to accommodate the SkyTrain infrastructure on the west side of the road.

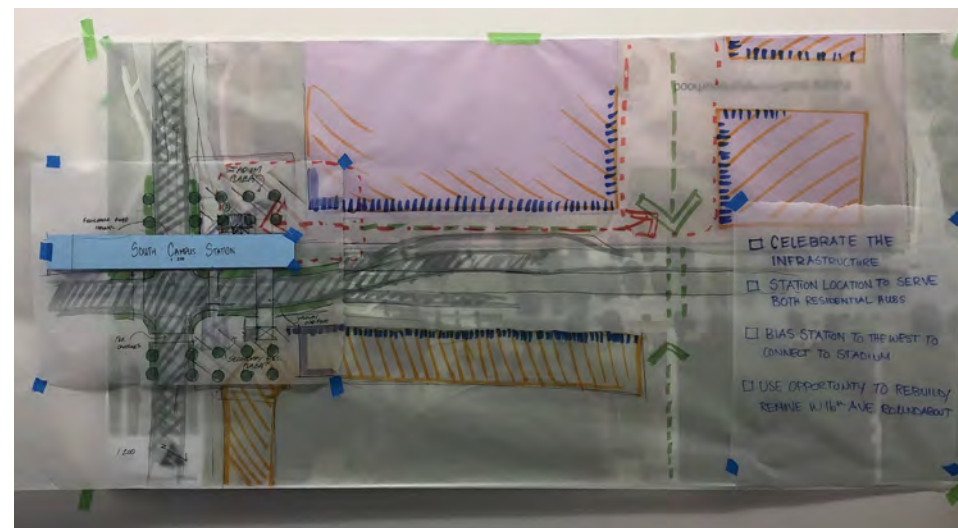


University Boulevard

The first stop in the University Boulevard is located within the Campus Heart. Workshop participants highlighted the student experience on campus and proposed new student housing and classrooms at the site. The single station option that incorporated a shuttle down East Mall to connect riders to the South Campus neighborhoods of UBC. This proposal attempted to keep the design of the SkyTrain area harmonious with the experience of the Campus Heart while also building new student housing and academic space. The Station itself would be pocketed away from University Boulevard as to not dominate the sightline down the street and to leave room for pedestrian movement on the ground. This concept sought to keep the Campus Heart as a valued landmark and a staple of the student and visitor experience at UBC and could be transitioned to a second SkyTrain station in the future.



Raw workshop outputs from the University Boulevard single station option



Raw workshop outputs from the University Boulevard two station option

East Mall

The third group explored the extension of the University Boulevard proposal option. The second station would aim to serve the South Campus neighbourhoods. The proposed East Mall South station would be a stand-alone, street jump station. The guideway and station would be biased to one side of the street to mitigate the challenge that the narrow street width of East Mall poses. The areas adjacent to the station would allow for active edges along with higher-density developments such as affordable student housing, cafés, restaurants, and shops.

WORKSHOP INSIGHTS

Design Strategies

The design strategies are a compilation of key features that are a direct result of the workshop outputs. These are actions that can help to address the challenges of accommodating a SkyTrain on Campus and achieve the five overarching project goals (Memorable and Accessible, Functional Connections, Lived Experience, Sustainable Connections, and Access to Nature). These approaches could be applied to any station and guideway proposal considered by C+CP in the future.

Key concepts related to these strategies were presented by workshop participants and are discussed in the following pages. Some of these approaches were carried forward and applied to two final concepts after the workshop.



Efficient Movement

By 2040, there will be nearly 10,000 people per hour flowing through the central campus station during peak periods with various destinations. SkyTrain stations will be people's first experience on Campus and a wayfinding landmark for both local and regional connections. Efficient pedestrian and cyclist pathways can enhance the experience of people on Campus.

Spaces for People

Stations and guideways should not supersede human scale design. Students and residents of UBC should have influence and feel ownership of the spaces in which they live, work, and study. The station areas can be considered an opportunity to create comfortable, flexible spaces that allow for dialogue, celebration, innovation, recreation, and learning.

Complete Neighbourhoods

As UBC continues to grow, the Campus will need to provide an increasing amount of diverse uses including affordable housing, jobs, services, and amenities for both the student and the non-student communities. Compact and complete communities provide a framework for sustainable growth.

Safe and Secure

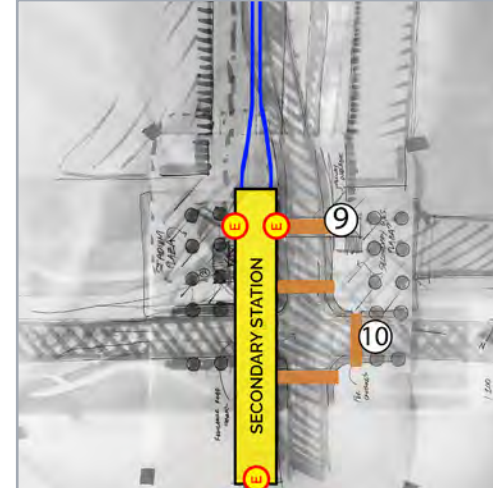
Both physical and perceived levels of personal security are significant factors in people's choice of transportation. Station area design should protect pedestrians against automobile and bicycle traffic as well as contribute to a feeling of activity and presence of natural surveillance.

Sense of Place

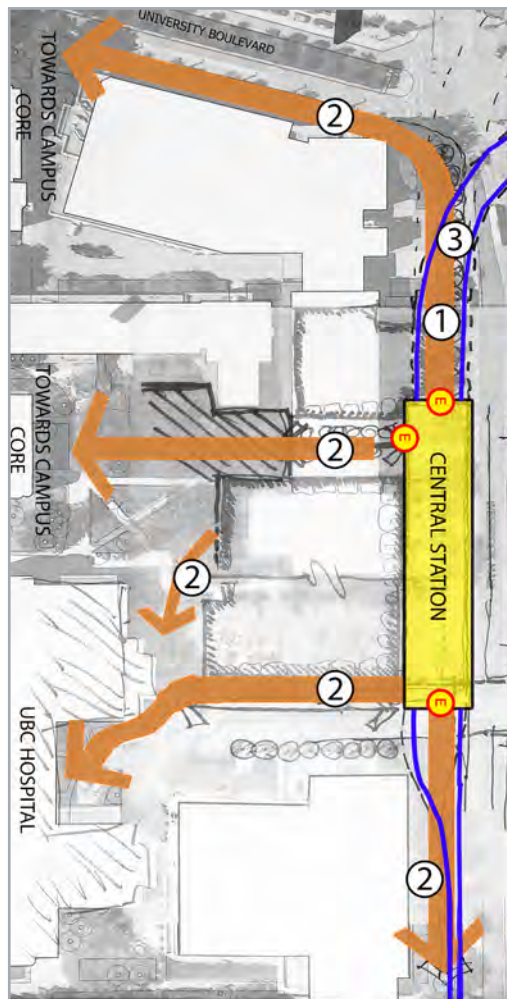
Stations should be a recognizable and enjoyable gateway to Campus with the land's history, culture, and community being primary features. The station should be seen as more than a transit facility, but rather, as a valued part of the University's identity.



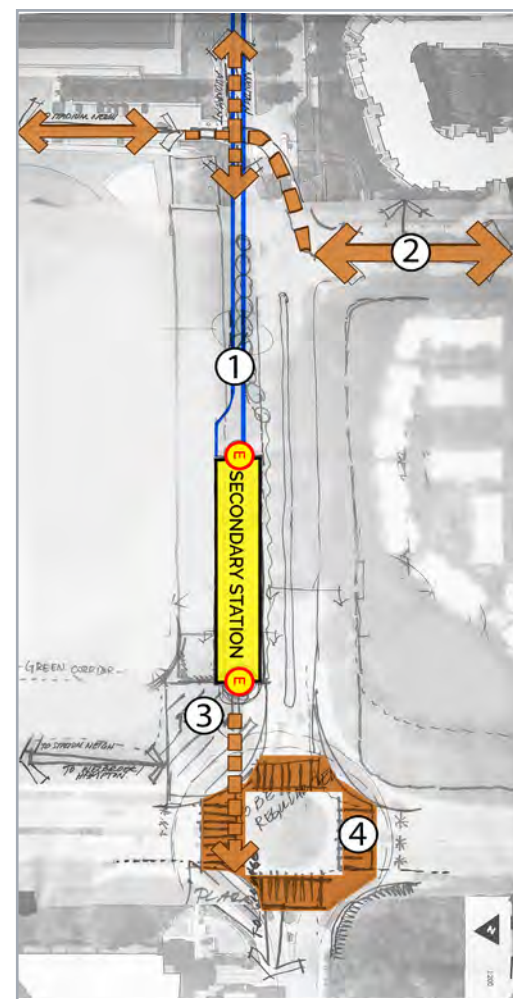
Central Station - University Blvd



Secondary Station - East Mall South



Central Station - Wesbrook North



Secondary Station - Wesbrook South

Key Concepts

Efficient Movement

1) Pedestrian Routes Under the Guideway

Taking advantage of the covered space underneath the guideway can allow for comfortable, covered, and direct pedestrian and cyclist transportation along Wesbrook Mall.

2) Improvement of Informal Pedestrian Paths

In the area around the first station, there are a number of informal pathways that pedestrians use to navigate the Health Sciences and Hospital area of Campus. These paths are often inaccessible for people with mobility impairments. With the addition of the station in this location, these pathways will need to be improved and formalized in order to accommodate the increased foot traffic and provide legible connections to the campus core.

3) Intermodal Transitions

The space immediately surrounding the station should be able to accommodate large numbers of people moving and transitioning from transit to other modes of transportations without "bottlenecking" or significant crowding.

4) Featured Crosswalks

Expanded crossings across Wesbrook Mall and 16th Avenue will help prioritize pedestrian movement across existing barriers dividing primarily residential spaces from the Academic Campus.

5) Shortened bus loop

By shortening the bus loop on University Boulevard, more space will be created for pedestrian flow towards the North side of the street and the area surrounding the AMS Nest. The bus loop would remain long enough in order to keep the vehicle entrance to the new underground parking garage and loading areas of the AMS Nest and Alumni Centre.

6) Weather Protection

The station and new academic buildings provide rain protection throughout the perimeter. Riders who exit the station will be able to reach the East Mall shuttle stop entirely protected from the rain.

7) Hardscaped Station Areas

High traffic areas around the station will be hardscaped in order to allow for easier movement and to increase durability.

8) Station Entrances

The entrances leading into the station would align with current pedestrian movement along formal and informal paths. The alignment of entrances would provide direct pathways from multiple directions in order to ensure the most efficient movement of people.

9) East Mall Street-Spanning Station to Favour One Side of the Road

The East Mall station would favour the west side of East Mall to better serve people who will be attending functions and/or sporting events at the Thunderbird Stadium. A station exit in the form of an overhead walkway would serve the south eastern neighbourhoods such as Wesbrook Village. More exits could be added as the communities around the station grow.

10) Regularize the road network

The current roundabout at West 16th Avenue and East Mall would be reconfigured to become a more conventional urban signalized intersection allowing for easier pedestrian and cyclist movement.

Spaces for People

1) Welcoming Plazas

Urban spaces around stations should provide intuitive wayfinding for visitors and new students. This space should also provide opportunities for passive recreation.

2) Improvement of open spaces between buildings

Courtyard-like spaces between buildings can breathe life into the currently residual areas by providing attractive spaces for students to rest, study, and gather.

3) Neighbourhood Courtyard

This courtyard is located outside of the proposed residential building. It would be preserved and enhanced in order to provide residents with an enjoyable neighbourhood gathering place at their doorstep.

4) Noise Reduction

There is concern that the noise of the SkyTrain will negatively affect the Campus Heart experience. The guideways and platform in this proposal would be covered to further reduce the noise of the SkyTrain in order to minimize disruption of activities in the area.

5) Preserve Trees

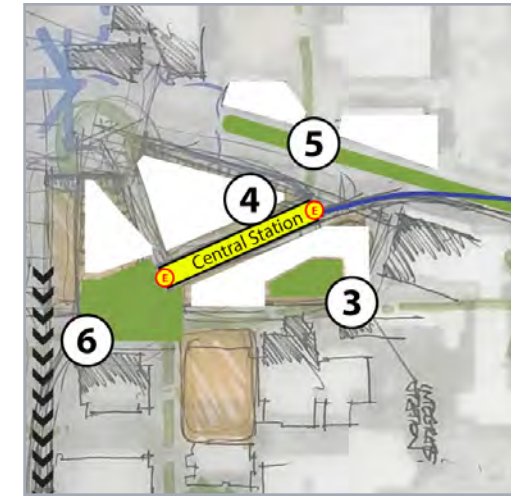
The station area includes valued trees that have been designated as high priority for preservation efforts, the station and guideway layout preserve these trees. Trees should be preserved where possible in order to minimize destruction of habitats and enhance the comfort and enjoyment for people.

6) Pavilion

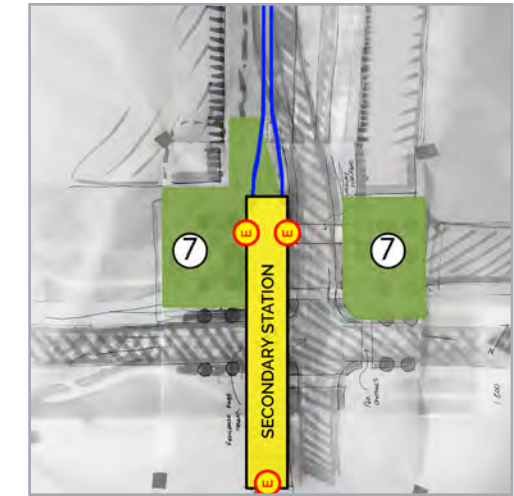
A pavilion provides space for a variety of student-focused activity. For instance, the space can be used to showcase student work or, more generally, be an extension of activities associated with the Student Union. The pavilion is intended to provide a flexible space that students have ultimate influence over.

7) Areas of Rest

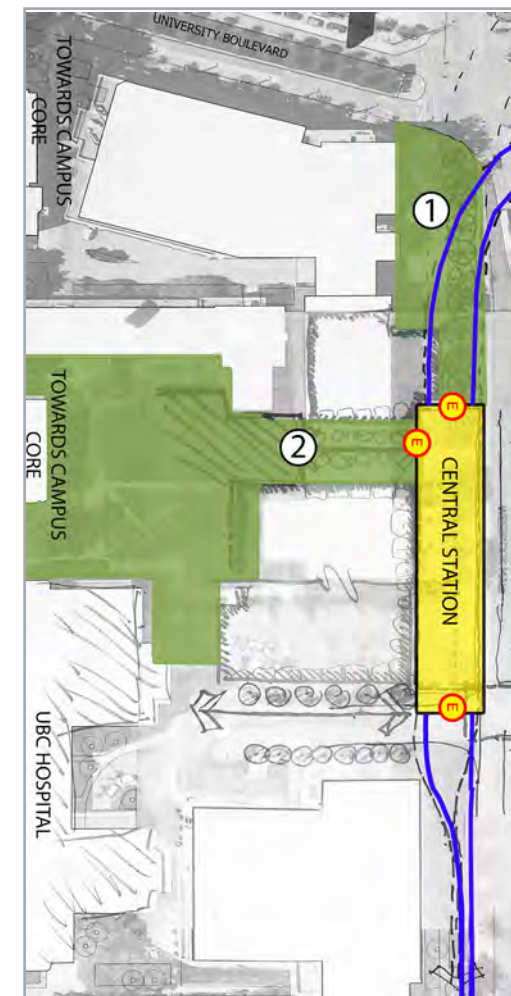
Allow for both formal and informal spaces around the station for people to gather and stay in.



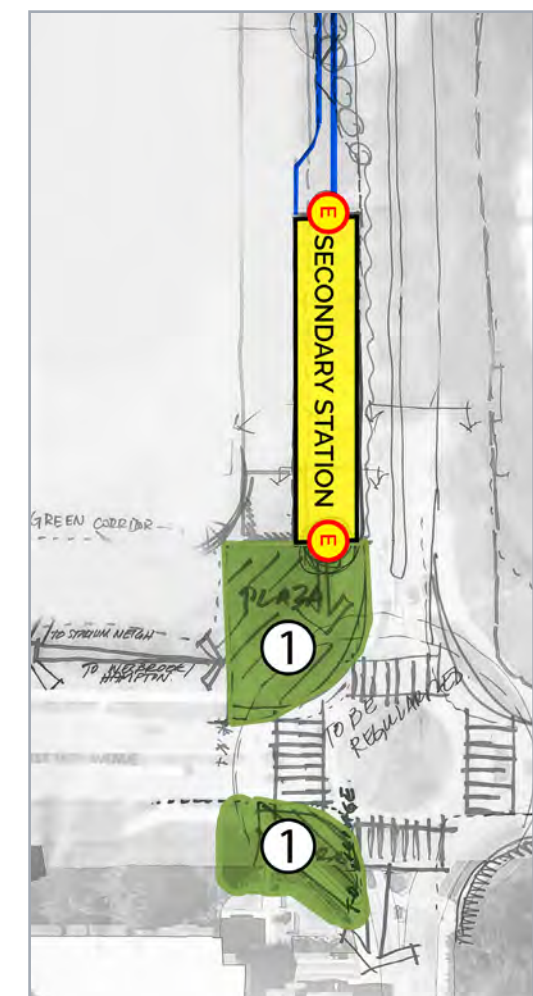
Central Station - University Blvd



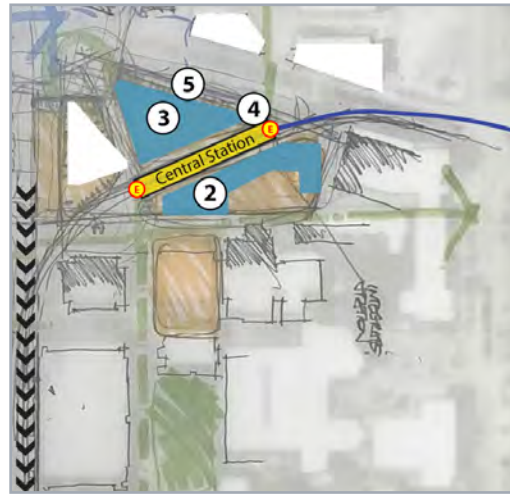
Secondary Station - East Mall South



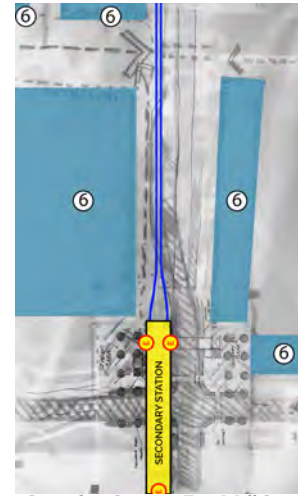
Central Station - Wesbrook North



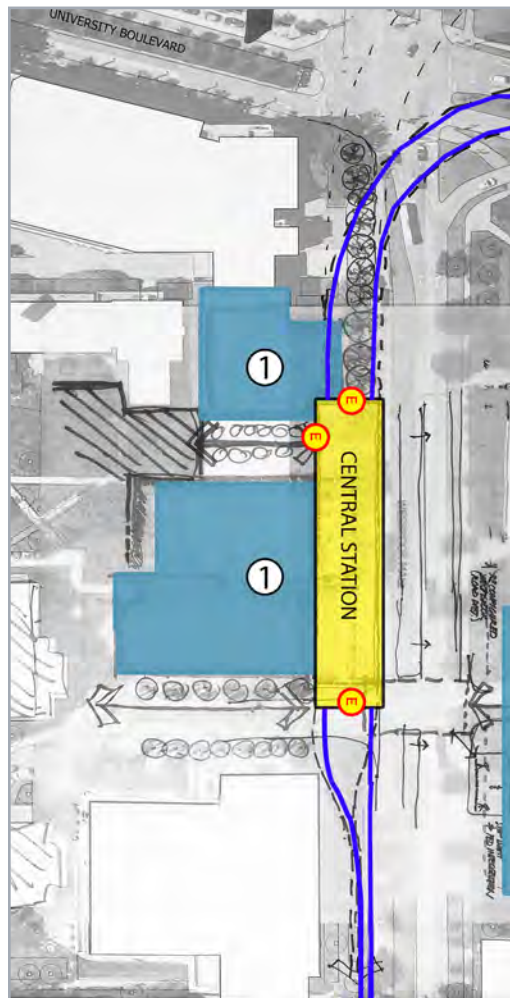
Secondary Station - Wesbrook South



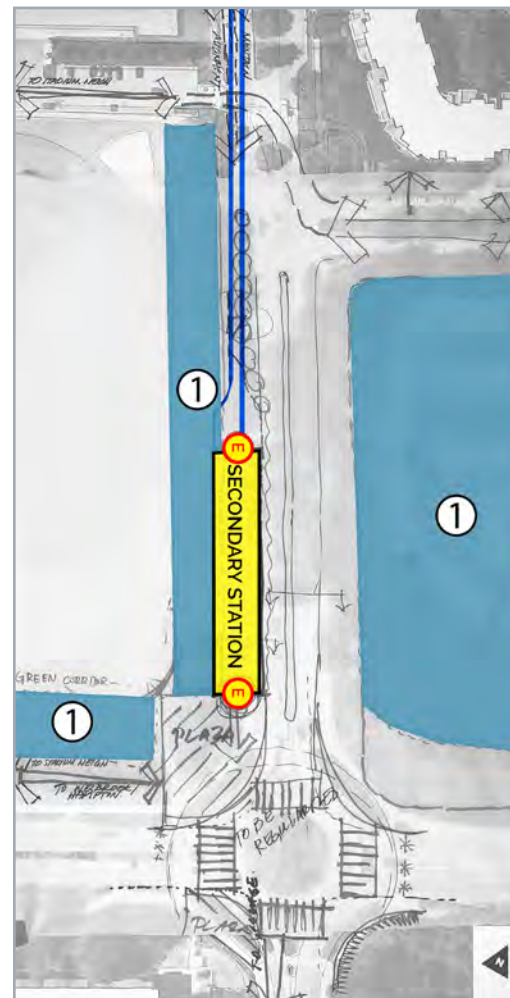
Central Station - University Blvd



Secondary Station - East Mall South



Central Station - Wesbrook North



Secondary Station - Wesbrook South

Complete Neighbourhoods

1) Enhanced TOD opportunities

Including mixed-use projects and student housing in underdeveloped lots along the corridor would contribute to goals of providing student housing and contribute to the future development of a more complete live-work-learn community at UBC.

2) Affordable Student Housing

As the University grows, it will be required to provide an increasing amount of student housing. The SkyTrain to UBC itself is seen partly as a way to reduce housing cost burdens on students. The University can act more directly on this issue by providing affordable housing on this site.

3) Academic Buildings

The removal of the two academic buildings at this site will create a need for new classrooms. The extra space at the station site provides plenty of space for replacing them.

4) Neighbourhood and Regional Areas

The two sides of the central station should be distinct and accommodate different needs. The North side will provide for the most efficient movement of people. The South side will provide for a slower, quieter experience for residents of the new residential building.

5) Active Edges

There are currently active commercial edges along part of University Blvd. West of Wesbrook Mall. The new building that envelops the station platform on University Blvd. will complete the street with continued commercial amenities on the ground floor.

6) Proposed developments around the station

All proposed developments around the station would be mixed-use, incorporating active edges with commercial spaces on the ground floor and housing above.

Safe and Secure

1) Diversity of use and extended street animation

The presence of the SkyTrain stations and future commercial and mixed-use developments along Wesbrook Mall will animate the predominantly residential and quiet corridor. Higher concentration of people in this space later at night would provide a sense of safety for users.

2) Commercial Spaces Open Late

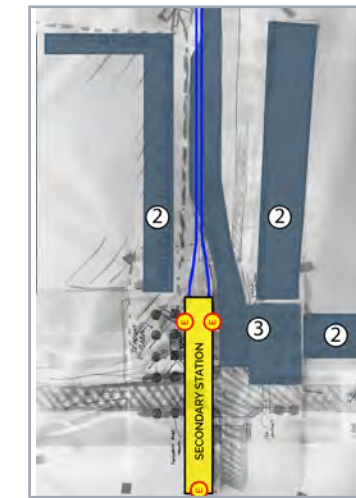
There will be a higher concentration of people in this space later at night as a result of the SkyTrain. There would be businesses that are open during all SkyTrain hours to help provide a sense of safety for users.

3) Animated at Night

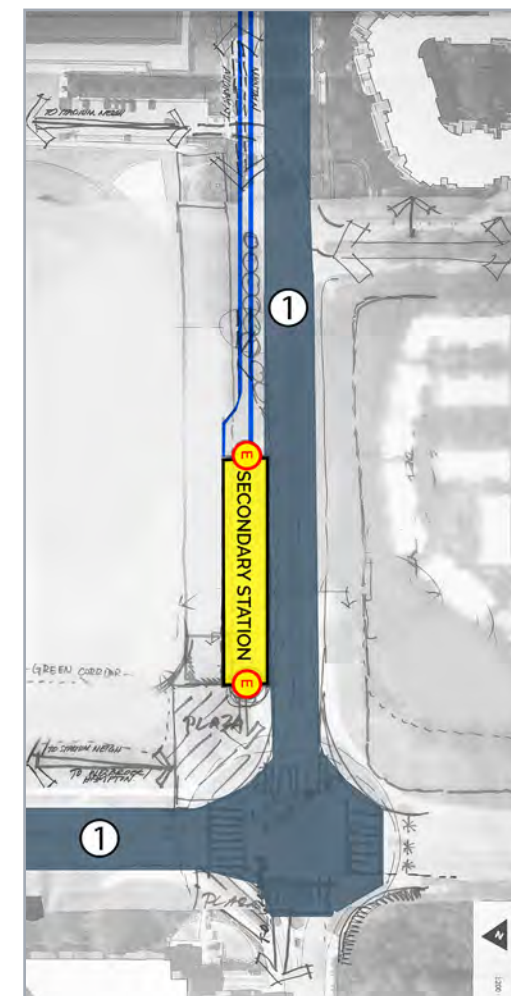
The station area would include design features that animate and illuminate the space at night. Adequate lighting is important to ensure actual and perceived safety for individuals.



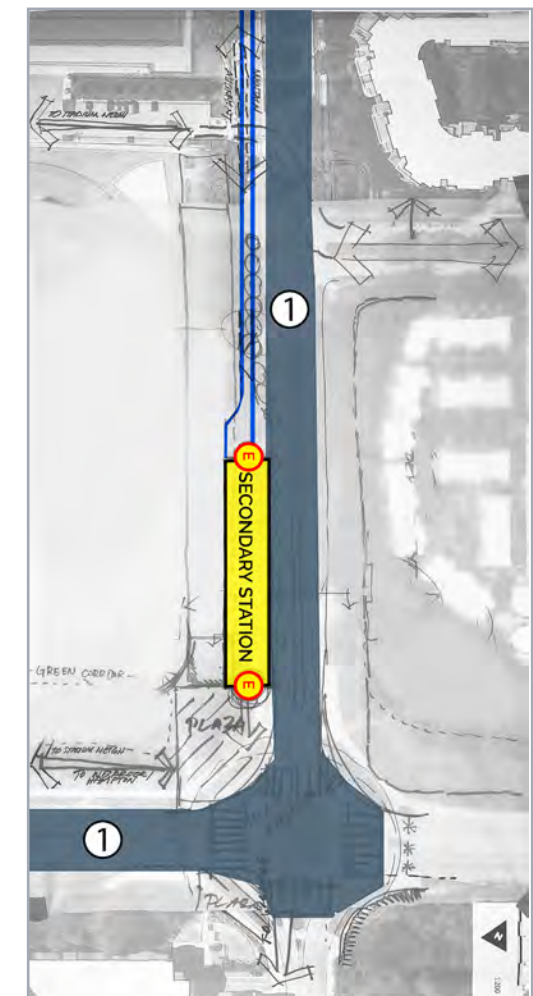
Central Station - University Blvd



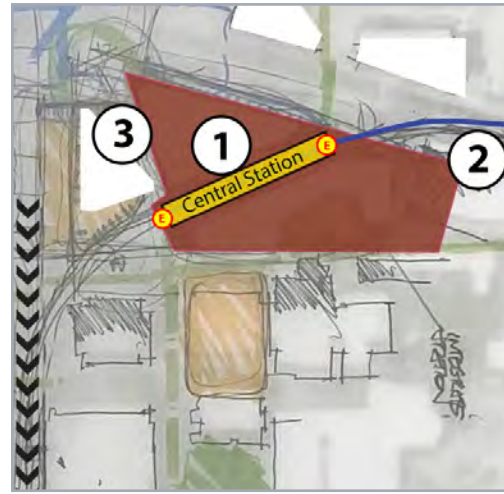
Secondary Station - East Mall South



Central Station - Wesbrook North



Secondary Station - Wesbrook South



Central Station - University Blvd



Secondary Station - East Mall South

Sense of Place

1) Hide/ Screen the Station Platform with Buildings

The station platform would be tucked away and screened by the proposed building uses so that it does not dominate the overall Campus Heart.

2) Glazed Beacon

In order to provide a clear indication of the station entrance on the North side, the proposed station there incorporates a glazed glass beacon extending out from the station as a subtle yet noticeable landmark

3) Commercial Space Provided Underneath the platform

In order to optimize the welcoming experience of UBC for SkyTrain riders, the commercial space will be located at the street-level underneath the platform and not inside the station itself. This would allow for the station to be used to highlight cultural and community pride and potentially showcase student work as the primary welcoming experience to the Campus.

4) Street Preservation Along East Mall

Five buildings along East Mall would likely have to be redeveloped to accommodate a cantilever guideway for short sections when vertical supports will be too disruptive. This would help maintain an adequate the streetscape along East Mall.

5) Biased East Mall Guideway

North of Thunderbird Boulevard, the guideway along East Mall would favour the East side of the street in order to cause fewer disruptions for the sensitive buildings that have been identified, during construction and operation of the SkyTrain.

FINDINGS



Otahuhu Station, Auckland (Jasmax). Incorporates Te Aranga Design Principles with the aim of restoring the mauri (life force) back to this highly degraded site. Image: Patrick Reynolds



Aerial perspective showing station location and guideway placement along Wesbrook Mall.

WESBROOK MALL

Shaping the Future

The first proposal along Wesbrook Mall provides an opportunity to shape the future development of primarily residential neighbourhoods to the East of Campus. The option provides both regional and local connections to the Academic Core and south residential neighbourhoods. Proposed design strategies would facilitate the enhancement of passive recreation spaces and support proposed mixed-use areas in the Acadia neighbourhood. This option has considerable flexibility because entire neighbourhood areas within walking distance of the stations have been identified for redevelopment in the future. Further, it is possible to integrate this option with existing plans for the 2019 Wesbrook Mall Upgrades. The second station location also allows for flexibility in selecting routes for future expansion of the SkyTrain. The option will increase the east-west barrier and may create negative sensory experiences for residents along Wesbrook Mall. However, the noise and vibration impacts may not be significant as Wesbrook Mall is already a busy, arterial road. As with all options that we have explored, the guideway pillars and station construction will disrupt permeable surfaces and trees. In this option, the South station location is in close proximity to sensitive forested areas of Pacific Spirit park.

Brickell Hammock Trail
The Underline, Miami
(James Corner Field Operations)

In order to enhance connections to green spaces, the areas surrounding the pedestrian paths would be flexible spaces that allow for dialogue, celebration, innovation, recreation, and learning.



Mt. Eden Station, Auckland
(City Rail Link)

A prominent entryway such as a plaza would people's first experience on Campus, provide opportunities for passive recreation and serve as a way-finding landmark.

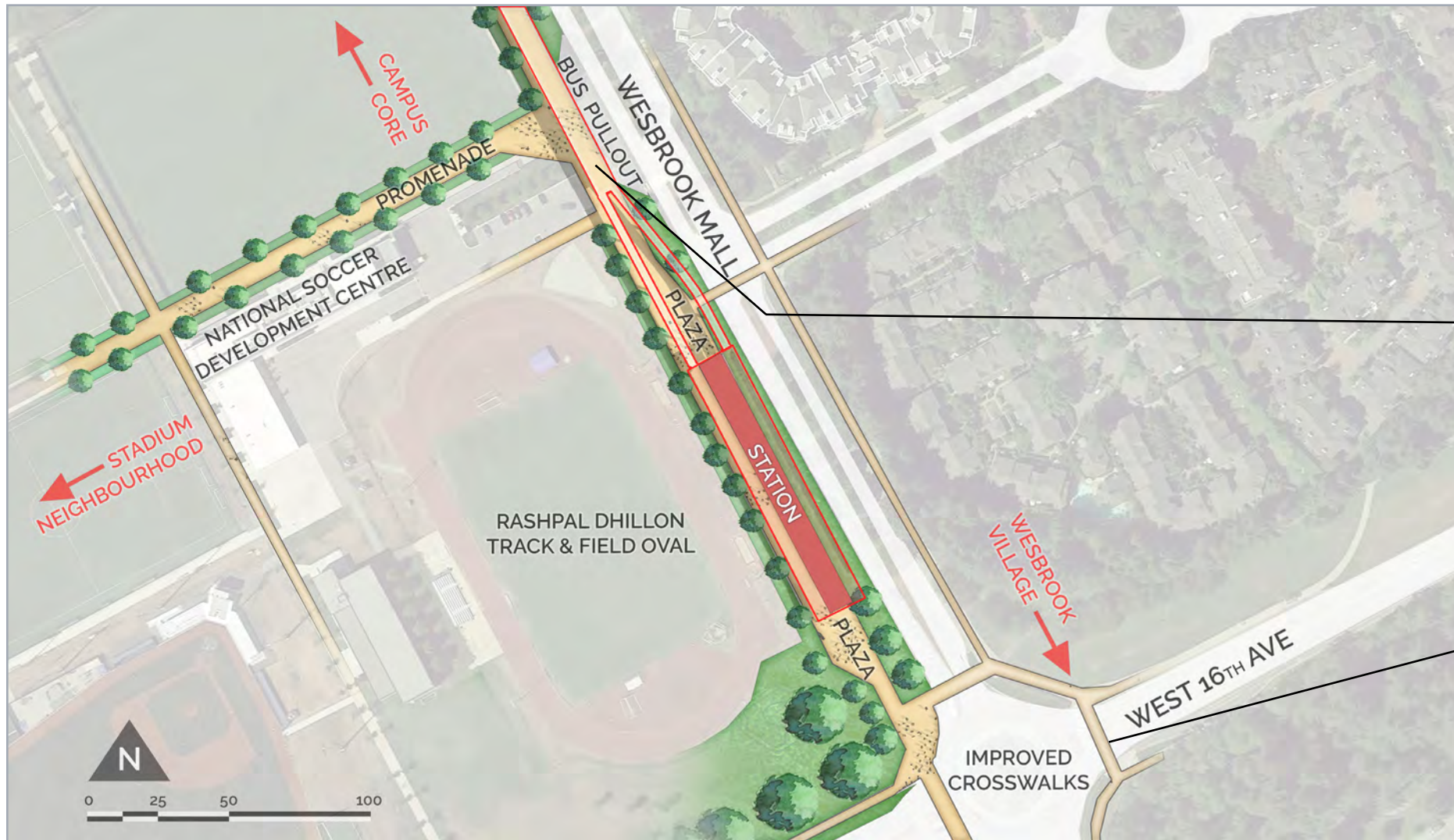


Davenport Diamond Grade Separation, Toronto
(Metrolinx)

The guideway provides rain coverage and weather protection for passerby's and to promote formal and informal spaces for gathering.



Wesbrook Mall North Station Area Plan. Upgrades to informal pedestrian pathways around the Health Sciences and Hospital areas would enhance pedestrian and cycling connections to the campus core. The redevelopment site adjacent to the station can provide a space for a memorable and welcoming gateway to campus.



Wesbrook Mall South Station Area Plan. A station in this location contributes to the overall goal of creating functional and sustainable connections for UBC residents as it will influence the growth and development of neighbourhoods east of campus. Pedestrian and cyclist routes as well as enhanced public space surrounding the station make the area near a busy intersection less car dominated.



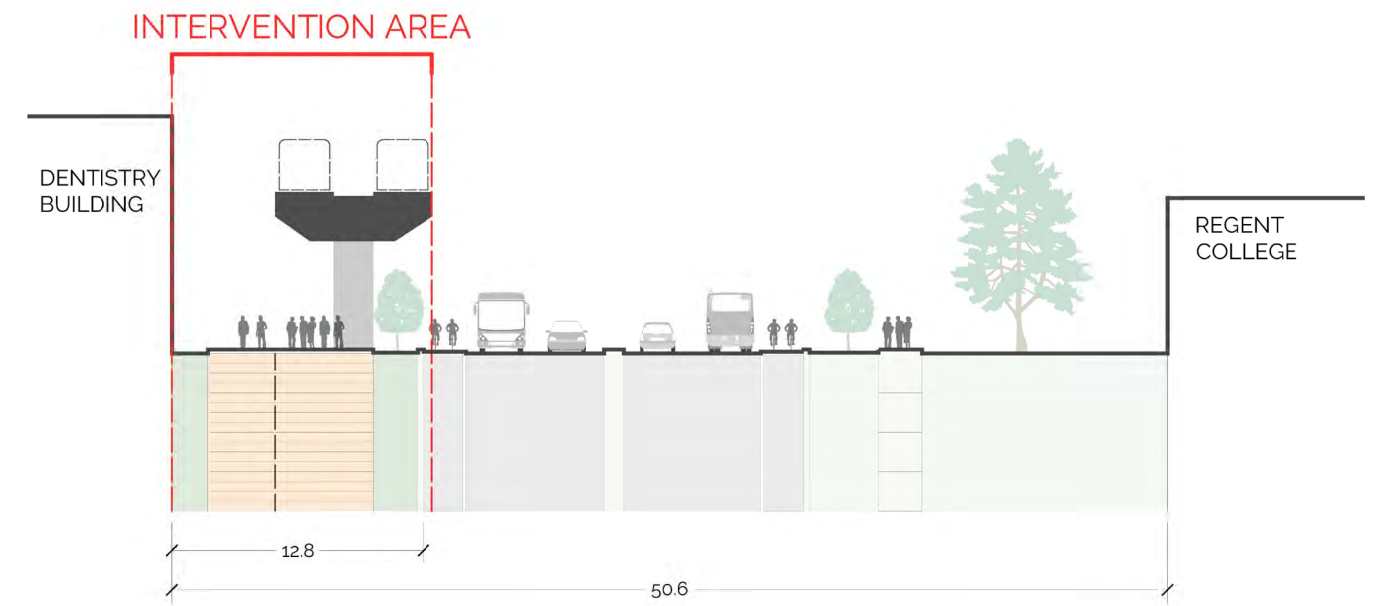
Bus Bay
(Nacto, 2013)
A bus pullout would connect regional and local bus routes to a SkyTrain station.



Crosswalk Concept Design, Seattle
(Slough, 2017)
Notable crosswalks will help protect pedestrians against automobile and bicycle traffic and aid people in choosing the SkyTrain as their primary mode of transportation.



Wesbrook Mall North Perspective Facing South West. This guideway placement is compatible with current upgrades to Wesbrook Mall that provide more room for pedestrian and cyclists. The guideway may enhance the separation between the campus core and residential areas to the east.



WESBROOK MALL NORTH
FACING NORTH



Wesbrook Mall South Perspective Facing South West. The area underneath the guideway can provide weather protection for walking and cycling routes and animated features along the way.

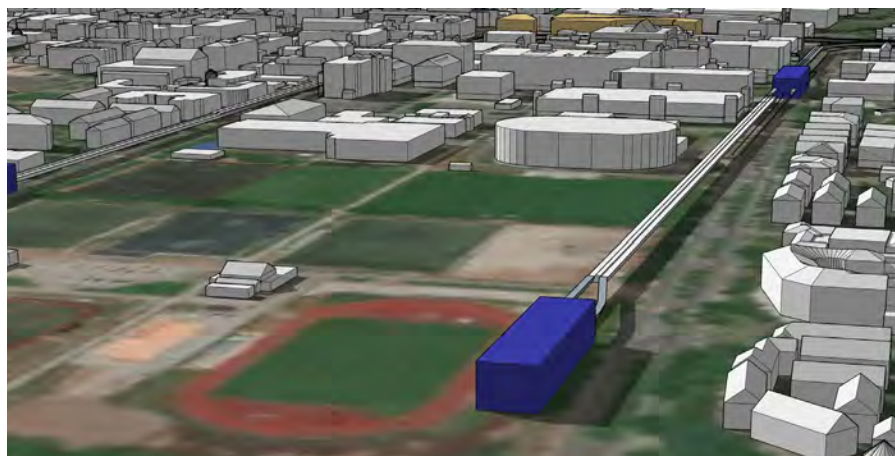


WESBROOK MALL SOUTH
FACING NORTH

Wesbrook Mall Sections. The guideway can be incorporated into the current streetscape. Permeable surfaces and trees would be removed to accommodate the guideway.



Westbrook Mall North Aerial Perspective



Westbrook Mall South Aerial Perspective

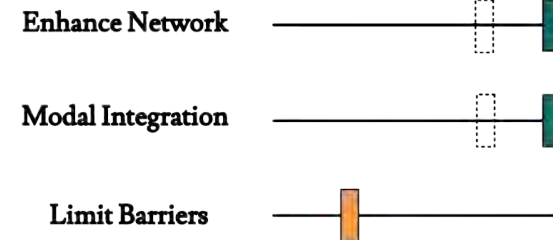
PROS:

- Enhance network connectivity
- Support modal integration
- Opportunity to shape community growth
- Flexibility
- Extendibility

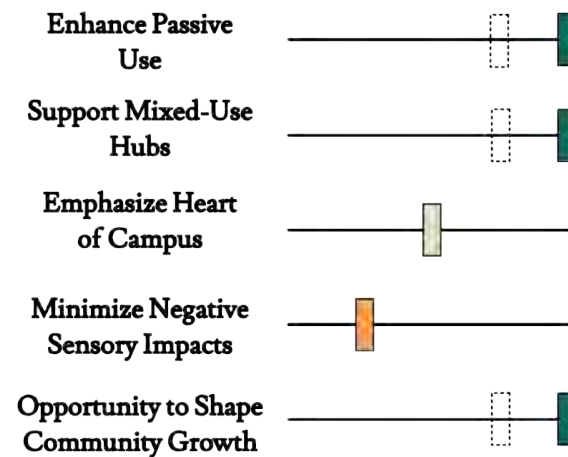
CONS

- East-west barrier
- Removal of permeable surfaces
- Potential disruption to species and habitats

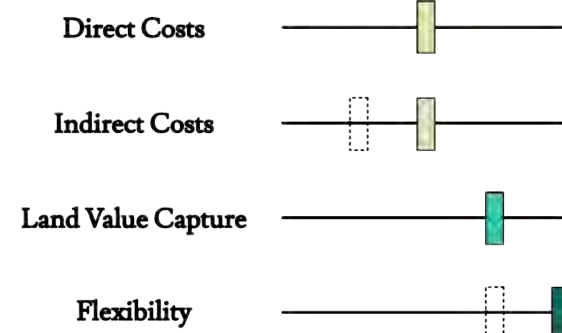
Connectivity



Community



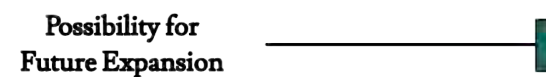
Economy



Environment



Additional



Original Evaluation

Re-evaluation

Re-evaluation of the Westbrook Mall option resulted in some positive changes to the team's initial assessment which did not consider the changes to the streetscape mentioned in 2019 Westbrook Mall upgrades. These changes, specifically the removal of one lane of traffic on some portions of Westbrook Mall will help accommodate the guideway pillars. There is potential to incorporate the pedestrian and cycling space from the Westbrook Mall Upgrades into a covered multi-modal route.

Upgrades to informal pedestrian pathways around the Health Sciences and Hospital areas would enhance pedestrian and cycling connections from north to south. However, the guideway and arterial nature of Westbrook Mall still pose a significant challenge for east-west connections.

The Workshop participants proposed the re-location of the first station to the north of the Hospital in order to have the station closer to the Campus Heart and create more distance between stations. This would require the redevelopment of the Friedman building (identified by workshop participants as a potential long-term re-development site) as well as the acquisition of UEL lands to accommodate the guideway curve. For these reasons the team chose to keep the original station location and to replace the Ambulance Services building and the empty lot adjacent to it to create an urban open space.

The workshop identified that Westbrook Mall had greater opportunity for re-development than originally thought. The development of these areas would be supported by the two stations and would contribute to the shaping of community growth. Westbrook Mall has more flexibility in terms of design limitations than the University Boulevard Precinct.

Finally, the placement of the second station allows for flexibility in route options for future expansion of the SkyTrain network.



Campus aerial perspective

EAST MALL

Enhancing the Campus Heart

The second proposal along University Boulevard connects transit users directly to the Campus Heart and connects the future Stadium Neighbourhood to the Academic Campus. The fully extended option (i.e. phase 2) will contribute to enhanced modal integration and land value capture for current and near future mixed-use developments as well as within the proposed residential and commercial spaces in the Campus Heart. Development of buildings required for this design would create added cost to the project as the station is tied directly to these developments. Also, residential and academic uses in the associated buildings would be difficult to shield from noise and vibration impacts. The redevelopment of East Mall would require the demolition of multiple buildings not currently listed for redevelopment to accommodate the complex guideway design. Both phases would contribute to the disruption of permeable surfaces, trees, and green spaces that are important for species and habitat but also community wellbeing. The sensory and physical barrier created both on University Boulevard and along East Mall would likely contribute to a negative pedestrian experience underneath the guideway.

Covered Public Space

(Nodes, 2015)

The immediate spaces around the station will be covered to protect transit-users from the elements to ensure positive experiences and perceptions of public transit.



Neighbourhood Courtyard

(Conran and Partners, 2017)

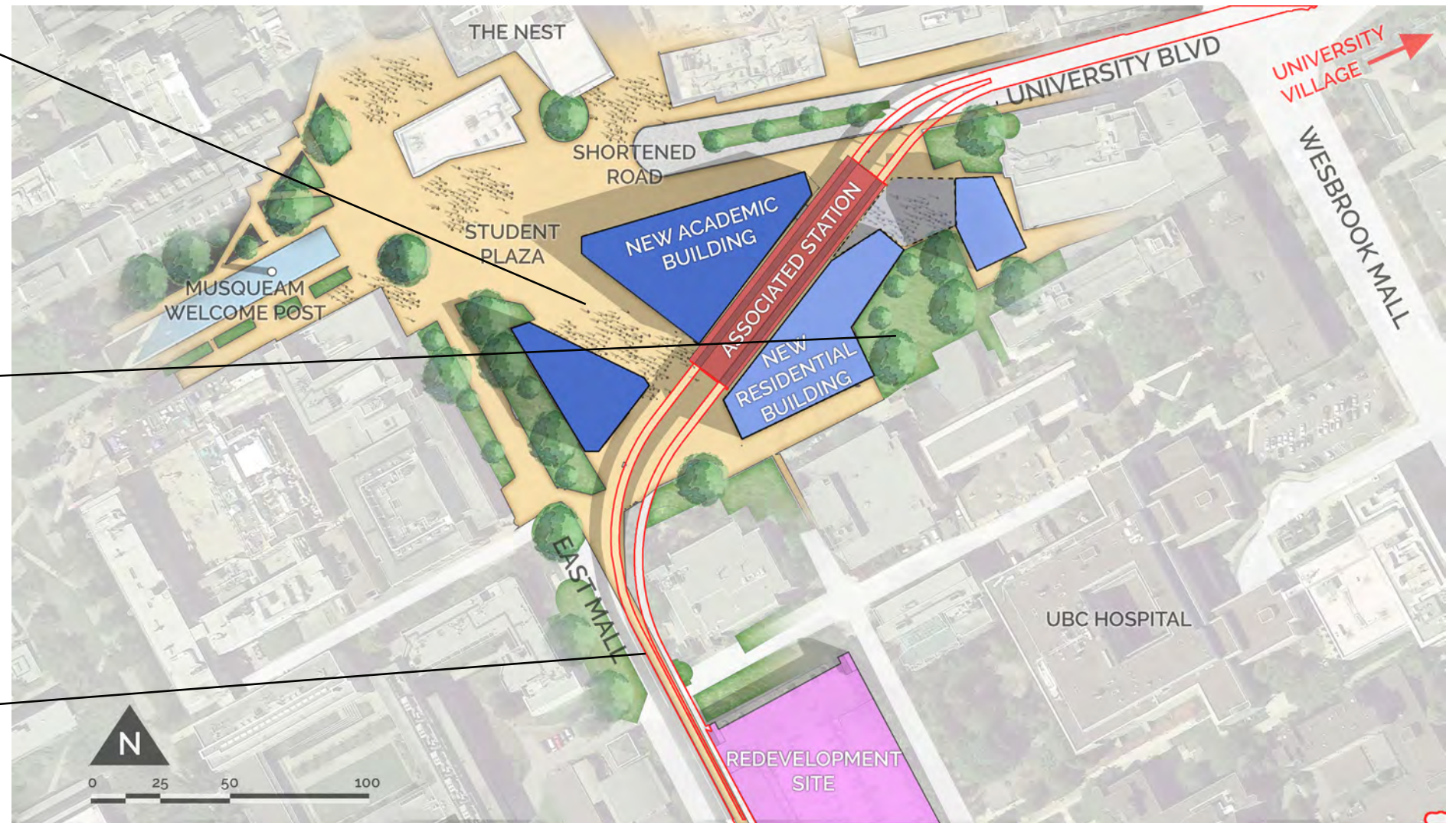
Preserving and rejuvenating the neighbourhood courtyard which serves as a flexible space for students and UBC residents is important to ensure that they continue to feel ownership of the spaces in which they live, work, and study.



Team Monorail Westlake Station Proposal

(Oocities, 2009)

A cantilever guideway would continue to allow for students and residents of UBC to enjoy the area without feeling the imposition of a guideway down the narrow width of East Mall.



University Boulevard Station Area Plan. The central station is pocketed between academic and residential buildings in order to minimize the impact on the Campus Heart. Transit users exiting the station towards a student plaza are welcomed with sightlines down East Mall towards the Musqueam Welcome Pole. On the southeast side, a neighborhood greenspace provides a quieter communal area to create a neighborhood vibe at the doorstep of residential buildings. The shortened bus loop provides more plaza space and easier pedestrian connections to the central station.



East Mall South Station Area Plan. The south station connects Stadium Neighbourhood to the campus and region. A pedestrian promenade aligned with the station entrance enhances the connection from East Mall to Wesbrook Mall.



Wind Street Nightlife, Swansea (Omnia Space)
The ground level of developments around the station will include shops, cafés and restaurants that are open during SkyTrain hours to help animate the space and provide a sense of safety and security to transit users using services late at night.



Plaza Saltillo Mixed-Use Development, Austin TX (Endeavor Real Estate Group)
The projected growth associated with the Stadium Road Neighbourhood will require new developments so that compact and complete communities are being built to promote sustainable growth on Campus.



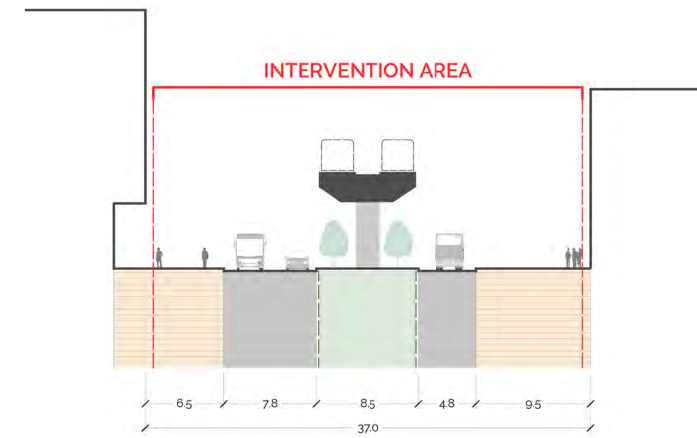
Front Street Promenade West Don Lands, Toronto (McKinnon, 2014)
The proposed pedestrian promenade would be aligned with the South Station entrance and connect areas of Wesbrook Mall and future growth. This would allow for the East Mall station to be a recognizable and enjoyable gateway rather than serving as a stand-alone station.



University Boulevard Perspective Facing West. The guideway turns off of University Boulevard as quickly as possible to keep it from dominating the experience of the public realm spaces outside the Nest. However, the guideway will still create a barrier on a portion of University Boulevard.

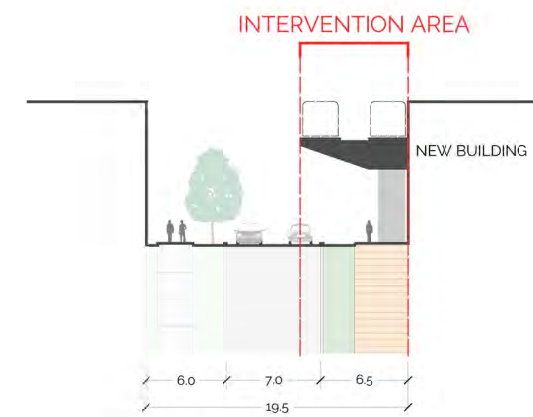


East Mall South Perspective Facing South West. The guideway along East Mall will contribute to negative sensory experiences for residents and pedestrians in this area.



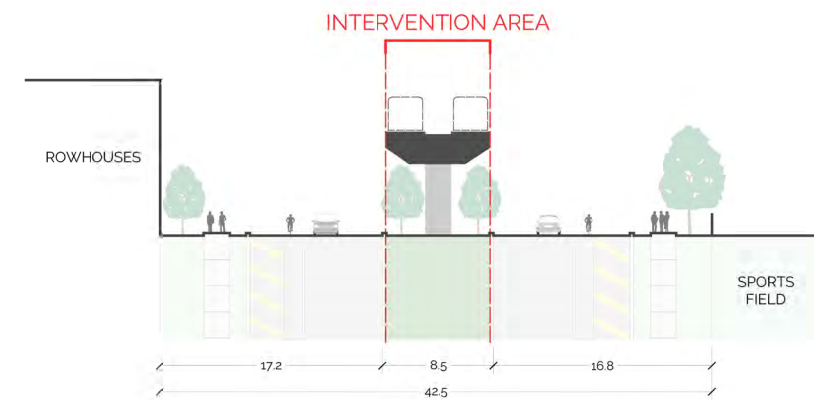
UNIVERSITY BOULEVARD
FACING EAST

University Boulevard Section: Elimination of a parking lane on University boulevard will be able to accommodate the increased pedestrian flow



EAST MALL NORTH
FACING NORTH

East Mall North Section. A cantilevered guideway in the narrowest section of East Mall will require the redevelopment of several buildings and increase the cost of this option.

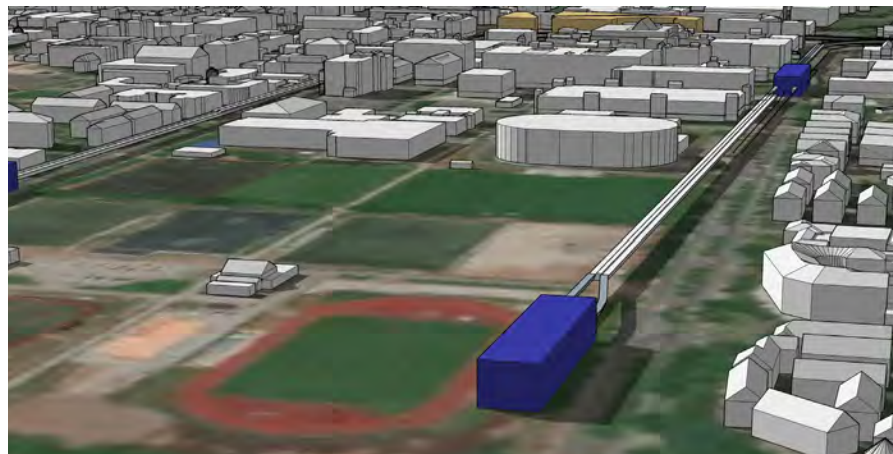


EAST MALL SOUTH
FACING NORTH

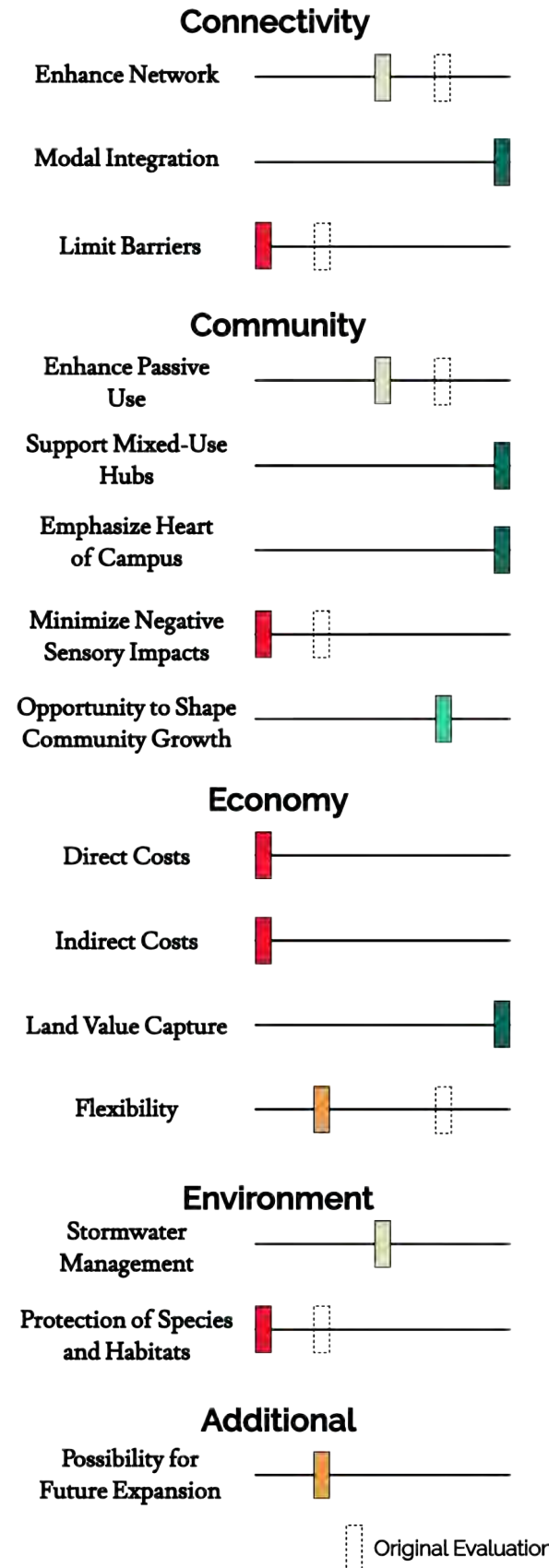
East Mall South Section. The guideway along East Mall will impact the experience of residents living in rowhouses on the west side. Protecting these residents from noise and vibration impacts will be a challenge.



Westbrook Mall North Aerial Perspective



Westbrook Mall South Aerial Perspective



Re-evaluation

Re-evaluation of the East Mall proposal did not result in any positive changes to the team's assessment.

In both phases, one lane westbound along University Boulevard would be eliminated to accommodate the guideway to accommodate the increased pedestrian flow at the central station. It is unclear at this point what the implications are for continued vehicle access to this space. With the underground parking facility currently under construction south of The Nest, eliminating vehicle traffic on University Boulevard would be a direct contradiction to existing plans for this space.

In the initial evaluation, the first station was assumed to be an integrated station with primarily commercial uses. However, in the updated proposal residential and academic uses are located at the first station site. While the cutting in the of the Central station will minimize impacts to the Campus Heart, the sensory experience of the people living and learning in these buildings would be a greater challenge to mitigate.

There would be less flexibility for future growth than previously thought, as more redevelopment opportunities have been identified in the Acadia Neighbourhood area. The development opportunities at this location are less beneficial than the initial evaluation indicated. Further, the University Boulevard precinct design guidelines limit the potential for large-scale changes.

Hardscaped plaza spaces and walkways added to this option will reduce the amount of permeable surfaces present in this high flood risk area. Stormwater management and any additional green or blue infrastructure would be an added cost to the sustainable development of this option. The alignment of the guideway to the south side of the street would be disruptive to existing businesses, outdoor patio spaces, and the pedestrian experience on University Boulevard. The station design is more complex in this proposal because it is tied to the development of the three associated buildings.

With this proposal, a new barrier would be created along East Mall. The cantilevered guideway for short distances was proposed as a way to mitigate disruptions to the public realm on the ground level. As portions of the guideway will be cantilevered, and need the extra space the redeveloped buildings would be set back further. This complex design implies greater costs as buildings on East Mall have not been identified for redevelopment.

Finally, possible routes available for expansion beyond the second station as proposed by the workshop participants would be restricted to Ross Drive which would be extremely challenging with existing technology due to tight turns and narrow street widths.

PROS

- Modal integration
- Supports mixed – use hubs
- Emphasizes the Campus Heart
- Land value Capture

CONS

- Creation of barrier on University Boulevard and East Mall
- Negative sensory impacts for residential and academic uses
- Direct and indirect costs
- Disruption of permeable surfaces, trees, and open green spaces

RECOMMENDATIONS FOR FUTURE STUDY

Extension Beyond UBC

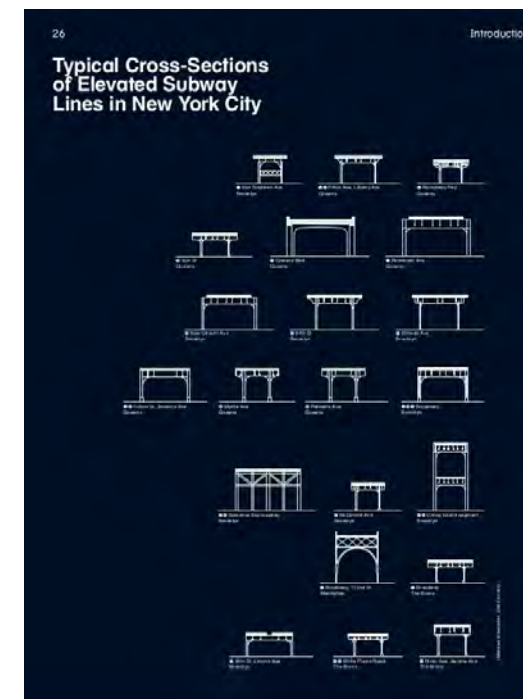
The route of a future extension of the SkyTrain from UBC back towards Vancouver should be considered in depth before selecting a final placement for a south end station. Moreover, alternative operating approaches could also be explored such as a shared UBC terminus station for separate lines. The direction of future extension has major implications for the preferred location and is a significant factor in developing a long-term transportation vision for the UBC Campus. For example, placing a station on Wesbrook Mall North of West 16th Avenue, as with the Wesbrook Mall proposal presented above, does not serve the residential and commercial areas of Campus as directly as if the station was located South of West 16th but does allow for the extension of the SkyTrain in either direction. Thus, the above proposal is flexible but potentially less desirable in terms of accessibility and future TOD.

Gateway Street-Spanning Station Feasibility

Workshop participants suggested street spanning stations as a way to bypass busy intersections along West 16th Avenue. Though we did not incorporate this strategy into our two final concepts, we feel it is worth exploring further for the Wesbrook Mall alignment. A cost analysis should be considered along with its potential advantages including the possibility of giving UBC an iconic entrance to the campus, and other place-making opportunities to fully understand the feasibility of these options moving forward.

Guideway Specific Study

Our analysis focused on the public urban realms and desirable locations and designs for elevated stations and routes through UBC's campus. However, we feel that an in-depth study of options for guideway design along these routes mandatory. The broad implications such as noise and vibration sensitivities are highlighted in this report and are based on Vancouver precedents which do not generally reflect the urban campus character. Strategies and solutions can be explored in much greater detail. Materials, height, column design, column location, and the experience underneath the guideway should be considered in depth to give the elevated guideway a clarified form at the urban scale. Specifically, short sections of guideway where Vancouver precedents may not apply should be considered an opportunity for creativity and innovation.



Benefits of Elevated Rail "RailUP!" (2015). Brick, concrete, plants and recreation space beneath the tracks.



Benefits of Elevated Rail "RailUP!" (2015). Strategic pillar placement to create covered public space.

Under the Elevated, Design Trust for Public Spae (2015).



Integrated Stormwater management (Diamond Head Consulting, 2017)

MOTION

15. Mandatory Green Roofs

At the Regular Council meeting on July 24, 2018, Vancouver City Council referred the following motion to the Standing Committee on Policy and Strategic Priorities meeting on July 25, 2018, to hear from speakers.

MOVER: Councillor Carr
 THAT the Committee recommend to Council

WHEREAS

1. Climate change is predicted to produce wetter winters, hotter, drier summers, and more extreme rainstorms in the Vancouver area, which the City's infrastructure was not built to accommodate. Climate change impacts are already being felt in Vancouver and are accelerating;
2. Green roofs mitigate climate change impacts. They absorb greenhouse gas emissions (GHGs), absorb rainwater, reduce stormwater volumes, peak flows and related flooding, and reduce GHGs related to heating and cooling (buildings currently account for over 50 percent of Vancouver's GHG emissions);
3. Green roofs contribute to a better quality of life. They reduce the urban "heat island" effect, insulate buildings from summer heat and winter cold, provide more comfortable indoor temperatures year-round, insulate buildings from noise, and improve air quality by absorbing particulates and pollutants. They provide a more natural visual aesthetic for residents and workers in multi-storey buildings looking down on the roofs of other buildings, an increasingly common reality for many Vancouverites;
4. Green roofs can offer opportunities for urban agriculture, support biodiversity and provide urban habitat for wildlife struggling to cope with changing weather patterns, including birds and pollinating insects such as bees and butterflies;
5. Green roofs save money by reducing the costs to heat and cool buildings, extending the life expectancy of a roof by double or triple the time, and lowering the municipal costs of managing storm water runoff;
6. Green roofs were identified as one possible policy direction for Vancouver's "Rain City Strategy", a strategy in development for deploying green infrastructure to effectively manage rainwater and included in the Integrated Rainwater Management Plan best management practice toolkit;
7. Cities such as Toronto, San Francisco, and Copenhagen already require green roofs on all new commercial, institutional, industrial and multi-family residential developments.

THEREFORE BE IT RESOLVED THAT as part of the Rain City Strategy, staff bring back a draft policy for Council's consideration that would require all new commercial, institutional, industrial and multi-family residential developments to incorporate green roofs and provide maximum opportunity for green roofs in renovations to older commercial, institutional, industrial and multi-family residential development.

City of Vancouver Motion for Mandatory Green Roof Policy (Carr, 2000)



Salmon-Safe development certifications. salmonsafe.org



Silva Cells (Stebbins, 2017)

Provision of Ecosystem Services

Strategies for mitigating environmental impacts such as habitat disruption and removal of permeable surfaces were not explored in much detail in this report or in the workshop. However, we have identified sensitive habitats and flood risk zones which will need to be considered in more detail. If an elevated Skytrain is pursued further, there is an opportunity to explore innovative and creative strategies to both minimize the impact on species and habitat and provide green and open space assets to residents and community members. Some of these opportunities include:

- Green and blue roofing policies for newly developed buildings in flood risk areas such as University Boulevard and the south end of Wesbrook Mall.
- Semi-permeable and suspended pavement technologies in hardscaped spaces such as plazas, surface parking spaces, etc.
- The inclusion of greened living spaces on-top of guideways and stations adjacent to residential and academic buildings that will increase outdoor living space and provide noise mitigation benefits.
- Salmon-Safe building certifications and integrated stormwater management techniques.

LIMITATIONS

Environmental Assessment

The evaluation of environmental impact for this project utilized proxy measures for stormwater management and habitat disruption. This included the removal of trees and permeable surfaces, proximity to sensitive habitats, and disruption to habitat connections.

While these measures are useful for assessing environmental impact, the scope of this report was unable to provide an environmental assessment with the necessary detail and comprehensiveness to inform decision-makers. A full environmental assessment will need to be completed in the future, along with geotechnical and hydrological studies.

Cost Analysis

The capital and operational costs of a SkyTrain extension to UBC is a primary factor in the viability of its realization. Therefore, the cost of each particular option examined in this report was taken into consideration. The cost of each option was based off of assumptions informed by C+CP, TransLink documents, and other background research.

While this report was able to identify aspects of each option that will minimize or create additional cost, the exact amount was not established.

Community Engagement

There was no community engagement performed during the process of this study. The SkyTrain extension will no doubt have major implications on the surrounding neighborhoods, the UEL overall, as well as the Musqueam First Nation. Members of the community and Musqueam will need to be well-informed and consulted on the potential extension to UBC.

Historical Context

The project goals, evaluation criteria and proposed designs do not consider the historical context before UBC's existence. This may be problematic in that this project do not fully address the historical context of this land and its history prior to European contact. It is the team's hope that with Musqueam's interest and support in pushing for a SkyTrain to UBC that these elements of Traditional Ecological Knowledge as well as social and cultural values of the people belonging to this land are considered in more depth. With this historical context and understanding, the SkyTrain alignments and Stations could contribute to the enhancement of community connections at UBC.

It should be made clear that the findings and refined options identified in this report are in no way a final decision. Rather, the public should be clearly informed that the primary purpose of this project was to examine the viability and public realm impacts of an elevated SkyTrain at UBC.

Impacts Beyond UBC

The analysis presented in this report focuses on the land base within the UBC Campus's borders. Though this is helpful in understanding the campus needs, it does not consider the implications of an elevated guideway along the entire extension corridor. Specifically, the implications of the transition from underground to above ground somewhere east of Blanca would have a significant impact on the streetscape and urban realm surrounding the guideway and the preferred station locations to serve the neighbouring communities of West Point Grey, the Jericho Lands, and lelam'. To understand the feasibility of an elevated SkyTrain to UBC, partnerships with neighbouring communities are required.



CONCLUSION

As this is a preliminary step in the larger SkyTrain extension analysis, the team has presented the analysis and evaluation of two proposals for consideration along the main corridors of interest. The team identified options, explored approaches and presented design strategies which can be used to mitigate some of the considerable challenges associated with integrating an elevated SkyTrain on the UBC Campus. The findings from this report can be used in future SkyTrain planning processes move forward.

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APPENDICES

APPENDIX A: REGIONAL AND LOCAL POLICY CONTEXT

The UBC Point Grey Campus is on Vancouver's far western edge, surrounded by the Pacific Ocean, Pacific Spirit Regional Park, and the University Endowment Lands. Though the Campus is associated with Vancouver, UBC is outside of municipal boundaries. With nearly 2.5 million people, Metro Vancouver is Canada's third largest urban region. Nearly 1 million more people are projected to live in Metro Vancouver by 2041.

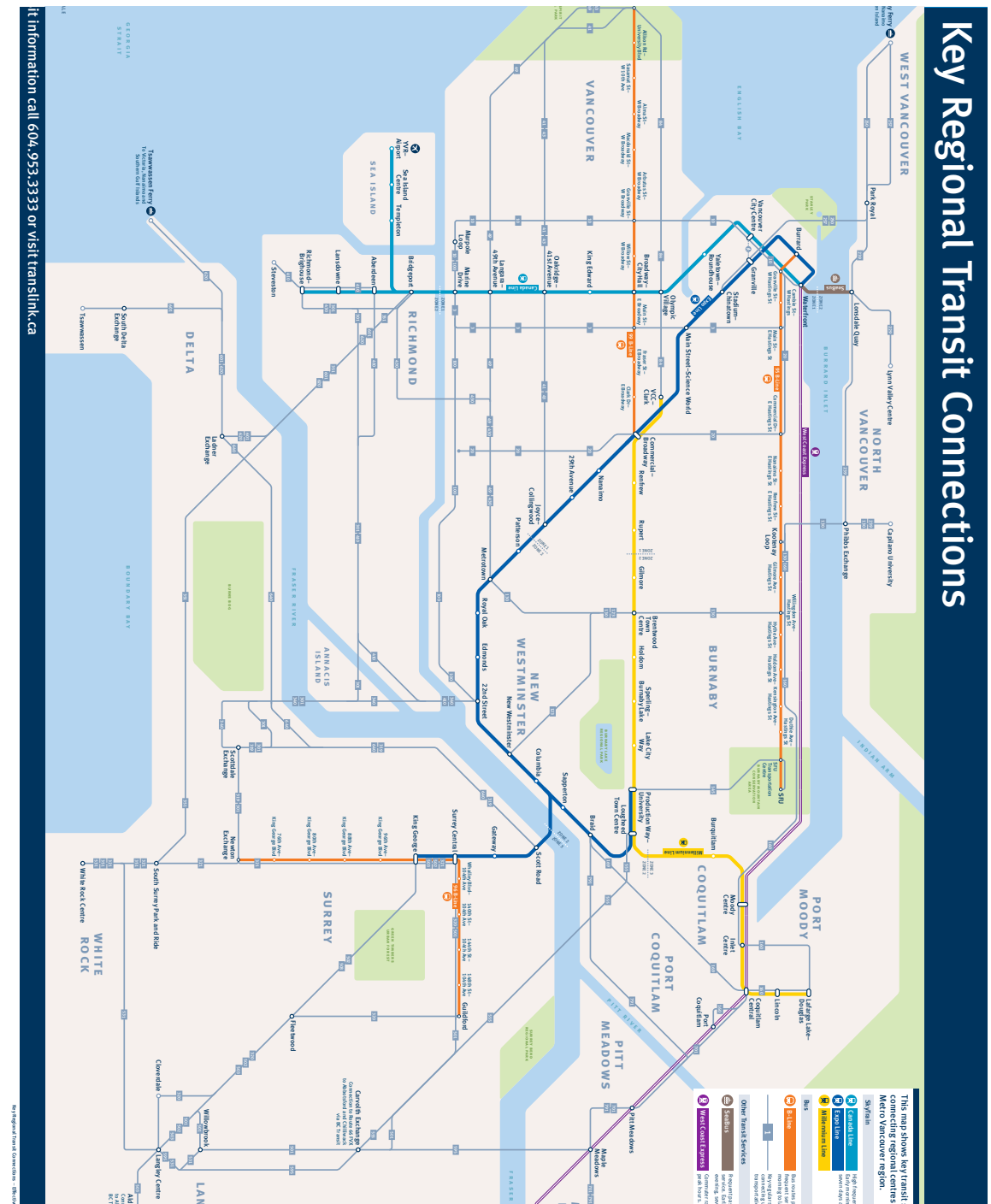
Metro Vancouver works in partnership with municipalities, Translink, Port Metro Vancouver, Airport authorities, and the Federal and Provincial government to coordinate decision-making. Metro Vancouver operates a regional rapid mass transit network known as TransLink, responsible for various modes of transportation including the maintenance of roads and bridges. TransLink prepares and implements strategic transportation plans for roads, public transit, and cycling, as well as the region's long-term transportation strategy. The map in Appendix 2. Shows the critical regional transit connections operated by TransLink. The Province prepares provincial highway and transit plans to assist guide the development of regional transportation plans. The Federal and Provincial government play significant roles in funding regional transit and goods movement infrastructure. The project will contribute to meeting regional goals as mentioned in the Regional Growth Strategy.

As mentioned previously, this project will help meet the key targets set out in local plans. The project will assist in meeting the three critical targets set out in the Transportation Plan. The first target states that by 2040, at least two-thirds of all trips to and from campus will be made by walking, cycling, or transit and 50 percent of all trips to and from campus will be on public transit. The second target aims to reduce single occupant vehicles (SOVs) travel to and from UBC by 20 percent from the 1996 levels and maintain at least a 30 percent reduction from the 1997 levels in daily SOV trips per person to and from UBC. The third target intends to maintain daily private automobile traffic at or less than 1997 levels. Moreover, the SkyTrain extension will provide relief to the 99 B-Line.

The Land Use Plan sets the long-term direction regarding how the campus will grow and change. It sets out areas for academic activities and neighbourhood housing. The SkyTrain project has the potential to allow UBC to meet the goal of providing an on-campus access system that favours pedestrians, cyclists, and transit users as mentioned in the Land Use Plan. The policies in the Vancouver Campus Plan guide the development on the academic lands to include more student housing, improving outdoor spaces, and using the campus as a living laboratory. The Vancouver Campus Plan predicts that a 33 percent increase in floor space will be needed to accommodate projected growth. The addition of a rapid transit station will influence where this density is added. The project will also help create transit facilities that are safe, accessible, weather protected, convenient and attractive as mentioned in the Vancouver Campus Plan.

The Musqueam Comprehensive Community Plan (CCP) is a high-level, holistic plan encompassing the critical planning areas for the Musqueam community and establishes important values and recommendations. The Musqueam CCP outlines the projected opportunities for future economic development to take place due to their land holdings like the University Golf Club. A current Musqueam development is Lelem. It is being constructed on University Boulevard just east of the UBC Campus and will have a mixture of residential and commercial space. The Musqueam CCP also outlines the need to address the current housing needs. There are currently 200 members on the housing waitlist, a limited land base that has competing possible land uses, and many homes that require significant upgrades and repairs. Thus, members have indicated that they want to see more member housing provided and they are requesting for the exploration of the potential lands that may be available for housing developments. The members have also outlined the need for efficient and effective land use that includes multi-family dwellings and maintenance programs to prolong the usability of the housing stock. Finally, The Musqueam CCP recognizes that there is a gap in the current transportation system, where the closest public transit stop is nearly a 30- minute walk from the heart of the Musqueam village. Therefore, members have requested that these areas be evaluated to increase transportation services for Musqueam. The SkyTrain extension may contribute towards Musqueam's goals as outlined in their CCP.

APPENDIX B. KEY REGIONAL TRANSIT CONNECTIONS TO UBC



APPENDIX C. DEFINING OBJECTIVES AND EVALUATION CRITERIA

Defining Objectives and Evaluation Criteria

After identifying broad goals for our project, we developed four evaluation principles: Community, Connectivity, Economy, and Environment. These principles took into consideration the goals and objectives of the regional and local plans, as well as the groups understanding of our partner's goals. The principles became the framework for evaluation of SkyTrain guideway and station location options.

To inform the specific criteria and measurements, the team gathered information and evaluated:

- Existing plans and policies from Canadian cities related to transit network analysis transit-oriented development, and transit technology option evaluations
- On-the-ground conditions in and around potential station locations
- Urban design considerations and existing SkyTrain design criteria
- Social policy related to transit-oriented development
- Sustainability measures relevant to the UBC Campus

The transportation network planning and evaluation studies focused primarily on land use, areas of employment, trip generators, and increasing transit ridership. These factors were divided between social, economic, and transportation connectivity. Often these measures were overlapping. Environmental indicators included in previous studies mainly revolved around reducing greenhouse gas emissions and single vehicle occupancy trips. Our group felt that the unique context of the UBC campus and the value placed on its natural setting and backdrop should be included. Thus, our group reviewed environmental assessment documents to develop proxy measures for ecological impact and sustainability.

APPENDIX D. DOCUMENTS REVIEWED

DOCUMENT TITLE	CATEGORY
Vancouver Campus Plan Part 1 – 3	Community/Neighbourhood Plans
UBC Public Realm Plan	Community/Neighbourhood Plans
UBC Land Use Plan	Community/Neighbourhood Plans
UBC Transportation Plan	Community/Neighbourhood Plans
Musqueam First Nation: A Comprehensive Sustainable Community Development Plan	Community/Neighbourhood Plans
Integrated Stormwater Management Plan	Community/ Neighbourhood Plans
Metro Vancouver 2040 Shaping Our Future	Regional Plan
University Boulevard Precinct Design Guidelines	Design
Benefits of Elevated Rail Case Study 1 & 2	Design
Urban Design for Rapid Transit SCARP	Design
Thinking Beyond the Station	Design
Public Transportation: Rethinking Concepts and Theories	Design
How Does Fear of Sexual Harassment on Transit Affect Women's Use of Transit?	Design
Planning the City Against Barriers. Enhancing the Role of Public Spaces	Design
Calgary Transit Evaluation Criteria	Evaluation Criteria
Toronto Transit Network Analysis	Evaluation Criteria
New Station Analysis: Methodology and Process	Evaluation Criteria
UBC Rapid Transit Study Phase 2	Evaluation Criteria
Current HCM Methodology	Evaluation Criteria
Multiple Account Evaluation for Alberta Transportation: A Decision-Making Tool	Evaluation Criteria
Surrey Rapid Transit Study	Evaluation Criteria

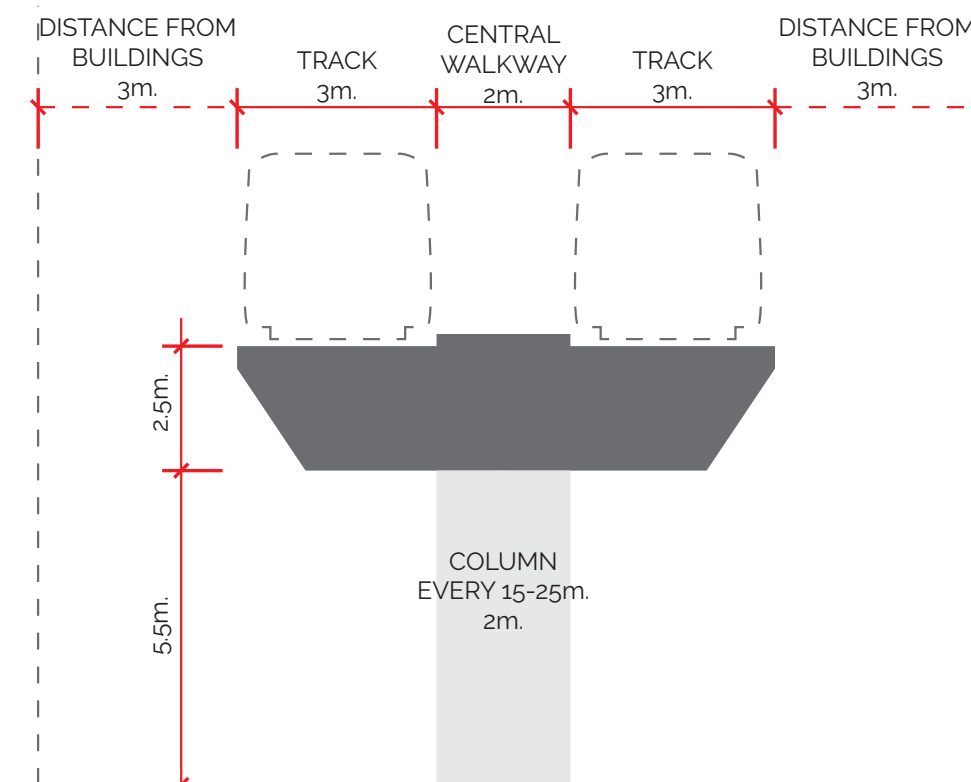
APPENDIX D CONT. DOCUMENTS REVIEWED

DOCUMENT TITLE	CATEGORY
Automated Light Rail Transit (ALRT) in Vancouver, Canada: Measured and Perceived Noise Impacts	Evaluation Criteria
City of Surprises	Evaluation Criteria
Mapping the biodiversity potential on the University of British Columbia Campus	Evaluation Criteria
Westside Extension Transit Corridor Study (Los Angeles)	Evaluation Criteria
Three steps to understanding restorative environments as health resources	Evaluation Criteria
Modelling Train Station Capacity	Technical Information
TransLink Passenger Facility Design Guidelines	Technical information
Downtown Moves: Transforming Ottawa's Streets	Technical Information
Millennium Line Broadway Extension (MLBE) Project	Transit Network Studies
Construction begins on 1,250-unit condo project at UBC Pacific Spirit Park	Media
Why aren't we designing cities that work for women, not just men?	Media
Women And Men Use Cities Very Differently	Media
Urban Planning's Role in Making India Safer for Women	Media

APPENDIX E. TECHNICAL ASSUMPTIONS

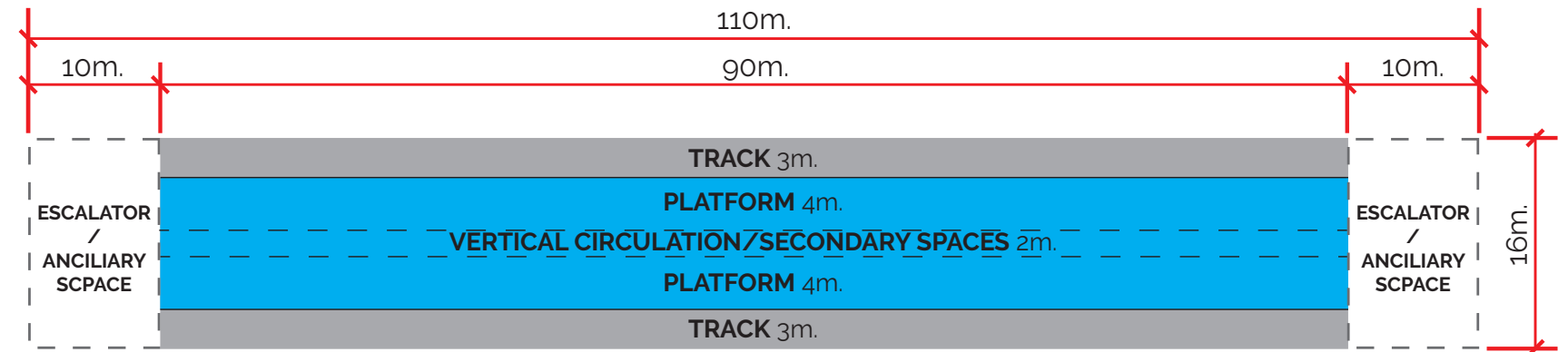
C+CP provided the following technical assumptions based on Translink's technical specifications for station and guideways, which provide a framework to understand limitations on station and guideway placement.

GUIDEWAY	
Width	8.0 metres (2x3m track + 2m central walkway)
Columns & Offsets at grade	5.0 metres Columns 2.0 x 2.0 metres Column every 15 metres
Depth	2.5 metres
Minimum Height	5.5 metres
Turning Radius	80 metres
Curve Requirements	20 metres of tangent track on either side of any curve

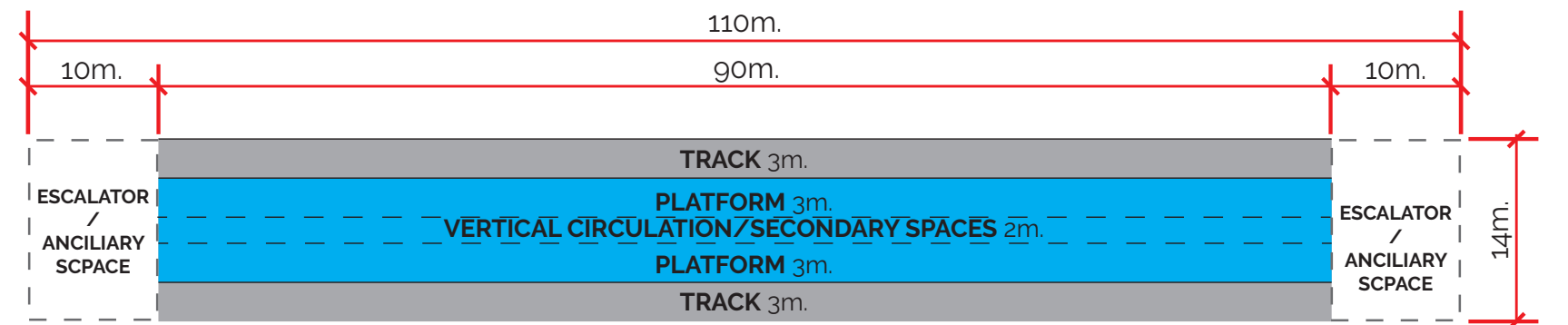


APPENDIX E CONT. TECHNICAL ASSUMPTIONS

STATION	
Length	90 metres x 20 metres to allow for 5-car train
Capacity & Infrastructure	<p>Central Campus: 96,000 people per hour (pph) in peak period (24 trains/hour x 400 passengers/train) 4 escalators (1 up, 1 down, 2 counterflow). 7 fare gates (based on 1500 pph processing ability) Multiple entrances to distribute flow 14 metre central platform width + 3 metre track either side</p> <p>South Campus Station: Platform width 8 metres 3 escalators (1 up, 1 down, 1 redundant for maintenance) 1 x 2.0-metre minimum stair) 4 fare gates minimum A single main entrance Side-platform configuration neighbourhood of 28+ metres at its widest point</p>
Limits of approach during construction	3-metre minimum buffer
Other assumptions	Centre-platform for operational flexibility. Single point of access unless multiple, strong pedestrian connections exist or multiple entrances are required to accommodate easier transfer to other transit modes. However, the goal is to have multiple access points to the platform so that the platform is better utilized and flows to and from the platform can be better managed.



CENTRAL CAMPUS STATION



SOUTH CAMPUS STATION

APPENDIX F. DESIGN WORKSHOP RAW OUTPUTS



Table 1: Plan view showing redevelopment sites.



Table 1: Plan view of first station on Wesbrook Mall and Plaza area.



Table 2: Plan view.



Table 2: Central station with pedestrian connections and proposed buildings.

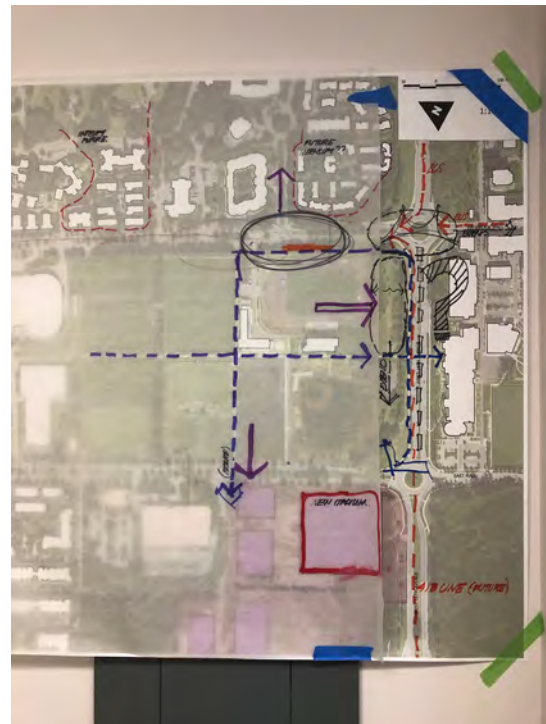


Table 1: Plan view of second station and intersection on Wesbrook Mall and 16th Ave. Pedestrian connections.

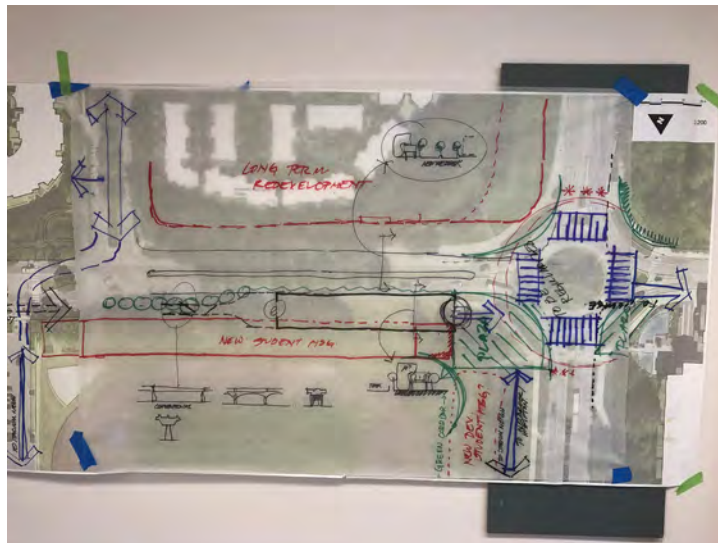


Table 1: Plan view of second station and intersection on Wesbrook Mall and 16th Ave.



Table 2: Central station with station entrances and plaza space.

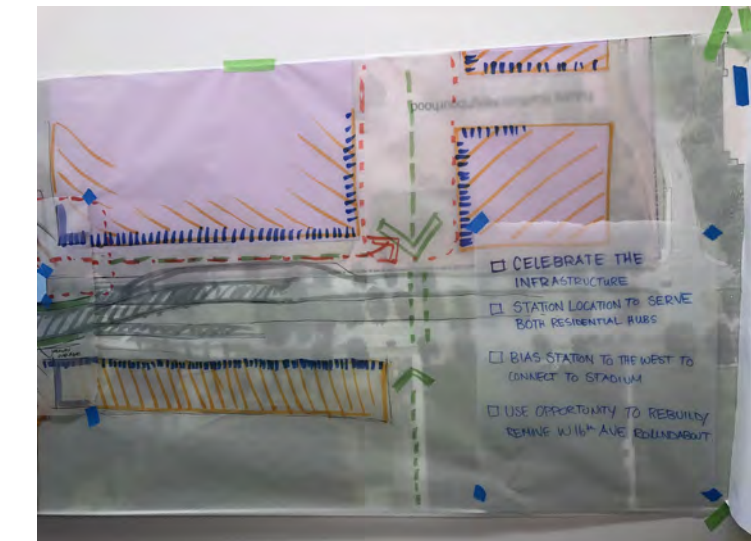


Table 2: South Campus Station area with pedestrian paths and key features listed.

APPENDIX F CONT. DESIGN WORKSHOP RAW OUTPUTS



Table 2: South "street-jump" station with proposed buildings.

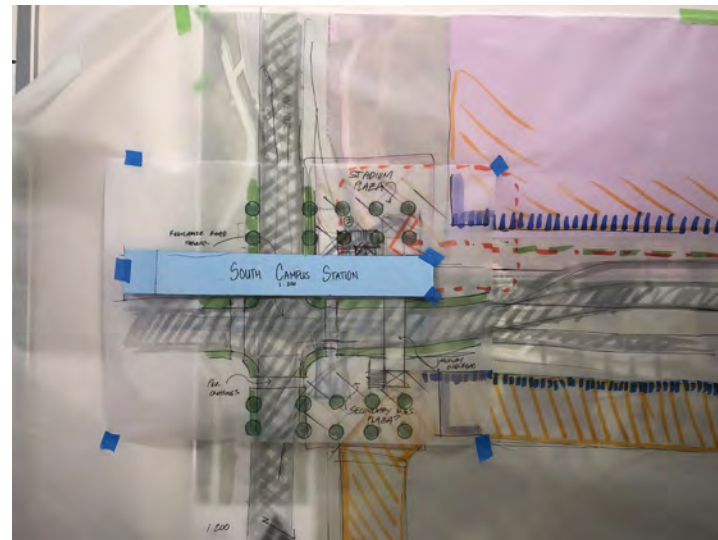


Table 2: South Campus Station with plaza areas.



Table 3: Plan view of second station and intersection on Westbrook Mall and 16th Ave. pedestrian connections.



Table 3: Plan view with key findings listed.



Table 3: Plan View with new buildings and shortened bus loop on University Blvd.



Table 3: Plan View with new buildings and design features.