University of British Columbia

CAMPUS TRANSIT PLAN

June 2003

UBC Campus Transit Plan

1332.0048.01
June 2003

CONTENTS

APPENDICES

UBC Campus Transit Plan

SUMMARY

UBC, TransLink, and the GVRD have worked together to produce this Campus Transit Plan, which describes how the main UBC campus will be served by transit in the future. The recommended transit service concept incorporates sufficient capacity to accommodate 20 or more years of growth in transit ridership, and expands transit services throughout the UBC campus.

Objectives

The primary objective of the Campus Transit Plan is to determine how transit can best serve UBC in the future. This means defining routes for regional buses travelling to and through campus, determining what other transit services are needed on campus, and identifying facilities are required to support these transit services.

Other objectives of the Campus Transit Plan include:

- Estimate future transit ridership as a result of U-Pass.
- Determine what services and facilities are required to accommodate increased transit ridership.
- Increase the attraction and use of transit, and thereby reduce single-occupant vehicle travel.

The Campus Transit Plan was developed within the context established by other plans, including the GVRD's Official Community Plan for UBC and UBC's Strategic Transportation Plan. The Campus Transit Plan was also based on plans and proposals related to the eight neighbourhood areas on the UBC campus defined in the Official Community Plan. In turn, the results of the Campus Transit Plan provide input to further development of the neighbourhood plans, as well as to updates of the Official Community Plan and the Strategic Transportation Plan.

Issues

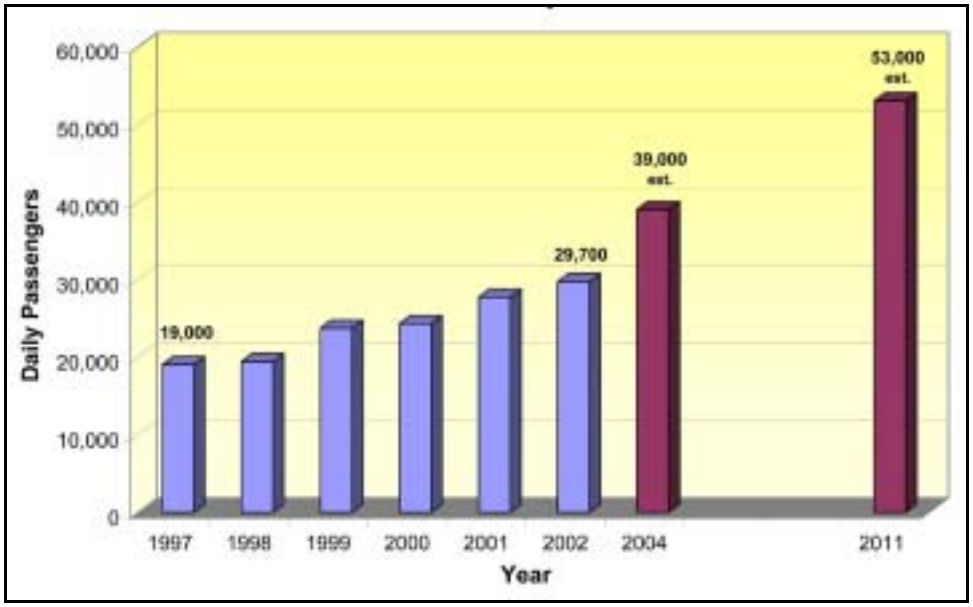
The Campus Transit Plan was initiated in response to several issues, including:

- **Increased transit ridership.** During the 2002/2003 academic year, almost 30,000 trips were made to and from UBC by transit each weekday, amounting to 25% of all trips. Transit use is expected to increase to almost 40,000 trips in September 2003 with introduction of a universal transit pass (called "U-Pass") for students. UBC then plans to introduce a U-Pass for staff and faculty, and eventually hopes to introduce a similar pass for residents at UBC. As a result of this and ongoing growth at UBC, transit ridership by 2011 is forecast to be more than 50,000 trips per day, as illustrated in Figure 1. The Campus Transit Plan identifies how this

1332.0048.01
June 2003

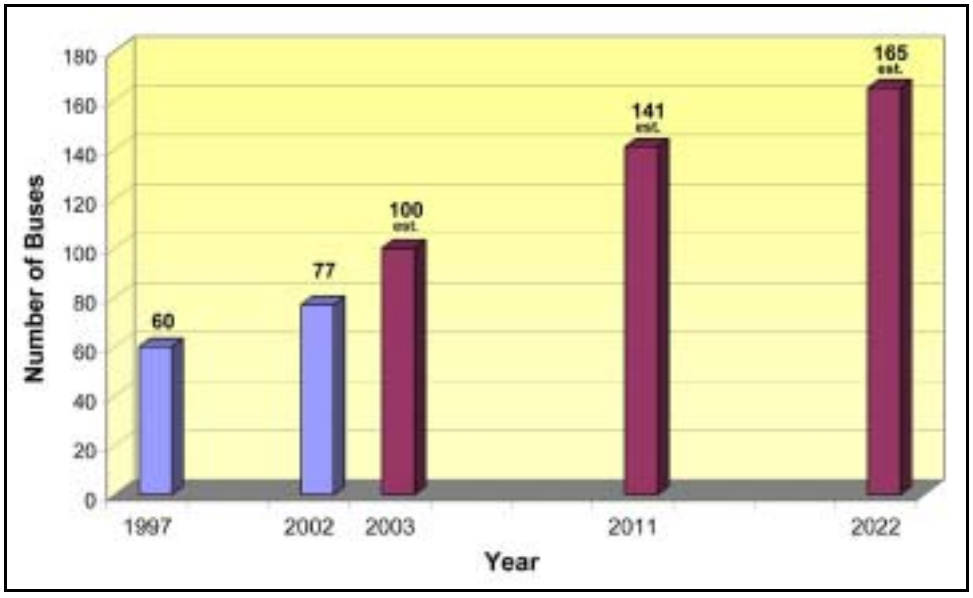
increase in transit ridership can be accommodated while maintaining an efficient and attractive transit service.

Figure 1: Transit Ridership at UBC



- **Transit service levels.** Currently, 77 buses travel to UBC between 8 and 9 a.m. Transit service levels will continue to increase as transit ridership increases, with the result that, by 2022, 165 buses per hour — equivalent to almost three buses per minute — will travel to UBC in the morning peak hour, as illustrated in Figure 2. The Campus Transit Plan identifies transit facilities to accommodate this number of buses on campus.

Figure 2: Number of Buses at UBC (morning peak hour, westbound)

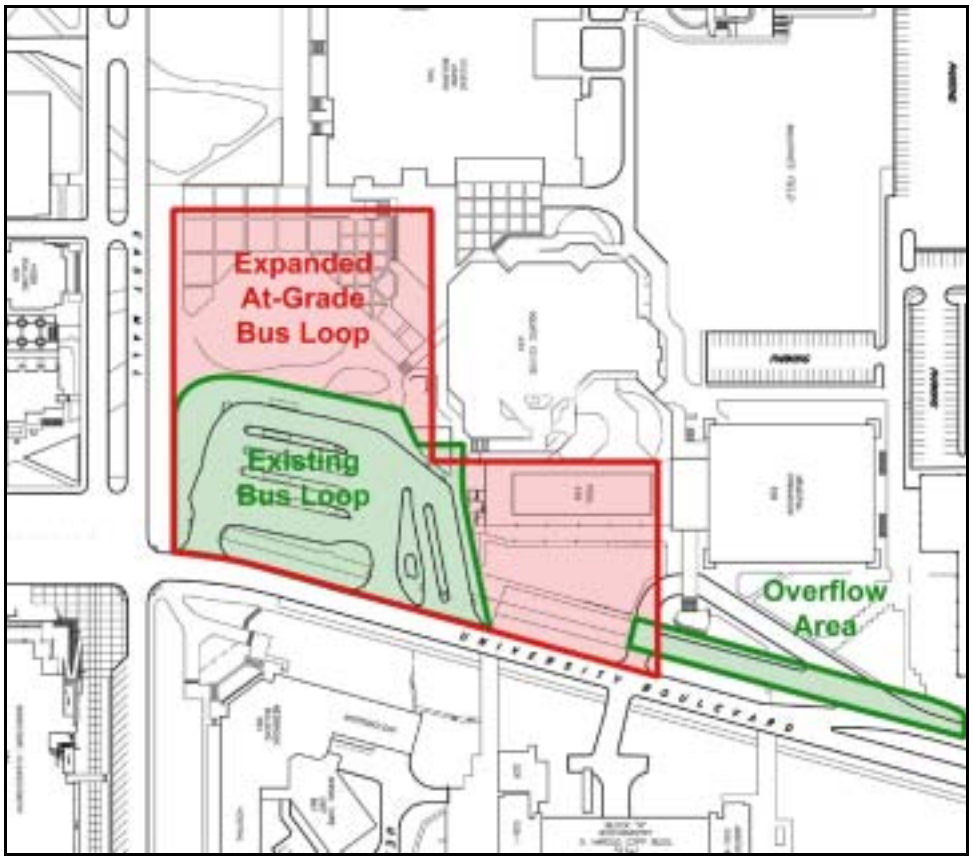


- **Bus loop capacity.** Despite being expanded twice in the past 20 years, the existing bus loop is over capacity. During peak periods, there is not sufficient room in the bus loop for all buses, and consequently an overflow area in front of the War Memorial Gym is used for some buses. Within the bus loop, many of the platforms are too small to accommodate waiting passengers during peak periods, as illustrated in Figure 3.

  Increases in transit ridership and service levels could be accommodated by further expanding the bus loop. However, continued expansion of the bus loop would mean that, 20 years from now, the bus loop would have almost tripled in size, as illustrated in Figure 4. The Campus Transit Plan considered a range of alternatives to expanding the bus loop to this size, and identifies an optimum configuration for a central transit station.

Figure 3: Passengers Overflowing Platforms in Bus Loop

Figure 4: Footprints of Existing and Expanded Bus Loops



- **Congestion and delays.** Congestion is a chronic problem on University Boulevard between Wesbrook Mall and East Mall. During much of the daytime on weekdays, traffic on westbound University Boulevard is backed up from the East Mall intersection at the bookstore — sometimes as far as Wesbrook Mall. As shown in Figure 5, buses are caught in this congestion, and can be delayed up to six minutes travelling along University Boulevard. The Campus Transit Plan identifies how congestion and delays to transit services can be minimized, so as to ensure that transit service remains fast, reliable and attractive.

Figure 5: Congestion on University Boulevard

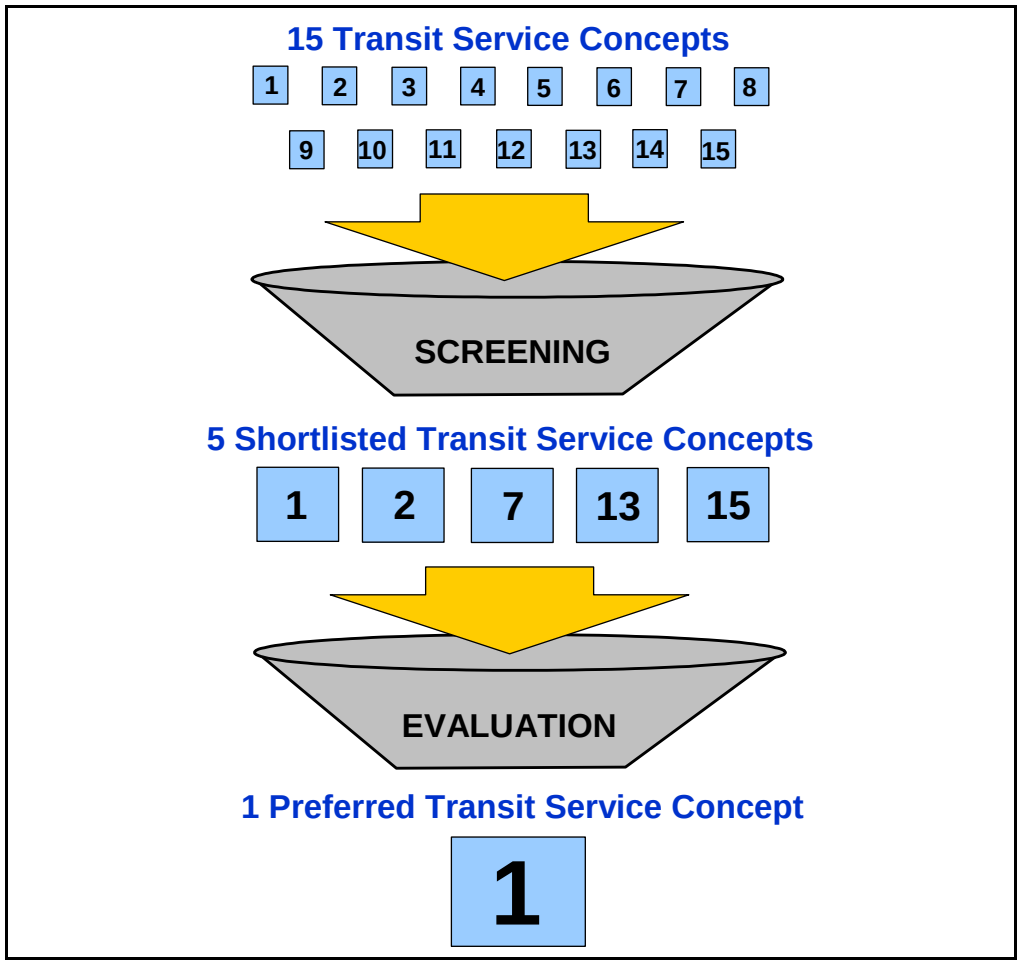
- **Coverage.** As outlying areas of the campus are developed, there will be a greater need for transit services to accommodate trips within the campus. The Campus Transit Plan identifies how coverage of the campus can be improved with Community Shuttle services.

- **Transportation targets.** UBC has committed to pursue targets of increased transit ridership and reduced single-occupant vehicle traffic. The Campus Transit Plan identifies improvements and changes in transit services and facilities that will increase transit ridership and reduce single-occupant vehicle traffic.

Study Process

A two-stage process was used to evaluate the transit service concepts. As illustrated in Figure 6, the first stage involved screening out 10 of the 15 concepts to reduce the number of concepts to five "shortlisted" concepts. These five concepts were then evaluated in detail in the second stage. Based on the results of the evaluation, a single recommended concept was identified.

Figure 6: Evaluation Process



The screening and evaluation considered a number of factors, including those summarized in Table 1. The evaluation of the shortlisted transit service concepts was based on analysis of existing and future conditions at UBC, using computer simulation tools and transit ridership forecasting models.

Table 1: Evaluation Criteria

Category	Criteria	Measure
Customer service	Passenger travel time	Average walk + in-bus travel time
	Coverage	Regional bus coverage of campus
	Clarity of service	Ease of understanding routes
Safety	Conflicts with vulnerable road users	Potential conflicts with pedestrians and cyclists
	Traffic conflicts	Potential bus–motor vehicle conflicts
	Personal security	Personal safety and access to assistance
Community	Land use	Sites affected by bus routes and facilities
	Traffic and parking	Effects on circulation and parking
Environmental	Noise	Change in noise levels on campus
	Air quality	Change in bus emissions on campus
	Appearance	Visual benefits and impacts
Transit operations	Delays	Average delay per bus
	Operations	Scheduling and operational flexibility
Ridership	"External" trips	AM peak hour ridership to/from UBC
	"Internal" trips	Ability to accommodate internal trips
Cost	Total annualized costs	Relative operating and capital costs
Implementation	Transit facilities	Timing and ease of implementation
	Roadway changes and transit priority	Timing and ease of implementation

Recommended Transit Service Concept

The recommended transit service concept is illustrated in Figure 7. This concept was identified as the best overall concept by a wide margin as compared with the other 14 transit service concepts that were considered. Table 2 provides a summary of the evaluation of the five short-listed concepts.

UBC Campus Transit Plan

1332.0048.01
June 2003

Figure 7: Recommended Transit Service Concept

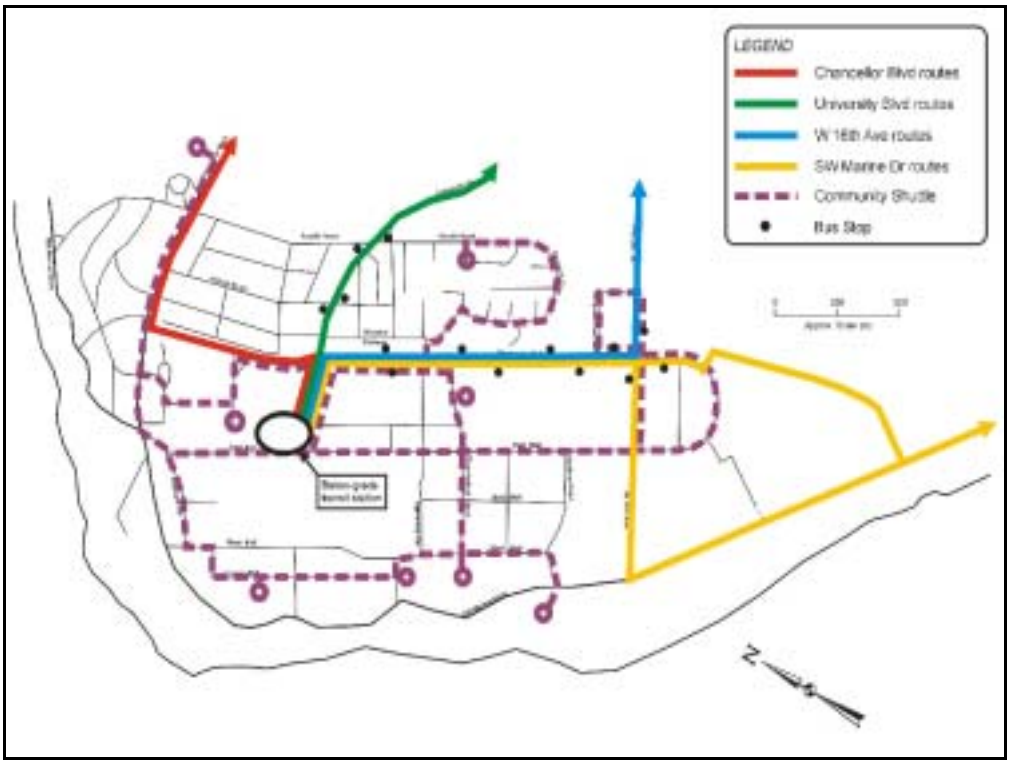


Table 2: Evaluation Summary

Category	Concept				
	1	2	7	13	15
Customer service	○	◓	●	●	◓
Safety	●	◒	◒	●	●
Community	●	◒	●	●	●
Environmental	●	◒	●	●	●
Transit Operations	●	◒	●	●	◒
Ridership	○	◓	◓	◓	◓
Cost	◓	○	●	●	○
Implementation	◒	◒	◒	●	●
Overall	●	○	●	●	○
Comparison with Existing					
● Better	◓	○ Neutral	◒		● Worse

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The key features of the recommended transit service concept include:

- **Existing regional bus routes are maintained.** All regional buses would follow existing routes, with the exception of Routes 41 and 49, which would eventually travel through South Campus via a new road (with transit-only access or traffic calming measures to discourage motorists from short-cutting through South Campus).

  A key benefit of maintaining existing regional bus routes is that buses are not routed through campus, avoiding potential noise, air quality and visual impacts. Instead, coverage of campus is provided by smaller Community Shuttle buses, as described below.

- **A new Community Shuttle service expands coverage of campus.** A key feature of the recommended transit service plan is a Community Shuttle service operating throughout campus during the daytime and evening. Community Shuttle services would extend coverage of campus within 300-m walking distance.

  Several buses would operate along a number of routes, providing service as frequently as every 15 minutes. Smaller buses would be used, as illustrated in Figure 8. Eventually, buses could be fuelled by natural gas, hydrogen or other alternative fuels in order to minimize noise and air quality impacts.

Figure 8: Community Shuttle Bus

Community Shuttle service would be intended primarily to provide mobility on campus for persons with disabilities, persons travelling alone at night, persons making long trips across campus, and persons travelling with large or heavy objects.

- **A single centrally-located transit station.** All regional bus routes and Community Shuttle routes would converge at a single transit station, located where the existing bus loop is located. This provides several benefits:

  - *Direct and convenient access to buses.* The transit station would be located close to the centre of the academic core, which is the destination for most transit passengers. Any location within the academic core area would be within a 10-minute walk of the transit station.

  - *A choice of routes at one location reduces waiting times.* Many transit passengers can use two or more bus routes to travel from UBC to their destination. For example, a student who lives in Kitsilano on 6th Avenue near Macdonald Street would have a choice of up to five different routes to travel home. With a single transit station served by all routes, this student could board the first bus leaving the station on any of these routes, which reduces the waiting time for a bus.

  - *Easy to understand.* A common departure point for all buses leaving campus is easy for passengers to understand. Passengers know they are able to catch a bus on any route at a single location. With a more dispersed system, transit users would need to be familiar with the on-campus routings to be sure that they walk to the correct stop when they want to leave campus.

- **A below-grade transit station.** The transit station would be located below grade, below where the existing bus loop is located. Buses would enter and exit the below-grade station on University Boulevard at Wesbrook Mall. The transit station would have a capacity of 40 or more buses, which is sufficient to accommodate increased transit service at UBC over the next 25 years and beyond.

  The primary benefit of a below-grade transit station is faster transit service and fewer delays to buses. A key feature of the transit station would be a "fare-paid zone," which could only be entered by paying a transit fare. Because everyone inside the fare-paid zone would have already paid the fare, passengers would be able to board buses through all doors. This means that an articulated bus could be loaded in 60 to 90 seconds, as compared with as much as five minutes without a fare-paid zone. Faster bus loading means faster transit service.

A below-grade transit station also means that buses would avoid traffic congestion and delays at pedestrian crosswalks on University Boulevard. As a result, transit service would be faster and there would be fewer delays to buses.

Key features of the below-grade transit station at UBC would include:

- *Safe.* The station would be well-illuminated, would incorporate a secure fare-paid zone, and would be patrolled by security personnel.
- *Accessible.* The station would be accessible by ramps, escalators and/or elevators to accommodate persons with disabilities.
- *Attractive.* The station would be integrated with a new plaza at surface level and with adjacent buildings. It would be illuminated by natural light, supplemented with a high level of lighting. The station could also include retail uses, as well as secure bicycle storage. The bus entrance on University Boulevard would be landscaped and designed as a feature of the roadway.
- *Comfortable.* The below-grade transit station would be weather-protected, heated and climate controlled. Seating, telephones and other amenities would be provided.
- *Ventilated.* Passengers would be separated from buses by glass doors. When buses are ready to depart, the doors would open and passengers would walk directly onto the bus. Exhaust from buses would be vented from the transit station, and could be filtered and cleaned so as to maximize air quality in the station and outdoors.
- *Efficient.* Real-time information displays would provide timely and accurate information regarding bus departures for transit passengers. Bus circulation, loading and unloading would minimize bus travel times and emissions.

- **Lowest overall cost.** The annualized costs for the recommended transit service concept total an estimated $10.6 million per year, as summarized in Table 2. The costs for the recommended concept are lower than for any of the other service concepts, due to lower transit operating costs, which are the result of shorter regional bus routes on campus. The costs in Table 2 represent the costs for all participating agencies (UBC, TransLink and others). The regional transit service costs represent only the portion of the costs of regional routes on the UBC campus. The estimated cost of constructing the below-grade transit station — which as of May 30, 2003 is estimated to be $17 million — represents an annualized cost of $1.2 million.

UBC Campus Transit Plan

Table 2: Estimated Annualized Costs
(total costs for all participating agencies)

Transit operating costs*	Regional buses	$5.2 million
	Community Shuttle	$2.3 million
Vehicle capital costs*	Regional buses	$1.3 million
	Community Shuttle	$0.3 million
Transit facility capital costs		$1.2 million
Transit facility operating costs		$0.3 million
Total annual cost		**$10.6 million**
* Transit operating and vehicle costs are for portions of regional routes on UBC campus		

Consultation

The preliminary results of the Campus Transit Plan were presented to the community at an open house held in April 2003. Prior to the open house, presentations were made to UBC's Transportation Advisory Committee during the development of the Campus Transit Plan. In all cases, feedback from the community was incorporated into the Campus Transit Plan.

Overall, the response to the recommended transit service concept was positive. Some members of the community remain concerned about the below-grade transit station. Many persons who attended the open house and expressed concerns regarding the below-grade transit station revised their opinion of a below-grade transit station after they had an opportunity to view photographs of other similar facilities, and discussed the issue with staff. Others remained concerned, specifically regarding the appearance and aesthetics of the station and the bus entrance, safety and security, and ventilation.

The Campus Transit Plan responds to much of the community input. Specific issues regarding the design of the transit station, the location of the bus entrance and implementation of the transit station will be addressed in subsequent detailed planning and design work undertaken by UBC and TransLink. Preliminary evaluation of the below-grade transit station and examination of similar facilities in Vancouver and other communities indicates that a below-grade transit station can be implemented in a manner which addresses these issues. The Burrard SkyTrain station provides a local example of a below-grade transit station, as illustrated in Figure 9. Examples of below-grade transit stations in other communities are included in Figure 10.

UBC Campus Transit Plan

Figure 9: Burrard SkyTrain Station

Figure 10: Below-Grade Transit Stations in Other Communities

UBC Campus Transit Plan

1.0 INTRODUCTION

This report describes the development of a Campus Transit Plan for the main UBC campus on Point Grey.

The Campus Transit Plan study was initiated in July 2002. Work was undertaken by Urban Systems Ltd., under the direction of a Technical Steering Committee comprised of staff from UBC, TransLink, the GVRD and UBC Properties. The study itself was a partnership between UBC and TransLink, who both contributed financially to the study cost.

1.1 Issues

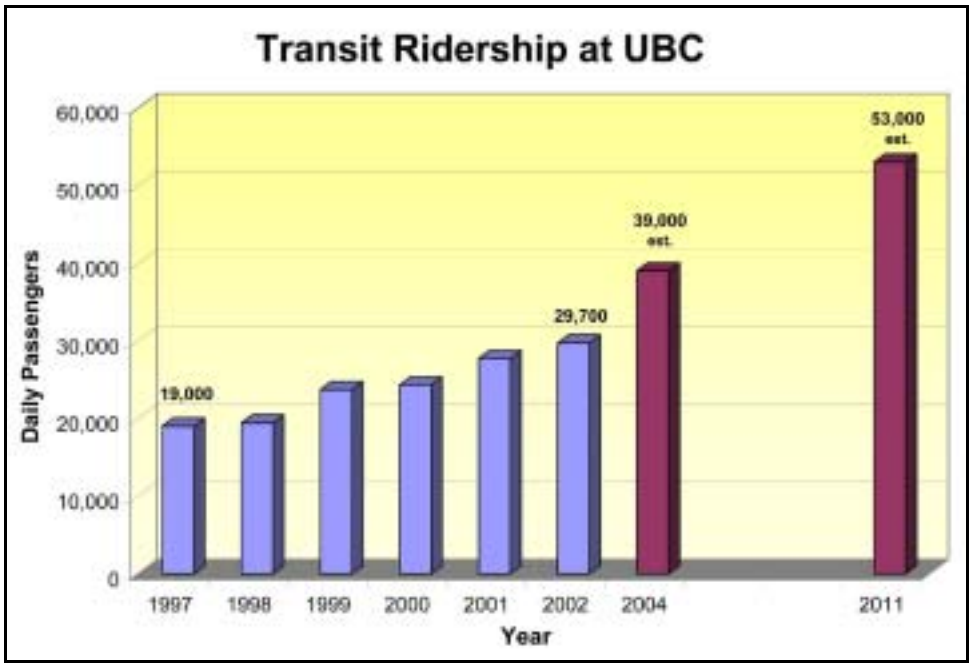
The Campus Transit Plan was initiated in response to several issues, most notably increased transit ridership and a lack of additional capacity at the bus loop. These and other issues are discussed in this section.

1.1.1 Increased Transit Ridership

UBC is the second-largest transit destination in the Lower Mainland — second only to downtown Vancouver. During the 2002/2003 academic year, almost 30,000 trips were made to and from UBC by transit each weekday. Transit ridership at UBC has increased over 50% in the past five years, and now accounts for approximately 25% of all trips to and from UBC.

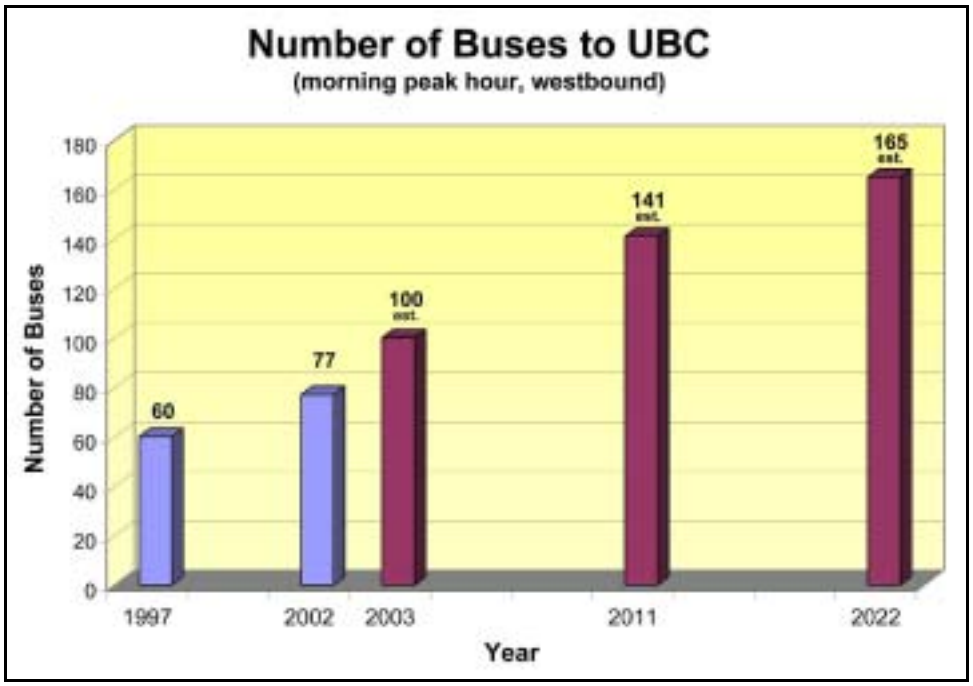
Transit use at UBC is expected to jump 30% in September 2003. Introduction of a universal transit pass (called "U-Pass") for students is forecast to increase transit ridership to 40,000 trips per day, as illustrated in Figure 1.1. Following the introduction of the student U-Pass, UBC plans to introduce a U-Pass for staff and faculty, and eventually hopes to introduce a similar pass for residents at UBC. As a result of this and ongoing growth at UBC, transit ridership by 2011 is forecast to increase almost 80% from current levels, to 53,000 trips per day.

Figure 1.1: Transit Ridership at UBC



To accommodate increased transit ridership, transit services will be increased a corresponding amount. This means that, for September 2003, there will be at least 100 buses per hour travelling to UBC in the morning peak hour from 8 to 9 a.m. By 2022, there will be 165 buses per hour or one bus every 22 seconds to UBC, as illustrated in Figure 1.2.

Figure 1.2: Number of Buses at UBC (morning peak hour, westbound)



1.1.2 Bus Loop Capacity

The success of transit at UBC is not without its problems. The most significant problem is that the bus loop is already over capacity. During peak periods, an overflow area in front of the War Memorial Gym is used for buses that cannot fit into the bus loop. Within the bus loop, many of the platforms are too small to accommodate waiting passengers during peak times, as Figure 1.3 illustrates.

Figure 1.3: Passengers Overflowing Platforms in Bus Loop

The extra transit service needed in September 2003 to accommodate increased U-Pass ridership will place additional strain on an already strained bus loop. Even though UBC and TransLink have developed plans to temporarily accommodate additional buses within the bus loop and overflow area in September 2003, it is clear that these plans are only a stop-gap measure. As transit ridership and service levels continue to increase, it will soon be impossible to accommodate all buses and passengers in the bus loop and the overflow area.

The bus loop has been expanded twice in the past 20 years, and could be expanded again. However, continued expansion of the bus loop would mean that, 20 years from now, the bus loop would have almost tripled in size, encompassing an area the size of three football fields. Figure 1.4 illustrates the increase in size of the bus loop from 1982 to present, plus one possible configuration for an expanded bus loop 20 years from now, which in this case would encompass the area where the Empire Pool is currently located.

Figure 1.4: Bus Loop Expansion

Another issue associated with transit service at UBC is congestion on University Boulevard between Wesbrook Mall and East Mall. During much of the time from 11:00 AM to 6:00 PM on weekdays, traffic on westbound University Boulevard is backed up from the East Mall intersection at the bookstore — sometimes as far as Wesbrook Mall. As shown in Figure 1.5, buses are caught in this congestion, and can be delayed up to six minutes travelling along University Boulevard. The result is less reliable and less attractive transit service, and increased transit operating costs.

Figure 1.5: Congestion on University Boulevard

As the university grows and the numbers of pedestrians, buses and cars on University Boulevard increases, congestion will get worse. Computer simulations prepared as part of the Campus Transit Plan indicate that, within a few years, University Boulevard could become gridlocked for much of the day.

1.1.3 Other Issues

Other issues affecting transit services at UBC include:

- **Safety.** Where buses operate along roads on campus, there is the potential for conflicts between buses and other road users, including pedestrians, cyclists and motorists. With more buses on campus, as well as more pedestrians and other road users as a result of growth, the potential for conflicts is increased. Any changes in bus routes could increase or decrease conflicts with other road users.

- **Coverage.** Historically, activity at UBC has been concentrated in the academic core around the existing bus loop. In the future, many people will live and work in areas farther from the academic core, such as Mid-Campus and South Campus. To support development of these areas, transit services in these areas will need to be enhanced.

- **Development.** UBC is currently developing plans for the University Boulevard neighbourhood, as well as plans for other neighbourhoods on

campus. The future of the bus loop and other issues affecting transit services on University Boulevard also affect the University Boulevard Neighbourhood Plan.

- **Transportation targets.** As described in Section 1.3, UBC has committed to pursue targets of increased transit ridership and reduced single-occupant vehicle traffic. Improvements and changes in transit services and facilities will have a direct effect on transit ridership and reduced single-occupant vehicle traffic.

Rather than respond piecemeal to these issues, UBC and TransLink initiated the Campus Transit Plan to establish a long-term strategy for providing transit services to UBC. The Campus Transit Plan addresses all of these issues.

1.2 Objectives

The primary objective of the Campus Transit Plan is to determine how transit can best serve UBC in the future. This means defining routes for regional buses travelling to and through campus, determining what other transit services are needed on campus, and identifying facilities are required to support these transit services.

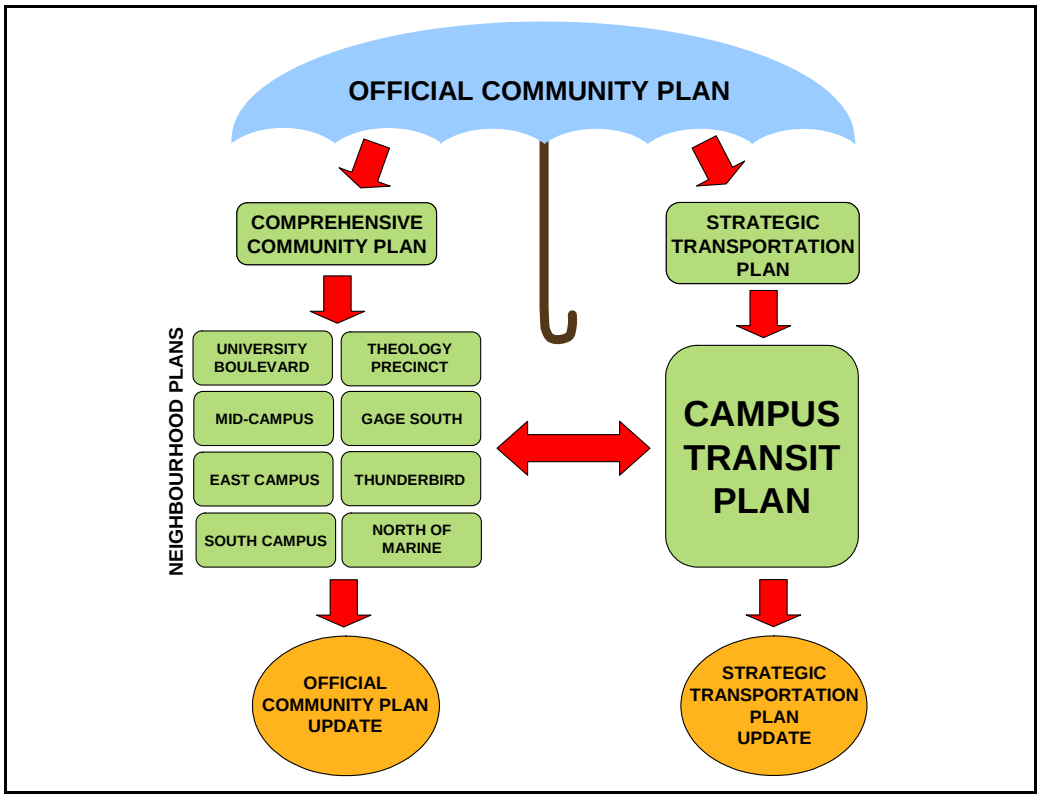
Other objectives of the Campus Transit Plan include:

- Estimate future transit ridership with U-Pass.
- Determine what services and facilities are required to accommodate increased transit ridership.
- Increase the attraction and use of transit, and thereby reduce single-occupant vehicle travel.

1.3 Relationship to Other Plans

The Campus Transit Plan was not developed in isolation. Rather, it was developed within the context provided by several plans, including UBC's Official Community Plan and Strategic Transportation Plan. As illustrated in Figure 1.6, the Campus Transit Plan was also based on plans and proposals related to the eight neighbourhood areas on campus defined in the Official Community Plan. In turn, the results of the Campus Transit Plan provide input to further development of the neighbourhood plans, and to updates of the Official Community Plan and the Strategic Transportation Plan.

Figure 1.6: Relationship of Campus Transit Plan to Other Plans



Key plans affecting the Campus Transit Plan include:

- **The Official Community Plan** (OCP) for UBC was adopted by the GVRD in July 1997. The OCP contains several transportation-related objectives that UBC has committed to pursue, including:
  - Reducing single-occupant vehicle travel to and from UBC by 20%. As of Fall 2002, single-occupant trips had decreased 9% per capita as compared with Fall 1997 conditions.
  - Increasing transit use to and from UBC by 20%. This target has been exceeded by a considerable amount. From Fall 1997 to Fall 2002, transit ridership at UBC increased 35% per capita.
  - Pursuing implementation of a universal transportation pass (known as a U-Pass). In March 2003, UBC students approved implementation of a U-Pass for September 2003.

  The objectives defined for the Campus Transit Plan in Section 1.2 reflect the transportation objectives in the OCP and, as such, the OCP provides direction for the Campus Transit Plan. The Official Community Plan is planned to be updated in Fall 2003. The update of the OCP will reflect the results of the Campus Transit Plan, as well as any other changes to

transportation facilities and services on campus that have arisen from other transportation plans.

- **The Strategic Transportation Plan.** As a means of meeting the Official Community Plan objectives and achieving other related transportation goals, UBC developed a Strategic Transportation Plan (STP), which was adopted in November 1999. The STP describes a comprehensive and integrated transportation strategy, and establishes specific targets for transit and single-occupant vehicles, consistent with the OCP commitments.

  With respect to transit services at UBC, the STP identifies a number of issues and goals for transit services, as well as several options for reconfiguring transit services and transit facilities on campus. These issues, goals and options were considered in developing the range of transit service concepts evaluated in the Campus Transit Plan.

- **The University Boulevard Neighbourhood Plan** is currently being prepared. The plan describes how lands adjacent University Boulevard between Wesbrook Mall and East Mall can be developed to create a mixed-use "university town" with residential, retail and institutional uses. The objectives of the University Boulevard Neighbourhood Plan have been incorporated into the Campus Transit Plan. In turn, the results of the Campus Transit Plan have been incorporated into the University Boulevard Neighbourhood Plan.

2.0 EXISTING CONDITIONS

This section of the report describes the existing transportation conditions at UBC. The following sub-section describes the existing transit services and facilities and their recent performance in detail. Subsequent sub-sections describe the road network and other transportation programs and facilities at UBC to provide a basis with which to develop potential transit improvements.

2.1 Transit Services & Facilities

UBC is currently served by 10 bus routes, all of which terminate at the bus loop in the northeast quadrant of the University Boulevard/East Mall intersection. The 10 routes serve a number of destinations in Vancouver, including downtown and SkyTrain, as well as central locations in West Vancouver, Burnaby, and Richmond.

The UBC bus loop is one of the busiest transit exchanges in the Lower Mainland in terms of both bus and passenger volumes. Between 8:00 AM and 9:00 AM on weekdays, 77 buses arrive at the loop and discharge passengers, an average of one bus every 50 seconds.

This section describes the existing bus services and facilities at UBC, including key issues affecting transit operations.

2.1.1 Transit Routes

The existing 10 transit routes serving UBC campus are illustrated in Figures 2.1 and 2.2 and summarized below. Table 2.1 also provides a summary of service characteristics for each of the routes serving UBC, including:

- Bus type
- First arrival at UBC
- Last departure from UBC
- Service frequencies for various time periods

TransLink is in the process of equipping all buses with bicycle racks, which have a capacity of two bicycles. Almost all diesel buses on routes serving UBC are wheelchair accessible. The trolley bus routes serving UBC are not currently wheelchair accessible, nor are they equipped with bicycle racks. New trolley buses will be acquired in 2005, and these buses will be both wheelchair accessible and equipped with bicycle racks.

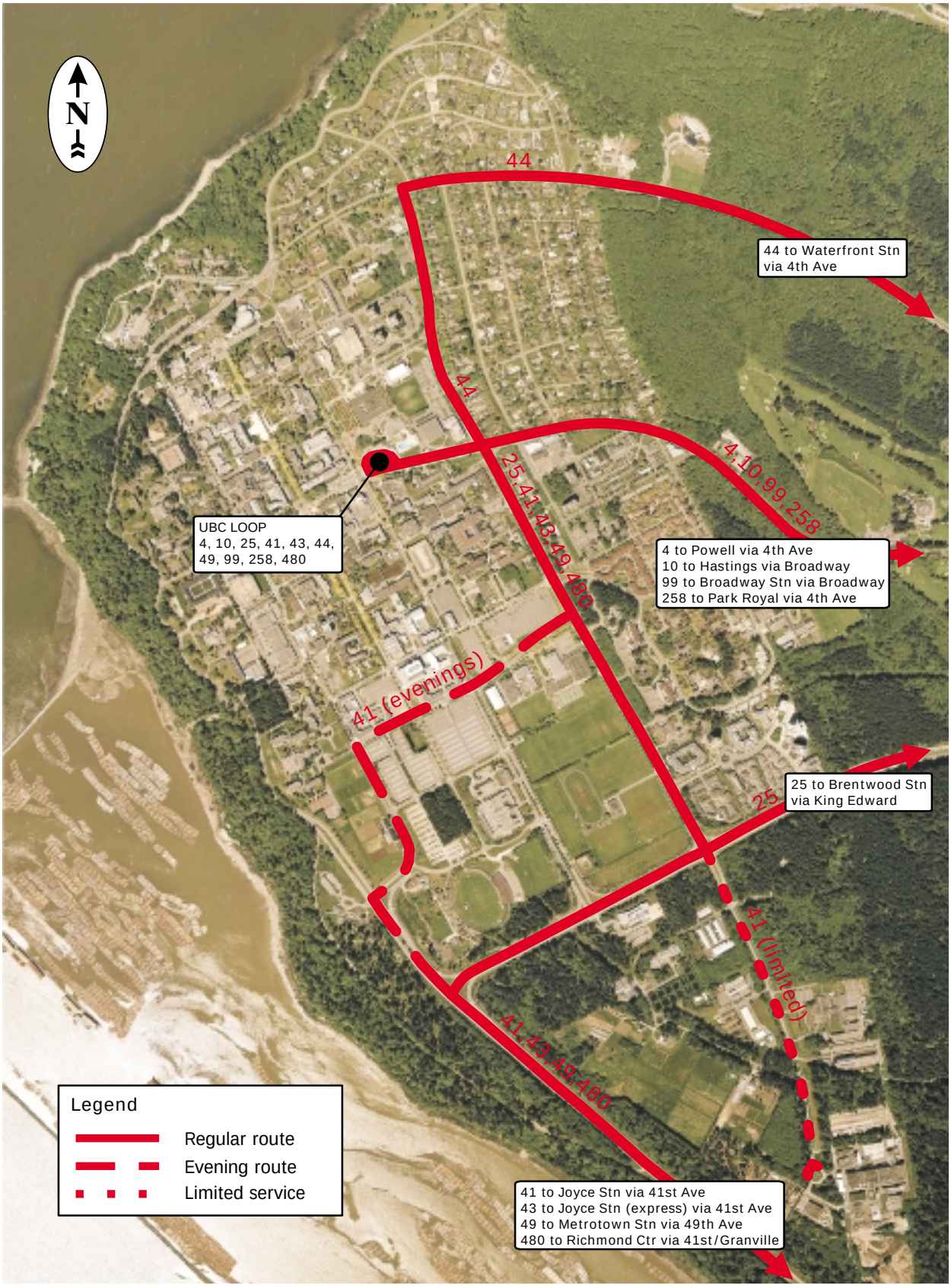


Figure 2.1
Existing Bus Services

Table 2.1: Summary of Existing UBC Transit Services (Fall 2002)

Route	Destination from UBC	Bus Type	Weekday Hours of Service at UBC		Approx. Service Frequency to/from UBC (minutes between buses)							Remarks
			First Arrival	Last Departure	AM Peak	Mid	PM Peak	Eve.	Sat. Day	Sat. Eve	Sun. Day	
4	Powell	Trolley	7:40	11:57 pm	12-15	15	10	20	15	20	15	Non-accessible, no bike racks
10	Hastings	Trolley	5:46	2:08 am	10	15	10	20	15	20	15	Non-accessible, no bike racks
25	Brentwood Stn	40-foot Diesel	5:59	12:10 am	6-7	15	12	30	15	30	20	
41	Joyce Stn	40-foot Diesel	6:48	12:01 am	5	15	7-8	30	30	30	30	Limited peak service to TRIUMF, Paprican Evening routing via Totem Park residence
43	Joyce Stn (Express)	Artic-ulated	7:15	7:07 pm	10	N/A	15	N/A	N/A	N/A	N/A	Peak-only limited-stop service overlaps Route 41
44	Waterfront Stn	40-foot Diesel	7:50	6:10 pm	15	N/A	15	N/A	N/A	N/A	N/A	Peak-only service
49	Metrotown Stn	40-foot Diesel	7:44	5:52 pm	6-7	N/A	10	N/A	N/A	N/A	N/A	Route extended to UBC only during peak periods
99	Broadway Stn	Artic-ulated	6:14	12:34 am	4	6	5	12	12	12	12	B-Line service
258	West Vancouver	40-foot Diesel	8:18	5:08 pm	3 trips	N/A	3 trips	N/A	N/A	N/A	N/A	Peak-only service
480	Richmond Centre	Express Coach	6:51	6:40 pm	20	30	20	N/A	N/A	N/A	N/A	Daytime service during weekdays

Figure 2.2: Existing Transit Routes Serving UBC

- **Route 4** is a trolley bus service connecting UBC with Kitsilano (via 4th Avenue), downtown Vancouver, and the Powell Street corridor through East Vancouver. The route terminates on Eton Street at Renfrew Street, and connects with SkyTrain at Granville Station. The route serves UBC throughout the day and evening, seven days per week.

- **Route 10** is also a trolley bus service connecting UBC with Kitsilano (via Broadway), downtown Vancouver, and East Vancouver via Hastings Street. The route terminates at Kootenay Loop near Boundary Road, and connects with SkyTrain at Granville Station. This route also serves UBC throughout the day and evening, seven days per week.

- **Route 25** operates with conventional diesel buses and connects UBC to Brentwood Mall in Burnaby. This route connects with SkyTrain at Nanaimo Station and Brentwood Station. Within Vancouver, this route operates primarily along King Edward Street and 16th Avenue. This route serves UBC throughout the day and evening, seven days per week.

- **Route 41** connects UBC with Kerrisdale, Oakridge, and Joyce SkyTrain Station via 41st Avenue, and operates with conventional diesel buses. This route serves UBC throughout the day and evening, and operates seven

days per week. Many westbound trips on this route are currently short-turned at Crown Street instead of being routed through to UBC.

Twice per weekday, this route diverts south along Wesbrook Mall to the TRIUMF and Paprican research developments to provide employees there with a bus connection to and from the UBC bus loop. Additionally, during evenings, the route operates along West Mall and Thunderbird Boulevard to provide a connection to and from the Totem Park and Thunderbird Residences.

- **Route 43** provides limited-stop express service along the same routing as Route 41, also terminating at Joyce SkyTrain Station. The service is provided with articulated diesel buses and operates in both directions only during the peak periods on weekdays.

- **Route 44** provides limited-stop express service in both directions between Waterfront SkyTrain Station and UBC during weekday peak periods. It operates across the Burrard Bridge and on 4th Avenue through Kitsilano. The route operates with conventional and articulated diesel buses.

- **Route 49** operates with conventional diesel buses and connects UBC with Metrotown SkyTrain Station in Burnaby. Within Vancouver, this route operates primarily along 49th Avenue. Route 49 serves UBC only during weekday peak periods. During off-peak and weekend time periods, this route terminates at Dunbar Loop, located at the 41st Avenue/Dunbar Street intersection.

- **Route 99** was the first of the Lower Mainland's B-Lines, which provide high-frequency limited-stop services along major transit corridors using specially-designated articulated buses. Route 99 operates along 10th Avenue and Broadway between UBC and Broadway/Commercial Drive SkyTrain Station. The route serves UBC seven days per week throughout the day and evening.

- **Route 258** is a peak-period, peak-direction service connecting UBC with West Vancouver via the Lions Gate Bridge and 4th Avenue through Kitsilano. It is operated by West Vancouver Transit (Blue Bus) and provides three trips to UBC in the morning peak period and three trips from UBC in the afternoon peak period.

- **Route 480** connects UBC with Richmond Centre via 41st Avenue, Granville Street, and the Oak Street Bridge. It operates only on weekdays and only during the daytime. Service is generally provided using TransLink's new Express Coaches (highway-style coaches).

There are four primary road corridors connecting UBC with the City of Vancouver and the rest of the Lower Mainland. These four corridors and the bus routes operating on them include:

- Chancellor Boulevard — Route 44
- University Boulevard — Routes 4, 10, 99, 258
- West 16th Avenue — Route 25
- SW Marine Drive — Routes 41, 43, 49, 480

Within campus, all routes currently access the bus loop via University Boulevard between Wesbrook Mall and East Mall, as illustrated in Figure 2.1.

2.1.2 Service Levels

As shown in Table 2.1, peak period frequencies are now as high as 3-4 minutes for Route 99 during the morning peak period. During off-peak periods and weekends, however, several of the routes do not operate (Routes 43, 44, 258) or are short-turned prior to reaching UBC (Route 49).

Transit service to and from UBC has generally been increasing over time. There is presently 30% more transit service to and from UBC in terms of annual service hours than there was in 1997. Since 1997, improvements have been implemented on Routes 25, 41, 44, 99, and 480. In addition, Route 43 was implemented in Fall 2000 to relieve overcrowding problems on Route 41 and to provide an alternative express route between SkyTrain and UBC. Service on some routes has been reduced. For example, Route 42, which connected UBC to the Spanish Banks area, was discontinued in 2001. Additionally, service on the trolley routes was reduced, including the elimination of Route 9 service to and from UBC, which only served the campus during peak periods. It now terminates at Blanca Loop during all time periods.

Table 2.2 below summarizes service frequencies by time period for 1997 and 2002 and shows which routes have been improved and on which routes service has been reduced over the past five years.

Table 2.2: 1997 and 2002 Service Frequencies (minutes)

Route	1997							2002						
	AM	Mid	PM	Eve	Sat	Sat Eve	Sun	AM	Mid	PM	Eve	Sat	Sat Eve	Sun
4	10	15	12	20	15	20	20	12-15	15	10	20	15	20	15
9	15	NS	12	NS	NS	NS	NS	Discontinued to UBC (to be restored September 2003)						
10	6	12	7.5	20	12	20	15	10	15	10	20	15	20	15
25	7.5	15	12	30	15	30	20	6.5	15	12	30	15	30	20
41	6	15	8.5	30	30	30	30	5	15	7.5	30	30	30	30
42	60	60	60	NS	60	NS	NS	Discontinued						
43	Not implemented							10	NS	15	NS	NS	NS	NS
44	15	NS	30	NS	NS	NS	NS	15	NS	15	NS	NS	NS	NS
49	6.5	NS	10	NS	NS	NS	NS	6.5	NS	10	NS	NS	NS	NS
99	6	7.5	7.5	NS	15	NS	NS	4	6	5	12	12	12	12
258	60	NS	60	NS	NS	NS	NS	60	NS	60	NS	NS	NS	NS
480	60	NS	60	NS	NS	NS	NS	20	30	20	NS	NS	NS	NS

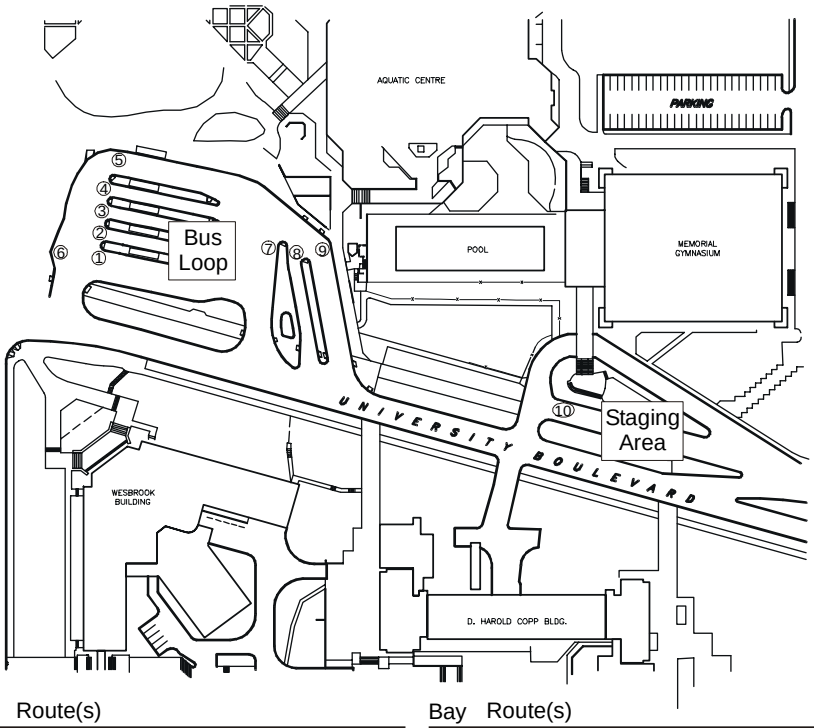
Key Service Improvement Service reduction NS No service

2.1.3 Transit Facilities

There are numerous facilities on campus to support the existing transit services, most notable of which is the bus loop. The bus loop is the hub of all transit services on campus and is the location on campus used by most transit riders to board and alight buses, as it is the location nearest the academic core of UBC.

The existing configuration of the bus loop is illustrated in Figure 2.3. There are presently 10 bays in the loop, including one bay in the staging area in front of the War Memorial Gym (see discussion below). Two bays in the loop are reserved for the 99 B-Line – one for unloading and one for loading. Most of the other bays in the loop serve individual routes. The exception is Bay #1, which accommodates three routes.

Figure 2.3: Existing Bus Loop and Staging Area



Bay	Route(s)	
①	43	Joyce Station (peak only)
	258	West Vancouver (PM peak only)
	480	Richmond Exchange
②	41	Joyce Station
③	4	Powell
④	10	Hastings / Downtown
⑤	99	Broadway Station (loading)
⑥	49	Metrotown Station (peak only)
⑦	44	Downtown (peak only)
⑧	25	Brentwood Station
⑨	99	UBC (unloading)
⑩	43	Joyce Station (peak only)

A small building adjacent to the bus loop houses drivers' facilities, including washrooms and a telephone (Figure 2.4). The facilities are only accessible to bus drivers.

Figure 2.4: Drivers' Facilities at Bus Loop

With the high frequencies of service provided to and from UBC during peak periods, there are often several buses laying over at the bus loop at any given time. However, the high frequency of service on some routes (particularly the B-Line) does not allow for long layovers within the stop area. For this reason, a staging area has been established in front of War Memorial Gym to accommodate buses waiting to enter the bus loop, as illustrated below in Figure 2.5. It accommodates buses for several routes, but particularly those that use Bay #1 in the bus loop. Because Bay #1 is used by several routes, the stop cannot be blocked for long periods of time during layovers. Route 99 buses sometimes use the staging area prior to entering the bus loop.

Figure 2.5: Staging Area

In addition to the bus loop and staging area, there are several bus stops located along the roadways that currently support transit service. Many of these stops include amenities for passengers, such as shelters and benches. The campus stops and associated amenities are illustrated in Figure 2.6.

2.1.4 Transit Issues

This section of the report provides a review of key issues associated with the existing transit services and facilities, focussing on the key issues of ridership and operations on campus. Additional issues pertaining to service outside of UBC campus are discussed in the last sub-section.

a. Service Coverage

A key aspect that affects the attractiveness of transit for potential riders is the distance they have to travel to reach transit services. Most transit users walk to catch the bus, so walking distance is the primary measure of service coverage. For most users, the maximum desirable walking distance to a bus stop is 400-450 m. This corresponds to a walking time of between five and 10 minutes for the typical adult.

TransLink's draft Service Design Guidelines recommend a maximum walking distance of 450 m for service coverage.

Figure 2.6
On-Campus Transit Facilities

Figure 2.7 illustrates the existing transit service coverage during the peak periods on campus by showing all areas within 450 m (straight line) of the existing bus routes. The evening routing of Route 41 via Totem Park residences is not shown. In addition, the coverage shown represents walking distance to the routes themselves, rather than to individual stops. The walking distance to certain stops may be higher.

The east side of campus is well covered by transit service. However, because all services are currently routed via Wesbrook Mall and University Boulevard to the bus loop, coverage is lacking on the west side of campus. There are many key buildings and areas on campus that are presently beyond the maximum desirable walking distance to transit, and that are attractions for more than just the UBC community, including:

- Chan Centre for the Performing Arts
- Cecil Green Park House and College
- Museum of Anthropology
- Belkin Art Gallery
- Wreck Beach
- First Nations Longhouse

In addition to these buildings that draw visitors from both UBC and the broader community, there are several residences and other buildings that are used primarily by the UBC and research community that are beyond the 450-m walking distance guideline, including:

- Place Vanier residences
- St. John's College
- Totem Park residences (daytime only)
- Thunderbird residences (daytime only)
- University Services Building
- Food Sciences
- BC Research (two transit trips daily)
- Paprican (two transit trips daily)

Outside of the peak periods, service coverage is reduced at the north end of campus because Route 44 only operates during peak periods. This means that the Theological Colleges and a large portion of the University Endowment Lands are beyond the maximum desirable walking distance to transit during all but the peak weekday periods.

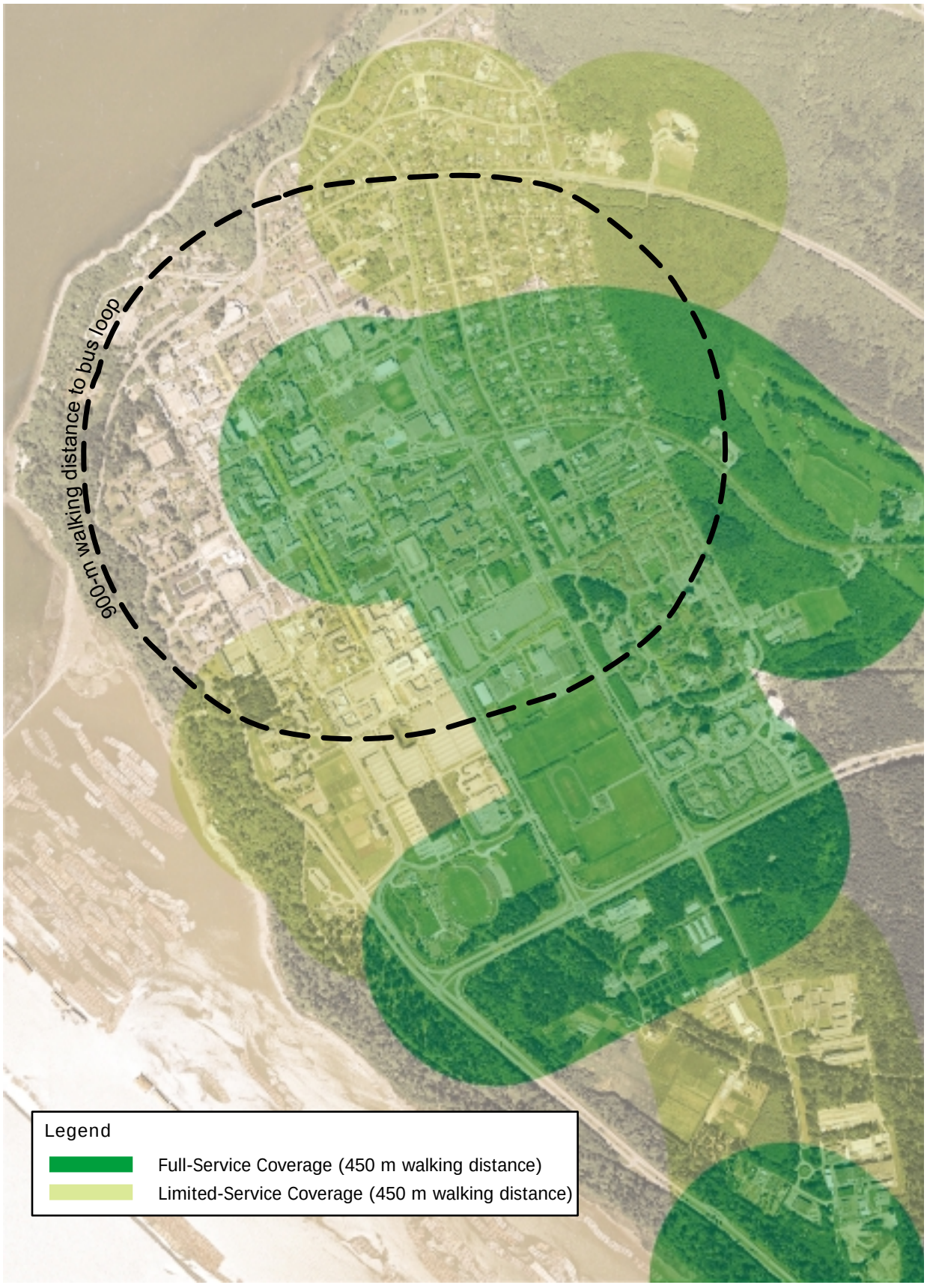


Figure 2.7
Existing Transit Coverage

b. Ridership

There are a number of patterns and issues associated with ridership that are identified in the following discussion, such as:

- Daily transit ridership has been increasing steadily over time. The growth in ridership has been greater than the increase in service levels over the same time period, indicating that loads are increasing.
- The peak in transit ridership – particularly for westbound trips in the morning – has spread over a longer time period. This is associated with the recent shift in class start times, which has increased the overall capacity of the transit system.
- Field observations over time indicate that average loads are increasing, particularly on limited-stop services, such as Routes 43, 44, 99, and 480.
- Loads on Route 99 well beyond the UBC boundaries (such as at Main Street) are high enough that riders cannot board buses bound for campus in the morning due to overcrowding. These observations were recorded prior to improvements implemented in Fall of 2001 and 2002, but anecdotal evidence indicates that overcrowding continues.

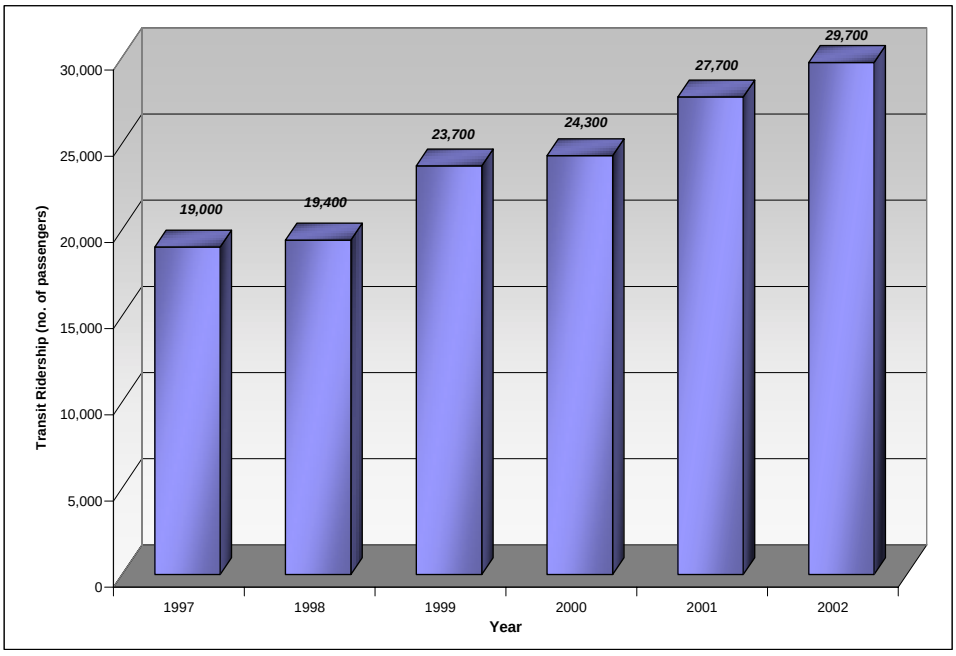
Ridership data for UBC are collected in two ways:

- **Annual transportation monitoring program.** UBC collects a full range of transportation data on an annual basis for the monitoring program established as part of the STP. These screenline data are usually collected in the Fall at the UBC cordon.
- **TransLink ridecheck program.** As part of its Area Transit Planning process, TransLink undertook a significant on-board ridecheck program in the Fall of 2000. The 2000 program included Vancouver/UBC routes. The results of the ridechecks are also included in the following discussion because the data provide performance indicators that are not available from the screenline monitoring data. The performance indicators apply to the entire route rather than UBC specifically. However, load profiles generated by the data can indicate average loads at the UBC screenline. It should be noted that ridecheck data were not collected for North Shore or Richmond routes during the Fall 2000 checks, meaning that there are no data available for Routes 258 and 480.

Daily Ridership Trends and Patterns

In Fall 2002, it was estimated that approximately 29,700 transit trips are made to and from UBC on a daily basis, representing approximately 26% of total daily travel. In 1997, approximately 19,000 trips were made to and from UBC by transit on a daily basis, meaning that UBC has experienced a 56% increase in daily transit ridership over the past five years, far surpassing the STP goal of increasing daily transit ridership by 20% over 1997 levels. This rate of growth also exceeds the amount that service has been expanded over the past five years (30% increase in bus trips). Daily transit ridership to and from UBC over the past five years is summarized below in Figure 2.8.

Figure 2.8: Daily Transit Passenger Trips to/from UBC (1997-2002)



On an individual route basis, daily ridership is highest on Route 99, which carries well over 10,000 passengers per day to and from UBC. As shown below in Figure 2.9, Route 99 accounts for approximately 44% of daily ridership at UBC. Routes 10 and 41 are the second and third most popular UBC routes in terms of daily ridership. Not surprisingly, ridership is concentrated on those routes that serve UBC throughout the day rather than those that only operate during peak periods.

Figure 2.9: Proportional Breakdown of Daily UBC Transit Ridership by Route (Spring 2002)

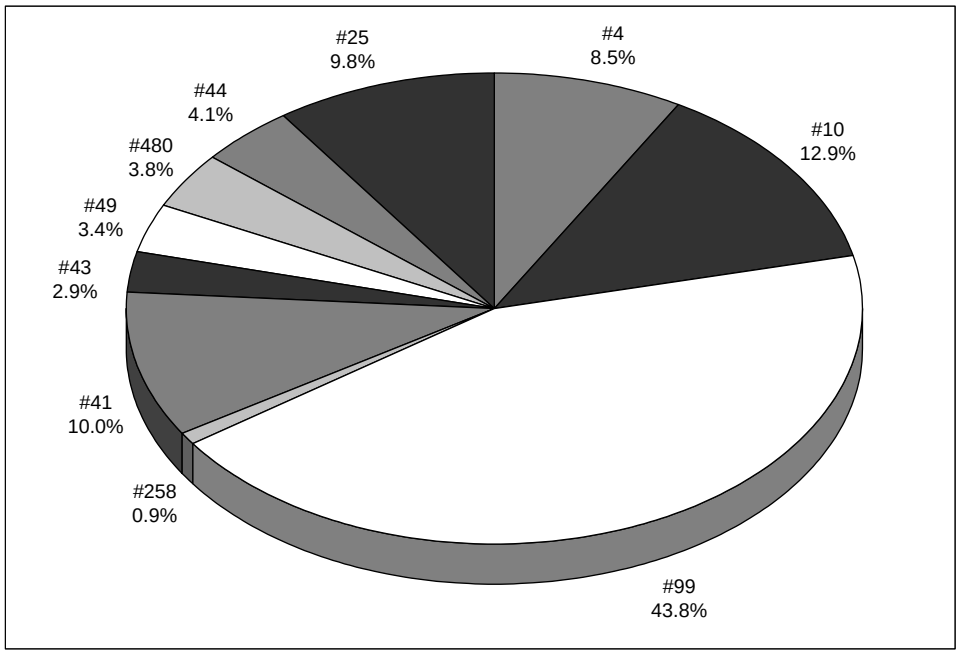
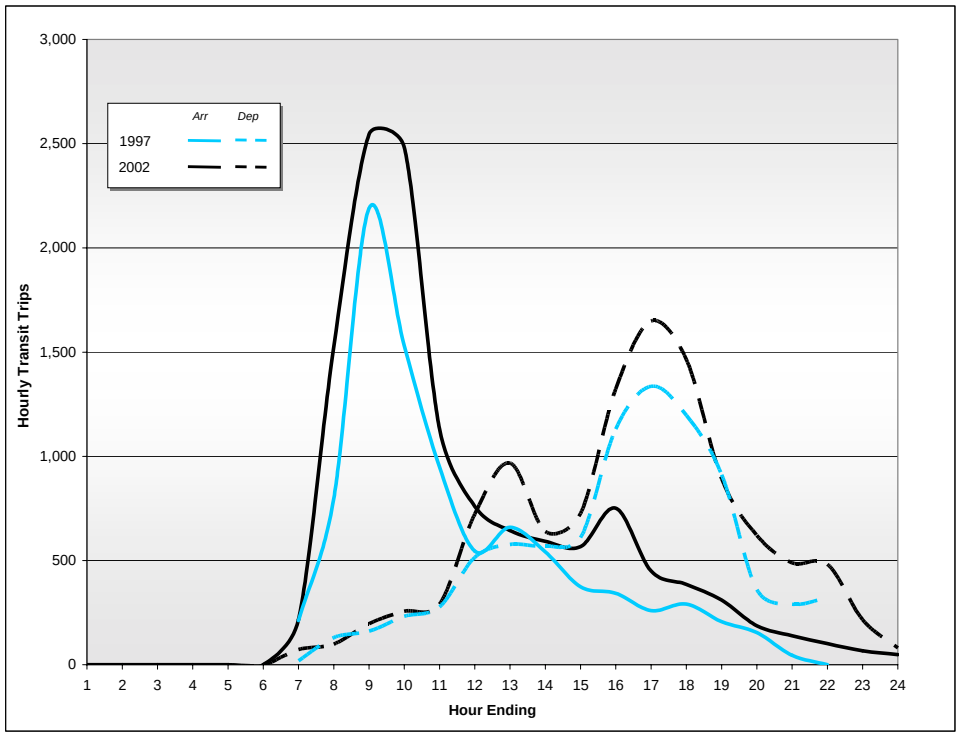


Figure 2.10 illustrates the time distribution of arrivals and departures by transit at UBC for 1997 and 2002. The figure illustrates that transit arrivals in the morning peak have spread over a longer time period over the past five years. Much of this can likely be attributed to the shift in class start times that was implemented in Fall 2001. Prior to then, all classes began at 8:30 AM, resulting in the sharp peaking characteristic shown for 1997 in the following figure. Because most riders arrived in the hour before 8:30, this required a significant amount of additional transit service to be provided over a relatively short time period. Since the shift to a mixture of 8:00 AM, 8:30 AM, and 9:00 AM class starts, transit demand has been spread over a longer time period, allowing for increased overall capacity and more efficient transit operations.

Students depart campus over a much longer time period, as illustrated in Figure 2.10. This is because students finish classes over a wide time range, allowing many people to leave campus well before the typical afternoon peak period. Similarly, many students have night classes that delay their departures from campus until well into the evening. There are, however, many UBC employees who work a typical workday, and depart campus between 4:00 PM and 6:00 PM. Transit departures begin to exceed arrivals at approximately noon (2002), and this pattern continues until the end of the day. This leads to a much longer afternoon peak period than for a typical employment site, but also means that the peak demand is much lower in the afternoon than during the morning peak period. This pattern is more efficient from an operational standpoint.

Figure 2.10: Time Distribution of Transit Arrivals and Departures at UBC (1997 & 2002)



Screenline Load Patterns

Transit load information collected during the annual screenline counts gives an indication of route performance and crowding conditions on a route-by-route basis and over time. Average loads for each route crossing the UBC screenline in each direction were determined based on the total loads counted and the number of trips crossing the screenline. These average load data are available for 1998, 1999, and 2002.

The following review of average loads considers crowding conditions for the transit routes serving UBC. The conditions are assessed based on the draft Service Design Guidelines under development for TransLink. The key guidelines are summarized in the following table and will be referenced in the subsequent discussion.

Table 2.3: TransLink Draft Maximum Occupancy Guidelines[1]

Bus Type	Max. Occupancy (No wheelchairs)		Max. Occupancy (1 wheelchair)		Max. Occupancy (2 wheelchairs)	
	Peak 15 Minutes	Peak 30 Minutes	Peak 15 Minutes	Peak 30 Minutes	Peak 15 Minutes	Peak 30 Minutes
12-m Trolley[2]	60	51	N/A	N/A	N/A	N/A
12-m Type 1 Low Floor	54	47	51	44	47	40
12-m Highway Coach	50	47	48	45	46	43
18-m Low Floor Artic	84	72	81	69	78	66

1 Guidelines are from Exhibit IV-9 of the Draft Service Design Guidelines Review.
2 There are currently no wheelchair-accessible trolleys in the fleet.

Figure 2.11 illustrates the trend in average loads for *all* routes serving UBC since 1998. These loads are for westbound morning peak period trips only.

Figure 2.11: Average Westbound Loads for All Routes Serving UBC (AM Peak Period – 1998, 1999 & 2002)

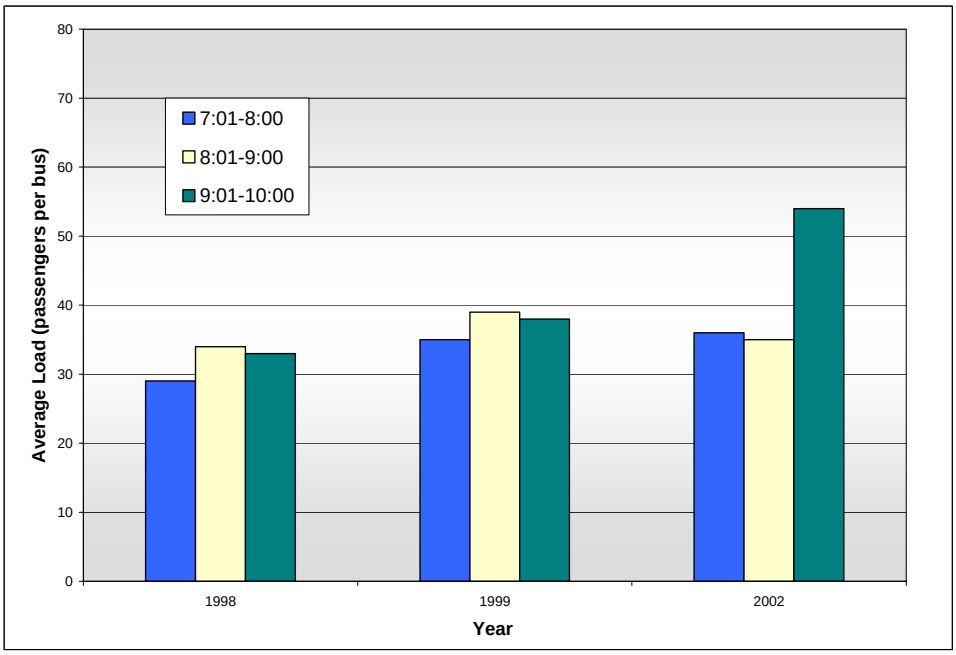
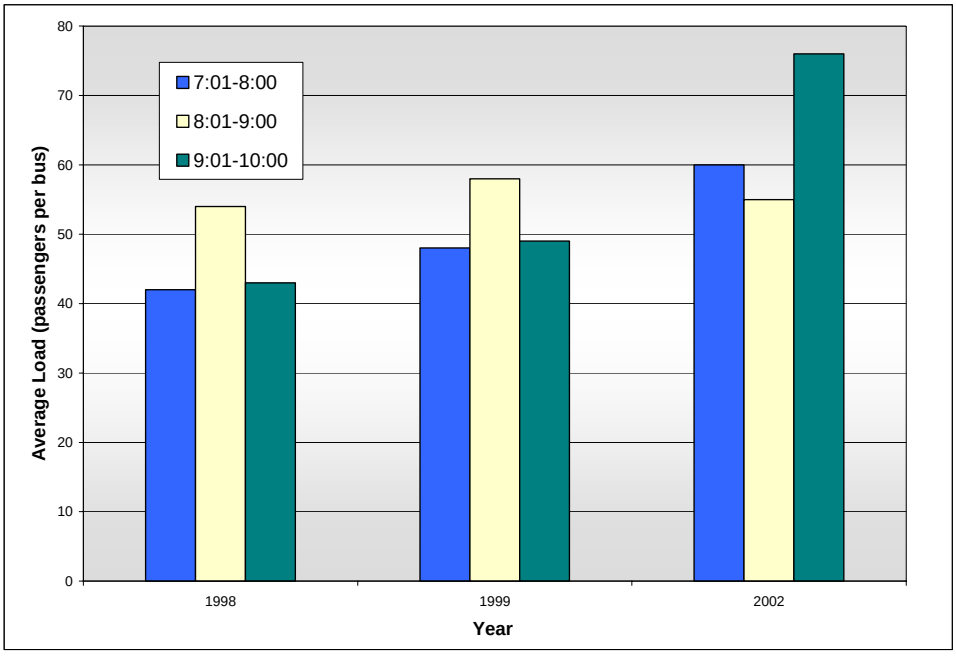


Figure 2.11 illustrates that average loads have generally risen over the past four years, particularly in the 9:00 AM to 10:00 AM time period. The shift in class start times that was implemented in Fall 2001 increased the capacity of transit, resulting in the spreading of peak ridership over a longer time period. Average loads actually fell during the hour between 8:00 AM and 9:00 AM as students, staff, and faculty adjusted their travel patterns. The patterns illustrated here confirm that ridership has increased overall since the class starts were adjusted. Within the last time period (9:00 AM to 10:00 AM), the average load westbound across the screenline is 54 passengers per bus. This value meets or exceeds the guidelines for 12-m low floor and highway coach buses, which are used on six of the routes serving UBC.

Although transit loads have generally increased over time, it is important to recognize variations in this trend for different routes that serve UBC. Figure 2.12 shows the average loads for westbound trips by express (limited-stop) services to UBC in the morning peak period (Routes 43, 44, 99, 480). The chart shows that there has been a significant increase in average loads for these routes since 1998, with the exception of the 8:00 AM to 9:00 AM time period. According to the chart, the average load on these routes between 9:00 AM and 10:00 is approximately 76 passengers, above the 30-minute peak design guideline for 18-m articulated buses. However, articulated buses are used regularly on only two of these routes – Routes 43 and 99. (It should be noted that these data represent hourly averages and that 30-minute average

volumes may actually be higher than those shown.) This trend illustrates the attractiveness of limited-stop services for transit users and explains why crowding on these routes continues to increase despite ongoing improvements to service. For example, service on Route 99 is generally increased annually, but complaints about pass-ups and ridership data indicate that overcrowding continues to be problematic and may in fact be suppressing transit ridership to and from UBC.

Figure 2.12: Average Westbound Loads for Limited-Stop Routes Serving UBC (AM Peak Period – 1998, 1999 & 2002)



Conversely, average loads on local services (Routes 4, 10, 25, 41, 49) have remained relatively stable since 1998, as illustrated below in Figure 2.13. In fact, average loads have declined in two of the three hours of the morning peak period, while loads have increased only slightly during the 9:00 AM to 10:00 AM time period. These average loads are well below the draft guidelines for trolleys and 12-m low floor buses, indicating that crowding is generally not a significant problem for these routes. Nonetheless, there are variations among these routes that should be considered, as described below.

Figure 2.13: Average Westbound Loads for Local Routes Serving UBC (AM Peak Period – 1998, 1999 & 2002)

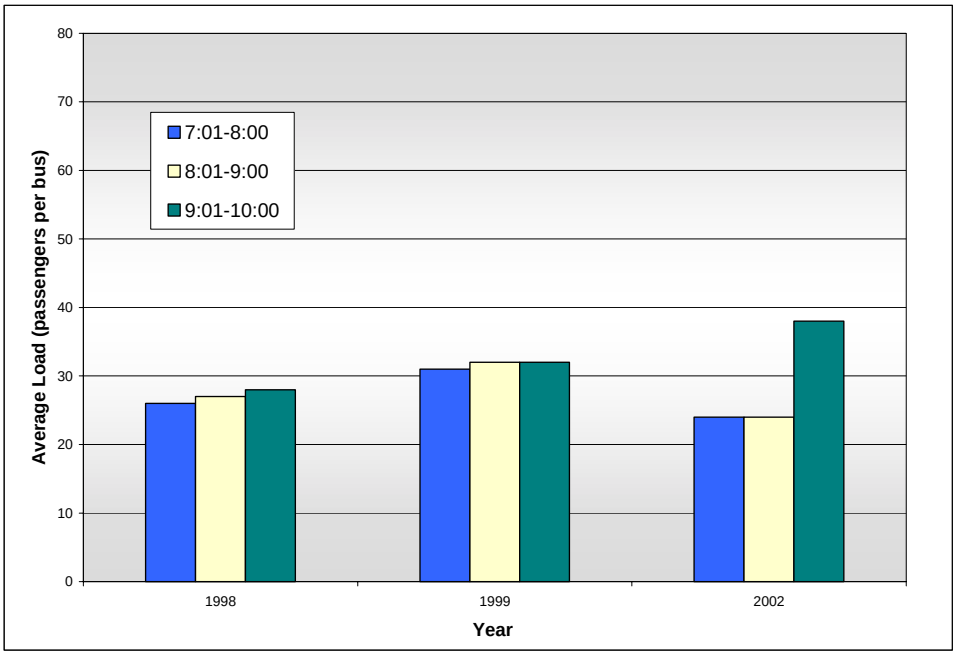


Table 2.4 contains average westbound loads during the morning peak period for each route at UBC. Route 258 has been excluded due to insufficient data. Graphical illustrations of these load patterns are provided for individual routes (except Routes 43 and 258) in Appendix A. Generally, the patterns for individual routes are similar to those described above, in that loads during the 8:00 AM to 9:00 AM time period have generally decreased while loads during the 9:00 AM to 10:00 AM period have increased significantly. In many cases, the average loads during specific time periods exceed the peak 30-minute maximum occupancy guidelines for the buses used to provide the service. This is particularly true for 2002, indicating that crowding is becoming more common. Those routes with apparent crowding problems within the past year during at least an hour during the morning peak period include Routes 25, 41, 44, 99, and 480. It should be noted, however, that these data do not reflect improvements implemented in Fall 2002 on Routes 25, 99, and 480, as the data are from Spring 2002.

Table 2.4: Average Westbound Loads for All Routes Serving UBC (average passengers per bus)[1]

Route	Guide-line[2]	1998			1999			2002		
		7:01-8:00	8:01-9:00	9:01-10:00	7:01-8:00	8:01-9:00	9:01-10:00	7:01-8:00	8:01-9:00	9:01-10:00
4	51	16	26	22	21	34	25	28	26	39
10	51	16	28	32	17	33	30	18	27	34
25	44	36	30	32	41	40	40	**51**	31	**46**
41	44	35	34	37	44	39	40	22	22	**53**
43	69							31	24	45
44	44[3]	43	**45**	33	**51**	43	39	**100**	41	**72**
49	44	31	23	27	42	22	27	15	15	23
99	69	42	57	51	46	63	54	**83**	69	**89**
480	45		**48**	21	**57**	42	27	40	38	**63**

1 Values in bold indicate average loads which exceed guidelines.

2 Guidelines represent peak 30-minute maximum passenger occupancy guideline for each bus type and assume one wheelchair passenger on routes where lifts are provided. Type 1 low-floor buses are assumed for all services using 40-foot buses.

3 Articulated buses are used for some trips on Route 44.

Ridecheck Data

Route performance statistics from the TransLink ridecheck data are collected on a route-by-route basis, but represent statistics for the entire route rather than a specific segment of route. Therefore, strong performance in the UBC area may be offset by poorer performance in other sections of the route. Nonetheless, the statistics provide a comparative between routes serving UBC.

The following performance indicators are typically used for ridership analysis:

- **Passenger-kilometres per seat-kilometre** is a measure of the utilization of a route and indicates the proportion of seats that are occupied throughout the length of the route, on average. A lower value (closer to zero) indicates relatively poor performance.

- **Average maximum load** is the maximum number of persons on a particular route during a specific time period, on average. The average maximum load is a measure of crowding at the peak load point for a route, and indicates whether maximum loads are typically above the maximum occupancy guidelines for a route. Moving averages of the maximum loads are calculated for various time intervals (15 minutes, 30 minutes, etc.) to provide an indication of the variability of peaking characteristics within the peak periods, for example, and to compare against TransLink's draft Service Design Guidelines.

- **Boardings per service hour** is a measure of route effectiveness that indicates the number of riders that board a given route for every hour of service provided on that route (including layover time).

- **Load profile.** The ridecheck analysis generates load profiles for each route to indicate the location of the peak load points on each route and to show whether the average peak loads typically exceed the seated capacity of a bus during certain time periods.

Each performance measure provides unique information on the performance of each route, but no measure should be considered in isolation. The performance measures must be considered together to accurately assess the relative success of each route serving UBC.

Table 2.5 below summarizes the key route performance data for the routes serving UBC, excluding Routes 258 and 480, for which data are not available. The data are provided for morning and afternoon peak periods for the peak direction in each case (AM peak westbound, PM peak eastbound). Under the column of Average Maximum Load, the draft Service Design Guidelines for maximum occupancy are provided based on the predominant vehicle type for each time period. The guidelines are slightly higher for the 15-minute moving average because higher loads are acceptable over a relatively short time period.

The results for Route 43 should also be viewed with caution, as the route was implemented in Fall 2000. Travellers would have still been adjusting to the new service when the ridechecks were undertaken, so ridership may be somewhat lower than it is currently.

Table 2.5: Fall 2000 Route Performance for UBC Routes[1]

Route	Passenger-kilometres per seat-kilometre		Average Maximum Load[2]						Boardings per Service Hour	
			15-minute moving average			30-minute moving average				
	AM Peak	PM Peak	Guide-line[3]	AM Peak	PM Peak	Guide-line[3]	AM Peak	PM Peak	AM Peak	PM Peak
4	0.69	0.50	60	56	**38**	51	**55**	38	87	62
10	0.55	0.73	60	47	**49**	51	**52**	48	83	87
25	0.62	0.73	51	**57**	**65**	44	**60**	**65**	68	80
41	0.67	0.68	51	**60**	48	44	**51**	**48**	81	91
43	0.61	0.34	81	69	34	69	51	34	74	46
44[4]	1.15	0.81	51	**57**	**48**	44	**57**	**48**	83	72
49	0.77	0.80	51	**71**	**67**	44	**64**	**67**	71	81
99	0.97	0.69	81	73	73	69	66	65	116	73

1 Data provided for peak direction (AM westbound, PM eastbound) for each time period. No ridecheck data available for Routes 258 and 480. Sample size for Route 99 is very limited and loads likely have a high margin of error.

2 Bolded values indicate that average maximum load exceeds draft Service Design Guideline.

3 Guidelines assume one wheelchair passenger on routes where lifts are provided. Type 1 low-floor buses are assumed for all services using 40-foot buses.

4 Route 44 operates with both conventional 12-m buses and articulated buses.

The ridecheck data indicate that most routes carry relatively high ridership during the peak periods. In general, morning peak period ridership is higher than the afternoon peak period, reflecting the arrival and departure patterns observed during the screenline counts (described above). Those routes with relatively high passenger-kilometres per seat-kilometre – particularly Routes 44 and 99 – carry large loads over relatively long distances. This implies that crowding may be experienced over a longer portion of the route, requiring many passengers to stand for long distances.

The ridecheck analysis generates load profiles that indicate the typical peak load point(s) along each route, the boarding/alighting patterns, and the absolute maximum load recorded during the surveys by direction. These load profiles indicate the average loads entering and exiting the UBC area, to provide a comparison against the screenline loads presented in the preceding discussion. They also identify whether crowding is highest at UBC, or whether crowding at other locations along a route is preventing UBC commuters from getting on the bus. The following table summarizes the average loads crossing the UBC screenline in the peak direction during the morning and afternoon peak periods.

Table 2.6: Average Peak Direction Loads at UBC Screenline (Fall 2000)[1]

Route	Guideline[2]	Average Transit Load at Screenline (passengers/bus)	
		Eastbound (PM Peak)	Westbound (AM Peak)
4	51	18	34
10	51	37	23
25	44	37	28
41	44	20	24
43	69	20	26
44	44	32	**50**
49	44	20	32
99	69	44	**90**

1 Bolded values indicate that average maximum load exceeds draft Service Design Guideline. Sample size for Route 99 is very limited and loads likely have a high margin of error.

2 Guidelines assume one wheelchair passenger on routes where lifts are provided. Type 1 low-floor buses are assumed for all services using 40-foot buses.

Table 2.6 indicates that crowding is a particular issue on Routes 44 and 99, with Route 99 carrying over 20 passengers more *on average* than the draft guidelines. Although these results indicate fewer crowding issues than identified in the preceding section on the screenline patterns, it should be recognized that the results cannot be directly compared. The results shown in the preceding section represent hourly averages, whereas these results represent average loads over a 3.5-hour period (6:30-9:00 AM). Therefore, these results indicate that crowding is sustained over a longer period on Routes 44 and 99 during the morning peak period. Once again, it must be noted that these data were collected prior to improvements to both routes.

c. On-Campus Transit Operations

Although transit routes on campus are limited to a relatively small number of roads, there are several operational issues that affect the existing services and that have a significant impact on long-term planning for transit at UBC.

- **Bus loop.** UBC's location at the westernmost tip of a peninsula makes routing buses through UBC (between two other regional destinations) impractical from an operational standpoint. Consequently, all routes serving UBC terminate at the campus. This presents unique requirements for facilities on campus because buses typically layover for several minutes at the terminus to allow drivers to depart for the subsequent trip on time, thereby maintaining overall schedule reliability. The layover also provides drivers with an opportunity to rest, eat, and use washroom facilities between trips. Therefore, space is required to accommodate terminating buses, particularly where frequencies are high during peak periods and several buses may be laying over at the same time.

  The current bus loop and staging area is operating at its practical capacity in terms of bus movements and passenger-handling capabilities. As mentioned previously, the loop currently accommodates over 70 buses during the hour between 8:00 AM and 9:00 AM and was expanded in 1997 to accommodate increased service. In most cases, peak frequencies are such that each route must be assigned its own bay in the loop, suggesting that the loop would have to be expanded if any new services were being considered.

  Another issue with the existing loop is the ability of the facility to handle significant pedestrian loads. The design of the loop is such that passengers board buses from "islands" in the loop area. As illustrated in Figure 2.14, waiting passengers sometimes overflow from the platforms and spill into the drive aisles.

  This particular style of bus loop requires passengers to cross the bus drive aisles to reach the platforms for several routes. Because passenger volumes are so high at the UBC loop, this implies a significant number of potential conflicts between pedestrians and buses. Although marked crosswalks are provided at the loop, many pedestrians cross at other locations, as shown in Figure 2.15.

  In addition, there are often several buses laying over in the stop area, such that there is little remaining space for other buses to manoeuvre into and out of the loop.

Figure 2.14: Passengers Overflowing Platfrom

Figure 2.15: Passengers Walking in Drive Aisles

- **University Boulevard** represents the key "gateway" into the heart of campus and accommodates significant pedestrian and cyclist traffic, as well as motorized vehicles, from private cars through to 18-m articulated

buses. The interactions and conflicts between the various users of University Boulevard create operational issues for transit.

The pavement on University Boulevard at the exit from the bus loop is hatched to warn motorists not to block buses, and a yield sign is in place, requiring motorists to yield to departing buses. However, vehicle queues often spill back from the University Boulevard/East Mall intersection and motorists often block the exit from the loop (Figure 2.16). Queues on University Boulevard are most problematic when there is significant pedestrian traffic around the intersection, causing additional delays to motorists. Vehicle queues have been observed to spill back as far as Wesbrook Mall in the early afternoon, meaning that arriving buses can be delayed significantly.

Figure 2.16: Bus Blocked at Bus Loop Exit

There is also a midblock unsignalized pedestrian crossing located approximately midway between East Mall and Wesbrook Mall, providing a connection across University Boulevard between the Wesbrook Building and the War Memorial Gym. This crossing is the source of additional delays for traffic along University Boulevard, as illustrated in Figure 2.17.

Figure 2.17: Buses Stopped at Midblock Crossing

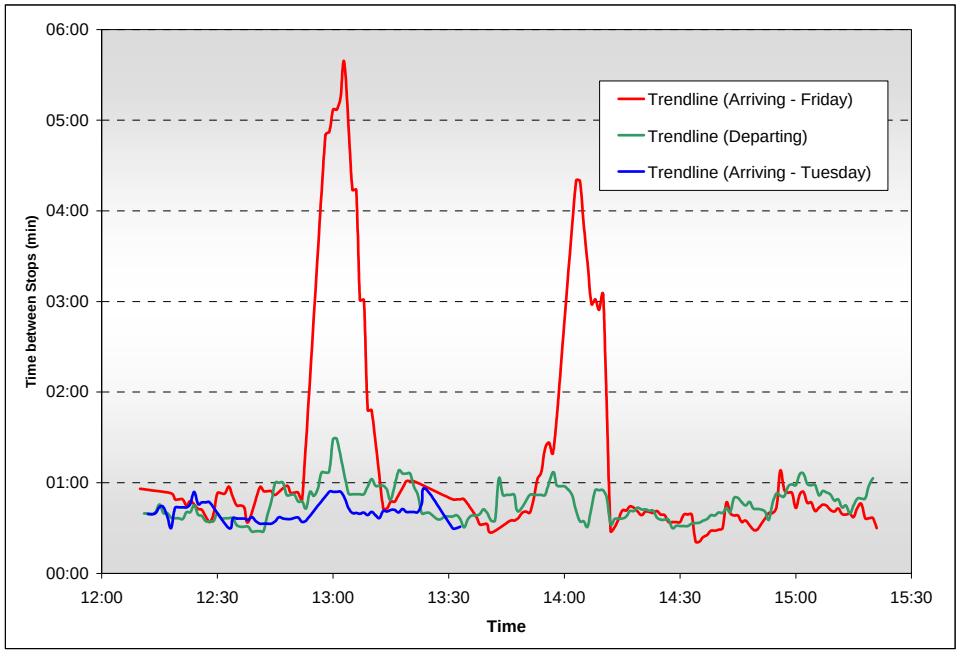
Pedestrian traffic around the bus loop increases around the top of the each hour, when classes change, and is highest in the early afternoon when many students, staff, and faculty are walking around campus during lunch. As well, many students leave campus in the early afternoon, creating additional pedestrian demand at the bus loop.

A survey of bus operations on University Boulevard was undertaken on Friday, September 13 and Tuesday, September 17, 2002 to quantify delays to transit vehicles caused by vehicle queues and blockage of the bus loop exit. The delays observed on Friday afternoon were much worse than those observed on Tuesday. Anecdotal reports indicate that Friday was representative of a worst-case condition, whereas Tuesday appeared to be typical of an average day. Figure 2.18 illustrates the length of queues observed on University Boulevard on September 13. The survey measured the time for departing buses to travel between the bus loop and the bus stops on University Boulevard at Wesbrook Mall, and vice versa for arriving buses. In addition, the number of buses blocked from exiting the bus loop was recorded.

Figure 2.18: Queuing on University Boulevard

Figure 2.19 below shows the travel time for transit vehicles between stops against the time of day. It illustrates that, on Friday (plotted in red), arriving buses experienced delays of between four and six minutes at 1:00 PM and 2:00 PM caused by vehicle queues spilling back from the University Boulevard/East Mall intersection. The results for Tuesday (plotted in blue) indicate that delays were less significant and illustrate that there is a high degree of variability from day to day. Delays to departing buses on both days (plotted in green) were much lower and did not increase significantly at the top of each hour.

Figure 2.19: Transit Travel Time on University Boulevard



Delays at the end of the route for arriving buses shorten the time available for layover, particularly if the bus is already behind schedule. In some cases, the additional delays experienced on University Boulevard may cause buses to depart behind schedule for their subsequent eastbound trips.

Although delays are less significant for buses leaving UBC according to the figure, blockages of the bus loop exit are frequent and cause frustration for bus drivers and passengers. Encroachment by motorists into the hatched area also makes manoeuvring buses out of the loop difficult, as illustrated below in Figure 2.20. During the surveys, 33% of departing buses were blocked or partially blocked from leaving the bus loop. The results indicate that blockages delayed buses by 15 seconds, on average.

Figure 2.20: Vehicle Encroachment into Hatched Area

d. Transit Reliability

An important issue with regard to regional transit services is reliability. This refers to how well buses adhere to scheduled arrival/departure times, and how well they maintain consistent headways between buses. Although this is an issue that relates to operations away from campus and is generally beyond the scope of the Campus Transit Plan study, it has several important effects on plans for transit on campus.

- **Attraction of transit services.** Reliability problems mean delays for transit users, and introduce an element of uncertainty into the use of transit. Delays reduce the attraction of transit by increasing the travel time by transit relative to other modes, in particular the automobile. Delays and uncertainty can cause frustration, anger, and other negative reactions, reducing the perceived attraction and quality of transit service. The result can be decreased transit ridership, as those who have a choice switch from transit to other modes.

- **Terminus capacity.** Poor reliability means that, at some times, there will be more buses at a transit terminus than scheduled. This means that either the terminus needs to be constructed to a larger size to accommodate extra buses, requiring more space on-street and/or off-street, or the extra buses will not be able to enter the terminus and will obstruct roadways. Similarly, the area allocated to waiting passengers

must either be larger than required, or waiting passengers will infringe on other adjacent activities.

An example of a typical reliability problem occurred on Friday, September 13 at 3:00 PM on Route 99 — the highest-ridership route at UBC. At this time, buses are scheduled to depart UBC every six minutes. For over 20 minutes, no Route 99 buses arrived or departed from the bus loop. When a Route 99 bus finally did arrive, it was followed within the next three minutes by four more Route 99 buses.

By this time, there were approximately 150 to 200 persons waiting for a Route 99 bus at the bus loop (Figure 2.21). While three Route 99 buses stopped to pick up passengers all at the same time, one bus departed from the bus loop empty, so as to pick up passengers waiting at bus stops along the route, ahead of the other buses. The fifth bus laid over until the other buses had loaded and departed.

Figure 2.21: Passengers Waiting for Route 99 B-Line

This particular reliability problem was likely caused in part by congestion along Broadway in Vancouver. Other factors that likely contributed to the problem include inadequate on-street supervision and lengthy dwell times at locations with high numbers of boarding passengers.

Ways in which service reliability could be improved include:

- **Transit priority measures** could be implemented at key locations to reduce delays to buses. On the UBC campus, a key location is the University Boulevard/Wesbrook Mall intersection. Adjustments to laning and signal phasing/timing at this intersection could reduce delays to buses as well as improve conditions for pedestrians and motorists.

- **All-door loading** reduces the amount of time required to load a bus, thereby reducing bus travel times. It can take over five minutes to load an articulated bus through the front door, whereas the time can be reduced to a minute or so with all-door loading and pre-payment of fares. All-door loading could be implemented at the UBC bus loop through the introduction of an enclosed fare-paid zone. Passengers would pay their fare (with cash, ticket, pass or U-Pass) when entering the fare-paid zone, and would then be able to board any bus through the front or rear doors.

2.2 Road Network

The road network at UBC is well developed, with the exception of planned roads to support development in the South Campus area. This section provides an overview of the current road network on campus.

2.2.1 Roadway Classification

Typically, the road network supports a variety of purposes ranging from mobility through to individual property access. Because these purposes can be conflicting (in terms of such characteristics as vehicle speed), a road classification or hierarchy is used to describe the design and operating characteristics of different roadways. For example, arterial roadways generally serve a mobility function, whereas local roadways provide access to and from individual properties. Collector roads typically connect the two. Although the UBC road network is primarily oriented to property access, there are several roadways on campus that provide connections to and from Vancouver and, therefore, are designed primarily for mobility.

The existing road network hierarchy at UBC is illustrated in Figure 2.22, which reflects the OCP road classifications. The arterial road network in the vicinity of campus consists of:

- SW Marine Drive
- NW Marine Drive
- Wesbrook Mall (West 16th Avenue to Chancellor Boulevard)
- West 16th Avenue (east of Wesbrook Mall)
- Chancellor Boulevard
- University Boulevard (east of East Mall)

U:/projects/61332/48.1/graphics/Transit Plan Figures - Road Classification.cdr NDS Sept 5, 2002

Source: UBC Official Community Plan

Figure 2.22
Road Classification

The collector road network on campus consists of:

- West Mall
- East Mall
- Thunderbird Boulevard
- Wesbrook Mall (south of West 16th Avenue)

Arterial roads are typically designed to a higher standard than collector roads, which are usually two-lane undivided roadways. In some cases at UBC, the designations do not currently reflect the roadway cross-sections in place. For example, Thunderbird Boulevard is a six-lane divided roadway in some segments and East Mall is a four-lane divided roadway south of Thunderbird Boulevard. Similarly, NW Marine Drive is two lanes wide between West Mall (south intersection) and East Mall. In the longer term, UBC intends to redevelop several of these roadways to reflect their classifications. In the meantime, however, it is important to recognize that some inconsistencies exist.

2.2.2 Traffic Controls

There are a variety of traffic controls used on campus, including traffic signals, stop controls, and a roundabout. The existing traffic controls and speed limits are depicted in Figure 2.23. Signals are in place at most of the major intersections throughout campus, and a new roundabout is located at the West Mall/Stadium Road intersection.

In addition to these standard traffic controls, there are a few traffic regulations and controls in place on campus that apply to transit vehicles only. For example, on both of the University Boulevard approaches to Wesbrook Mall, there are right-turn only lanes provided. However, there are posted exceptions to these regulations for bicycles and buses (Figure 2.24). These are in place to allow buses and bicycles to bypass queues at the intersection and to allow buses to manoeuvre easily into and out of the stops on the west side of Wesbrook Mall.

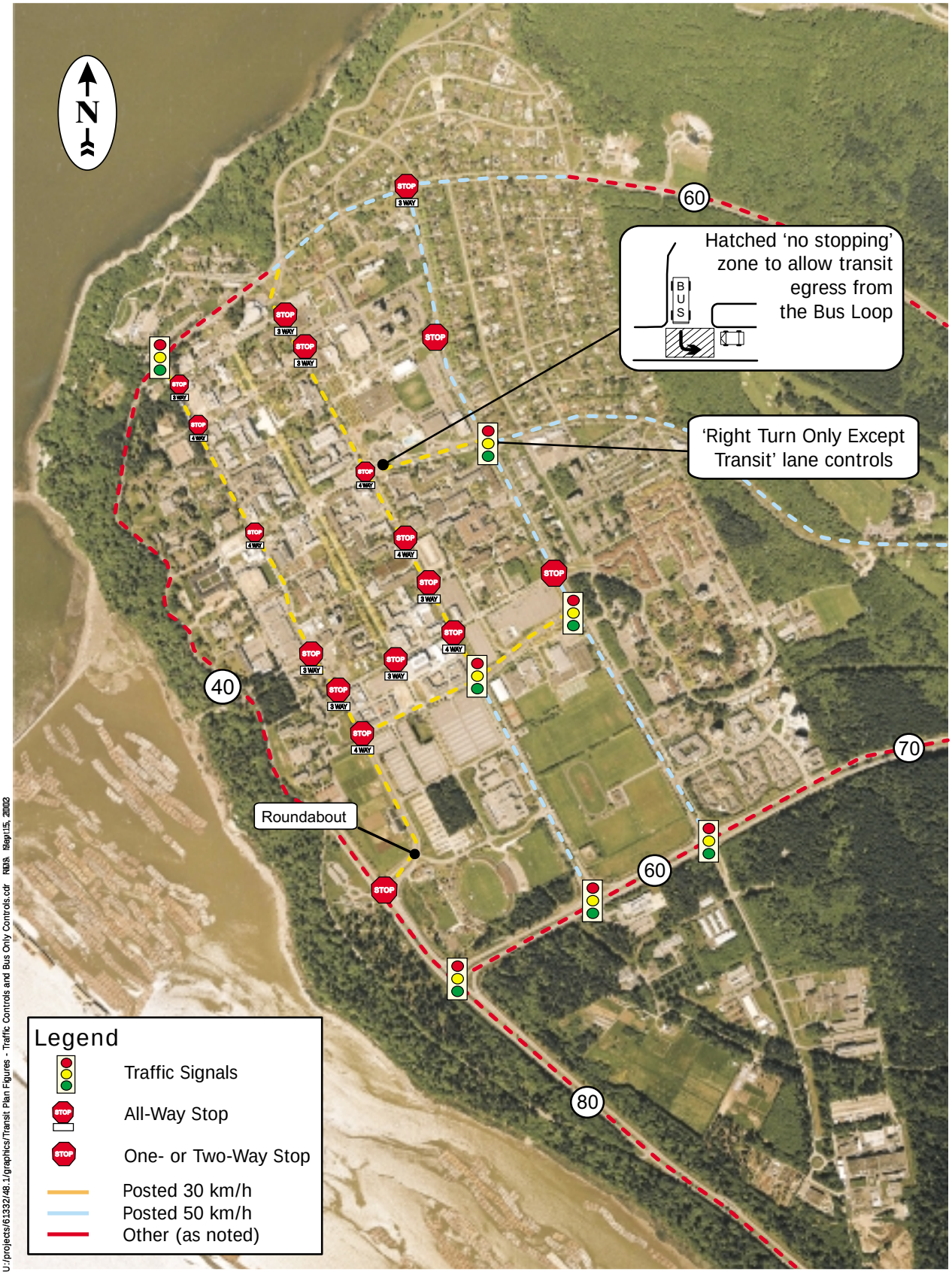


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Figure 2.23
Campus Traffic and Transit Controls

Figure 2.24: Signage on University Boulevard at Wesbrook Mall

As discussed in Section 2.1.4, there is a restriction on University Boulevard in front of the bus loop prohibiting motorists from blocking the exit from the loop. The restriction is identified by hatching on the pavement on approach of University Boulevard to East Mall. A yield sign is also in place at the upstream end of the hatching that cautions motorists about turning buses. Although this restriction is in place, it is violated frequently. This causes frequent delays for buses attempting to leave the bus loop.

Speed limits on campus are generally between 30 km/h and 60 km/h. Within the campus core (bounded by Marine Drive, 16th Avenue, and Wesbrook Mall), most roadways are posted at 30 km/h. Only East Mall south of Thunderbird Boulevard is posted at 50 km/h. Access to Main Mall and the section of University Boulevard between East Mall and West Mall is restricted to authorized vehicles only.

Traffic calming has been applied along three roadways to discourage speeding and to provide a safer environment for pedestrians on campus. Figure 2.25 illustrates the location of traffic calming measures and pedestrian crosswalks on the primary campus roads. The three corridors and the traffic calming measures that have been applied include:

Figure 2.25
Pedestrian Facilities
and Traffic Calming

- West Mall — Speed humps, raised crosswalks
- East Mall — Raised crosswalks
- Osoyoos Crescent — Speed humps, raised crosswalks

The campus perimeter roads – NW and SW Marine Drive, Chancellor Drive, West 16th Avenue, and Wesbrook Mall – have speed limits ranging from 40 km/h to 60 km/h, as illustrated in Figure 2.23. NW Marine Drive is posted at 40 km/h because it is relatively narrow and curvilinear, has on-street parking, and has a high level of pedestrian activity.

Roads leading to and from campus and connecting with the City of Vancouver – with the exception of University Boulevard – generally have higher speed limits, reflecting their design characteristics (multi-lane, divided roads). These are reflected in the figure.

2.2.3 Traffic Conditions

Every day, over 65,000 vehicle trips are made to and from UBC (Fall 2002) on the five roadways connecting the campus to the rest of the region – NW Marine Drive, Chancellor Drive, University Boulevard, West 16th Avenue, and SW Marine Drive.

The busiest route to and from campus is SW Marine Drive, carrying over 25,000 vehicles on a daily basis. NW Marine Drive carries fewer than 2,000 vehicles, while the remaining three routes accommodate between 11,000 and 14,000 vehicles per day. Daily traffic volumes on these roadways, as well as on primary campus roads, are depicted graphically in Figure 2.26. The following table summarizes morning and afternoon peak hour volumes, as well as 24-hour traffic volumes for key internal roadways on campus.

Table 2.7: Traffic Volumes on Internal Campus Roads

Location	AM Peak Hour	PM Peak Hour	24-Hour Volume	Year
University Blvd w/o Wesbrook	550	680	6,870	2001
West Mall s/o Thunderbird	170	140	1,800	2001
East Mall s/o Crescent	210	210	2,430	2001
East Mall n/o 16th Avenue	940	860	8,190	2000
Wesbrook Mall n/o 16th Avenue	1,060	1,000	ND	2000
Wesbrook Mall s/o Student Union	860	730	ND	2000

ND – no data

Bicycle and pedestrian traffic is also a key factor that influences the performance of the road network and the operation of transit. Not surprisingly, bike and pedestrian volumes are relatively high on campus,

U:/projects/61332/48.1/graphics/Transit Plan Figures - On Campus Volumes.cdr NDS Sept 10, 2002

UBC TRANS LINK

Figure 2.26

On Campus Traffic Volumes

24 Hour Volumes - Fall 2000 & Fall 2001

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particularly in the vicinity of the academic core and the bus loop. Figure 2.27 shows the bicycle and pedestrian volumes at several intersections on campus for the morning and afternoon peak hours.

In developed areas such as UBC, road network performance is determined primarily by the performance of major intersections. The primary measure of intersection performance Level of Service (LOS). LOS is essentially an indicator of the delay experienced by the average motorist at a particular location, or on a specific movement in the case of an intersection. LOS is represented by performance measures ranging from LOS A through LOS F, as shown in Table 2.8. LOS A implies that the corridor or intersection (or movement) is operating with minimal delays, while LOS F indicates that a facility is operating in a 'failing' condition, characterized by excessive delays (over 80 seconds per vehicle) and congestion. LOS E indicates that the intersection or roadway is operating slightly above capacity, but that it can still function with moderate delays.

Table 2.8: Level of Service Criteria for Signalized and Unsignalized Intersections

Level of Service	Average Delay per Vehicle (sec/vehicle)	
	Signalized	Unsignalized
A	≤ 10	≤ 10
B	> 10 and ≤ 20	> 10 and ≤ 15
C	> 20 and ≤ 35	> 15 and ≤ 25
D	> 35 and ≤ 55	> 25 and ≤ 35
E	> 55 and ≤ 80	> 35 and ≤ 50
F	> 80	> 50

Source: Transportation Research Board. 2000. Highway Capacity Manual. Washington DC.

Figures 2.28 and 2.29 illustrate the existing turning movement volumes and levels of service for several intersections on campus, both signalized and unsignalized, for the morning and afternoon peak hours, respectively. As the figure illustrates, most of the intersections currently operate well within the acceptable ranges of delay. As such, traffic congestion on the campus itself is not presently a significant issue. As described in Section 2.1.4, however, there are operational issues relating to the interactions between pedestrians and vehicles at the University Boulevard/East Mall intersection that have an effect on transit operations along University Boulevard.

2.3 Parking

The effective management of parking is an important technique for managing transportation demand at an employment/institutional site such as UBC. There are two key methods through which to influence transportation demand with parking:

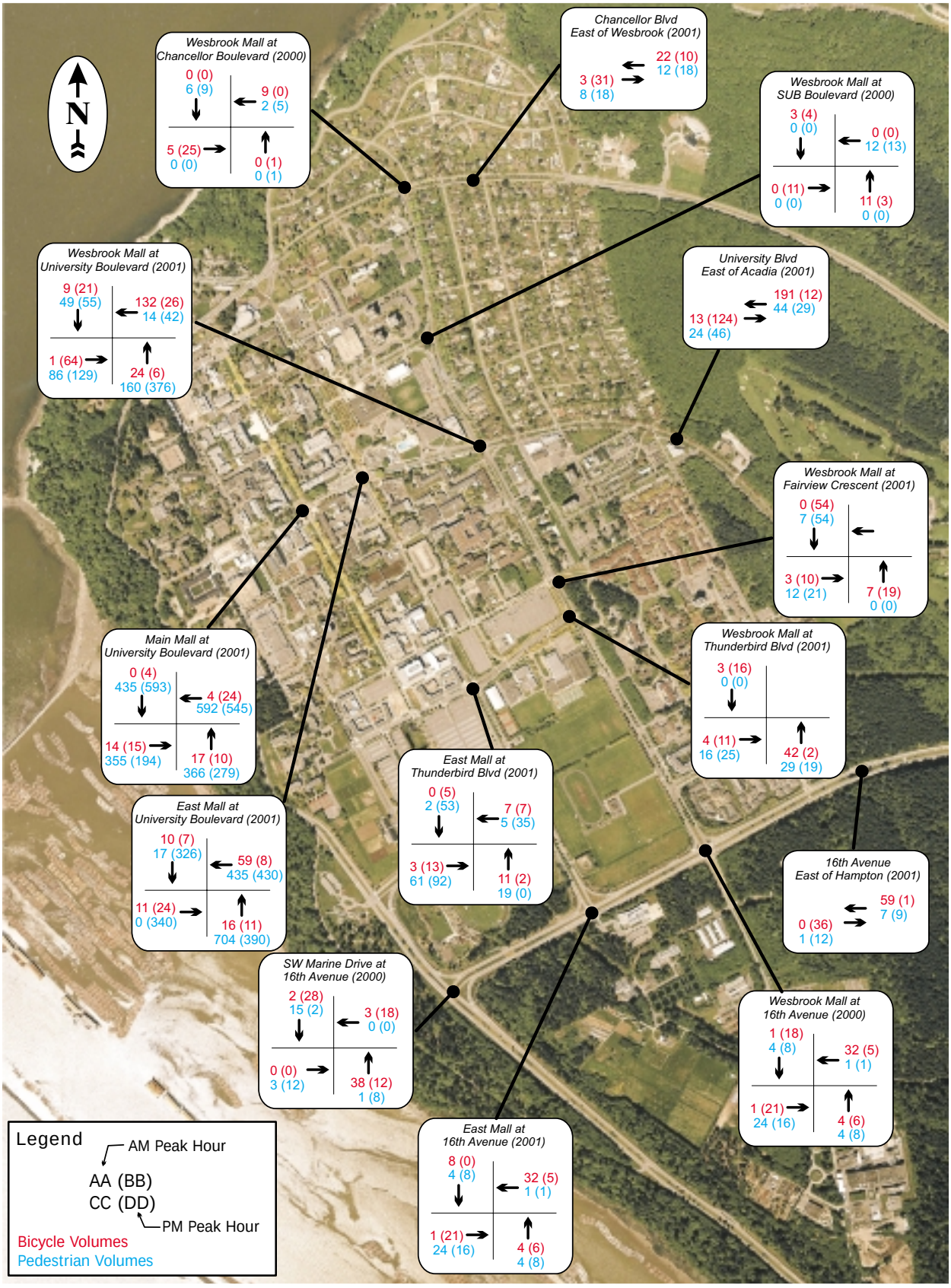

Figure 2.27

Peak Hour Bicycle and Pedestrian Volumes

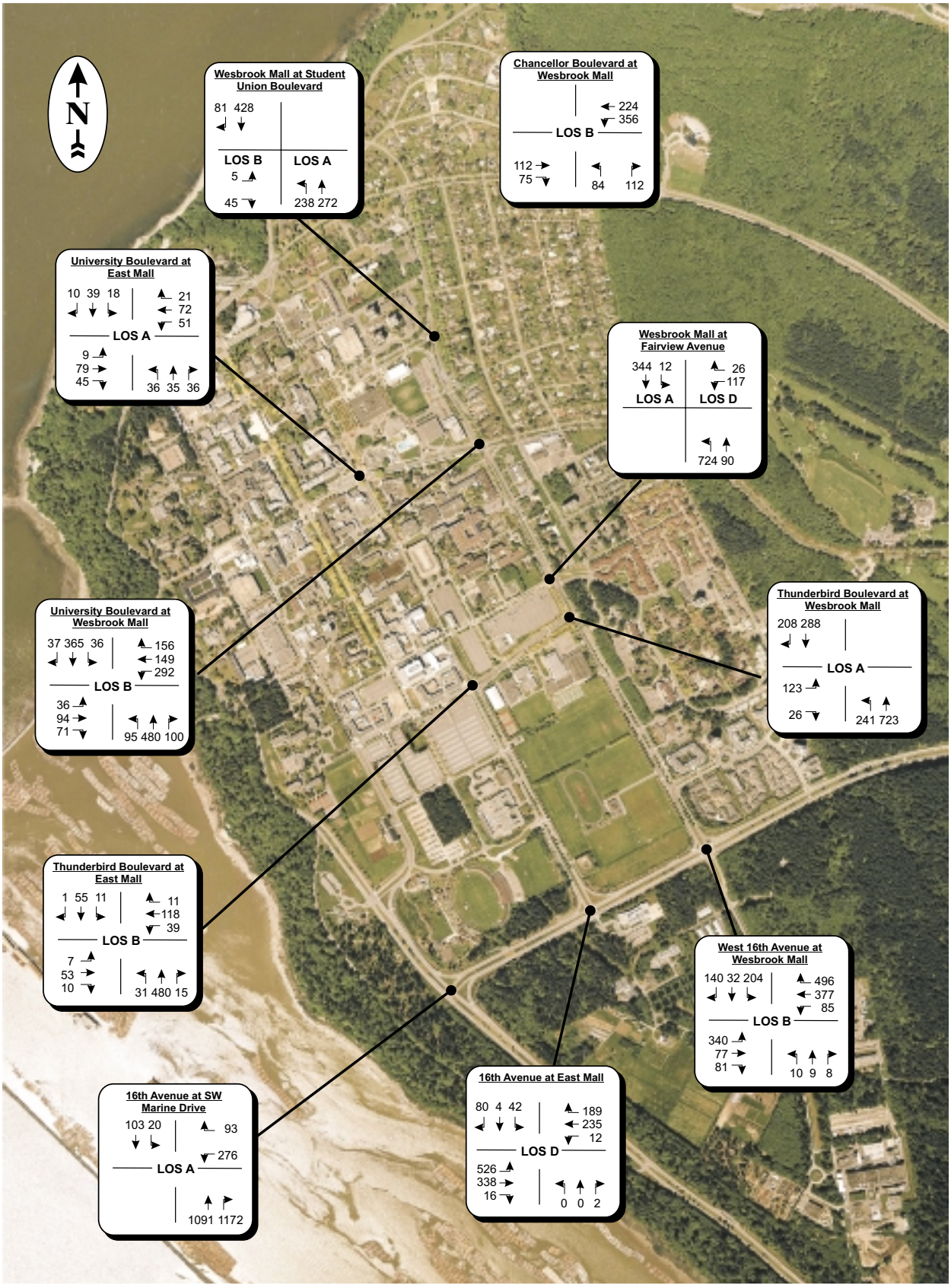

Figure 2.28
AM Turning Movements and LOS

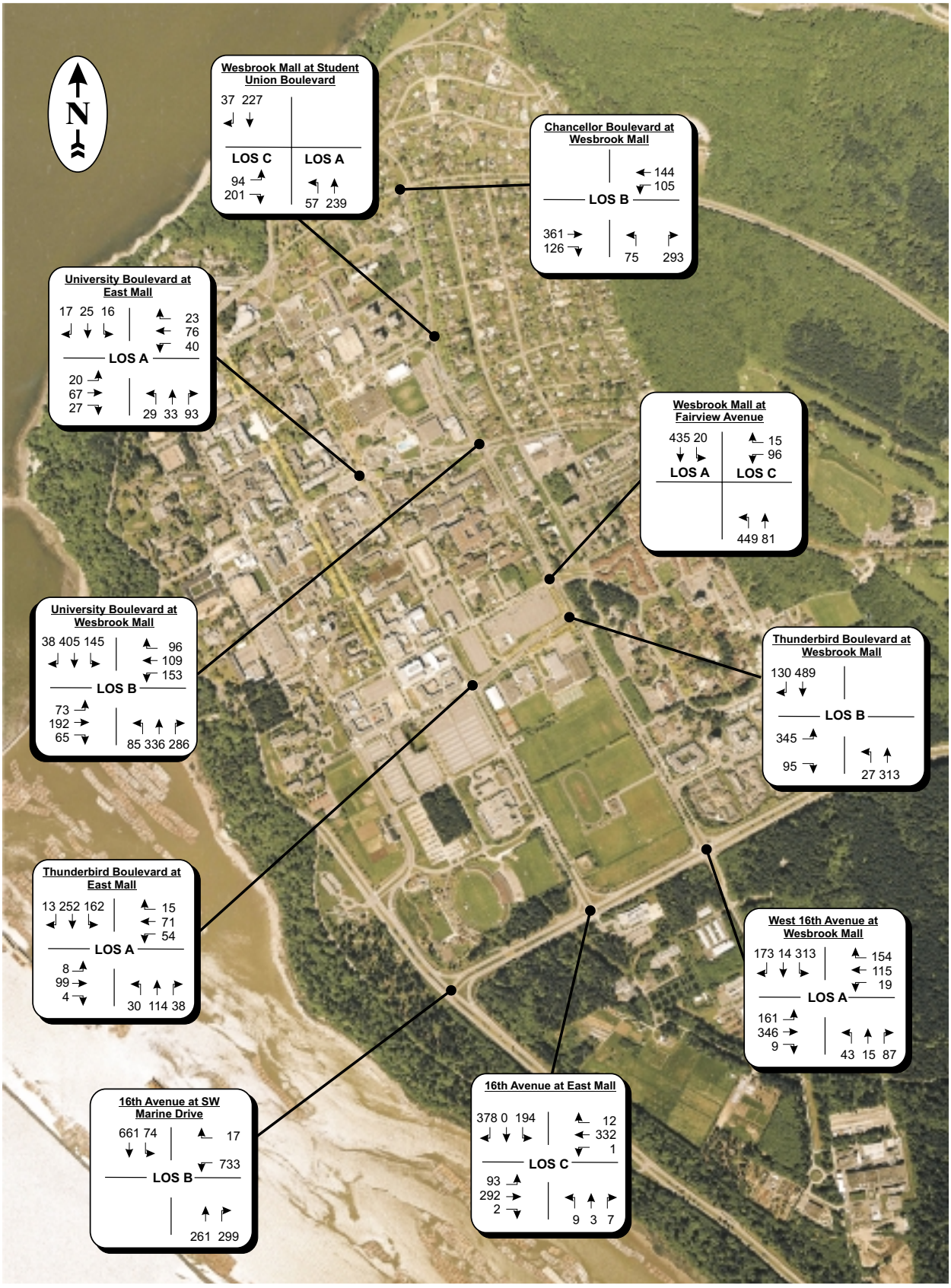

Figure 2.29
PM Turning Movements and LOS

- **Parking supply.** Limiting the supply of parking facilities to make parking a vehicle more difficult, encouraging commuters to consider other modes of transportation.

- **Parking pricing.** Adjusting parking pricing to match or exceed out-of-pocket travel costs for other modes (particularly transit) encourages commuters to consider less costly modes.

UBC is using both techniques as part of the STP to manage travel demand to and from campus by automobile.

Parking Supply & Pricing

UBC has a relatively large supply of parking on campus, estimated at over 11,000 parking stalls. Approximately 4,900 of these stalls are in parkades, while the remaining are in surface parking areas and along some streets. The supply of parking on campus is summarized in Figure 2.30, as identified in the 2002 Draft Parking Strategy Plan. The figure identifies the total number of parking stalls within a number of "zones" throughout UBC. It should be recognized that several areas of campus – including the Theological Precinct and the housing areas – are not included in the diagram, as they are generally treated separately from the general parking supply. Additionally, the shoulder parking areas along SW Marine Drive and West 16th Avenue are not included in the values shown. However, these areas are used daily by students, staff, and faculty wishing to park for free near campus.

There are five parkades on campus, namely:

- Rose Garden
- North
- West
- Fraser
- Health Sciences

The major surface parking areas are the B-Lots located at the south end of the academic core. Recently, a portion of the B-6 lot in the southeast quadrant of the Thunderbird Boulevard/West Mall intersection was removed from the supply and developed as faculty/staff housing. Over time, the remainder of the B-Lots will be developed as part of the CCP, and the overall parking supply will be reduced substantially. The Parking Strategy Plan estimates that the supply will be reduced by over 3,600 stalls by 2021.

The current pricing structure is shown below in Table 2.9. In most cases, these prices have risen over the past several years. In particular, the daily charge for parking in the B-Lots has risen from $2.00 per day in 1999 to $3.50 per day currently. It is anticipated that, as part of the implementation of U-Pass, the B-Lot rate would rise to $4.00 per day – equivalent to round-trip

U:/projects/61332/48.1/graphics/Transit Plan Figures - Parking Supply.cdr NDS Sept 6, 2002

Source: UBC Parking Strategic Plan - Bunt & Associates, August 2002

Figure 2.30
On-Campus Parking Supply

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transit fare within a single transit zone – and that the rate would subsequently be indexed to transit fares. In other words, the parking rate would rise every time transit fares were increased.

Table 2.9: Current Parking Price Structure

Type	Current Cost	Duration
Staff/Faculty permit	$676	12 months
Student permit		
- parkade	$528-600	8 months
- surface monthly	$400	8 months
- carpool	$336	8 months
- surface daily	$3.50	day
Meters	$2.50	hour
Motorcycle permit	$120	12 months

Source: UBC Parking and Access Control website

Parking Demand

The demand for parking at UBC is high and, as parking supply is constrained over time, the occupancy rate of parking lots is expected to increase. Figure 2.31 shows the current occupancy patterns (peak occupancy) of the various parking "zones" on campus, as determined in the Parking Strategy Plan. As shown, the parking areas closer to the academic core generally have a higher occupancy rate, reaching 95% in one of the areas.

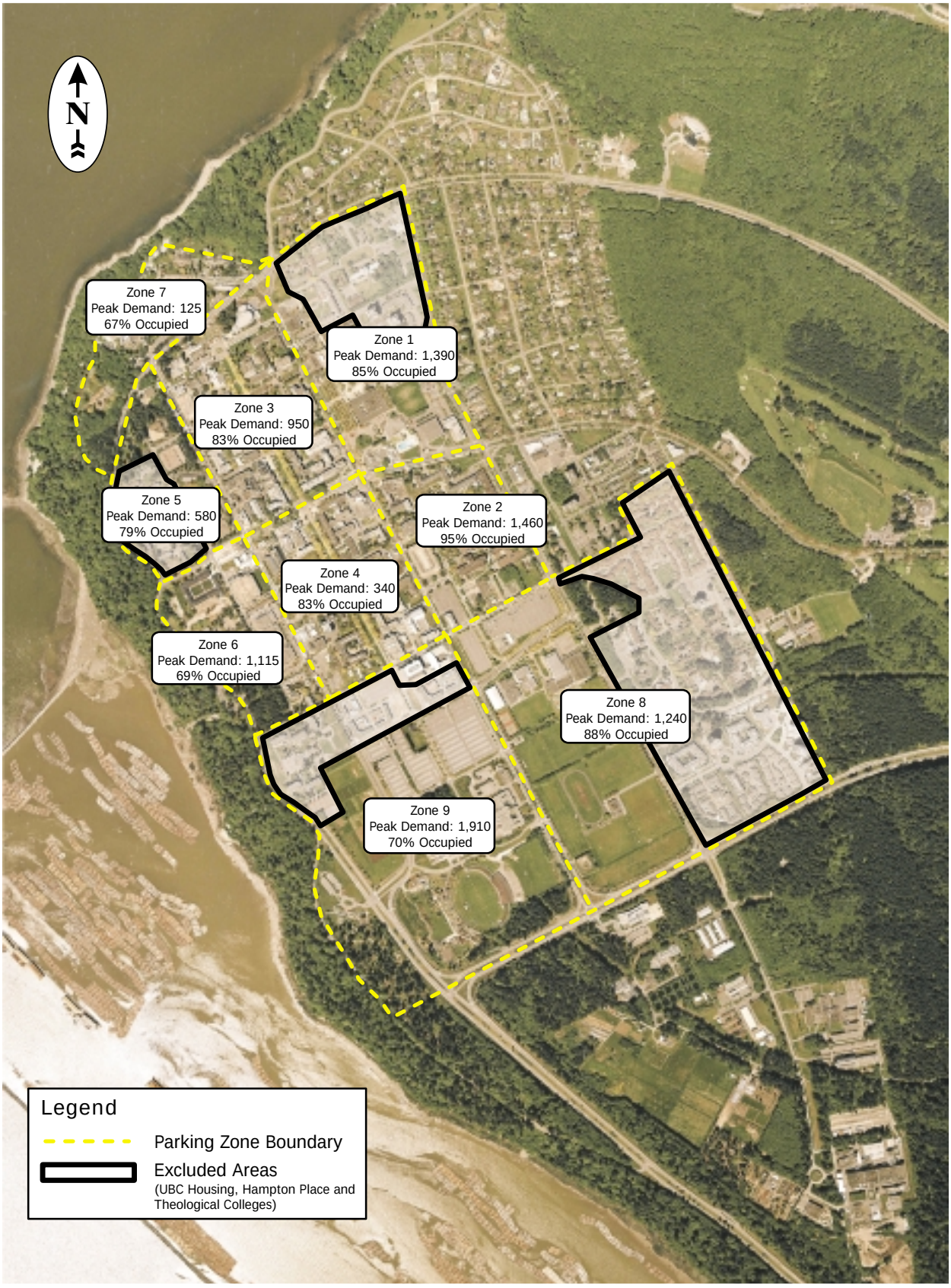
An important issue with respect to parking is the spillover effect on surrounding residential neighbourhoods, particularly after the implementation of U-Pass. As parking prices increase and supply decreases, and students, staff, and faculty are required to purchase U-Passes, there will be increased demand for parking on roadways off campus, such as along West 16th Avenue and SW Marine Drive (unless these areas become metered parking, which has been considered). In addition, it is likely that some members of the UBC community would park in residential neighbourhoods near campus, then use their U-Passes to ride transit to campus. This issue must be recognized and a strategy devised with the City of Vancouver to address potential problems that arise. In addition, this additional demand for transit needs to be considered as part of the Campus Transit Plan study.

2.4 Other Transportation Facilities and Services

There are several other facilities and services that are part of UBC's transportation system and the transportation management strategy laid out in the STP. These are outlined briefly in this section of the report.

2.4.1 Bicycle Facilities

Bicycles are an increasingly viable mode of transportation for UBC staff, faculty, and students, as well as residents of the UBC campus. On-street



U:/projects/61332/48.1/graphics/Transit Plan Figures - Parking Demand.cdr NDS Sept 19, 2002

Source: UBC Parking Strategic Plan - Bunt & Associates, August 2002

Figure 2.31
On-Campus Parking Demand

bicycle facilities have been developed on several routes leading to campus to support bicycle commuting. These routes and the major bicycle parking areas on campus are illustrated in Figure 2.32.

The most heavily used on-street facilities are the bicycle lanes along University Boulevard, which were created in 1999 by removing a traffic lane in each direction. It is estimated that daily bicycle traffic in the corridor rose by almost 50% after implementation of the lanes.

There are also bicycle lanes on West 16th Avenue east of Wesbrook Mall, and on NW Marine Drive/Chancellor Boulevard between West Mall and Acadia Drive. Potential improvements to these routes have been identified as part of the Five-Year Bicycle Capital Plan, completed in 2001, although these routes were outside the plan's study area. Cyclists on SW Marine Drive can use the wide paved shoulders along the roadway, but vehicles are often parked in the westbound shoulder near campus.

Within campus itself, there are relatively few on-street bicycle facilities. The CCP and the Bicycle Capital Plan identified a network of future bicycle routes on campus.

Bicycle parking is provided throughout campus, primarily with common bicycle racks. There are a large number of secure bicycle lockers located behind the War Memorial Gymnasium that are available for rent. Other major bicycle parking areas include the Forest Sciences Centre, the Buchanan Buildings, Neville Scarfe Building, and the David Lam Building.

2.4.2 Ridesharing Programs

Carpooling and vanpooling are also an important component of the UBC transportation demand, representing 25% of daily person-trips to and from the campus in Fall 2002. UBC is an active supporter of the Jack Bell Rideshare Program, and provides a carpool parking lot near the Forest Sciences Centre.

To encourage ridesharing, the UBC TREK Program Centre assists commuters with ridematching, whereby prospective carpoolers are matched with others who share similar travel characteristics (origin and time of travel).

2.4.3 U-Pass

A U-Pass program has been in development at UBC for several years, and will be implemented in September 2003 for all students, including graduate and part-time students. The pass will be mandatory for students. Options for providing U-Passes on a voluntary or universal basis to staff and faculty are also being considered. The U-Pass represents an integral component of the STP and will have a significant impact on travel patterns at UBC.

Figure 2.32
On-Campus Bicycle Facilities

The U-Pass will include:

- unlimited three-zone travel on transit
- ridematching
- a nighttime on-campus shuttle service
- subsidized vanpool fares
- reduced car/vanpool parking prices
- secure bicycle parking
- reduced prices for occasional daily parking
- a ride home in the event of an emergency
- discounts on goods/services at many merchants

TransLink is now identifying transit improvements that will be needed to support U-Pass implementation and the costs associated with those improvements. Also, UBC is working with student associations and other stakeholders on campus to develop other strategies that will be needed to facilitate U-Pass. For example, the TREK Program Centre has been working with UBC Parking and Access Control Services on a pricing strategy for parking after U-Pass implementation. As described previously, UBC intends to index parking prices to transit fares, such that parking prices will increase at the same time and rate as transit fares.

There will also need to be strategies to address the impacts of changing parking patterns, including the potential issues that might arise from UBC commuters parking in the City of Vancouver and riding transit to campus.

3.0 FUTURE CONDITIONS

This section presents the forecast transit ridership to and from UBC for several future scenarios as estimated by the regional transportation model. The assumptions used to develop future conditions are also described in this section.

A specific horizon year for analysis was not identified for this study, although it was agreed by the project steering committee that the analysis should consider conditions at UBC approximately 8-10 years from today. Instead, an enrolment threshold of 44,000 students was selected. This level of enrolment is expected to occur in approximately 2011, based on population forecasts and trend conditions.

Future base conditions for the selected enrolment threshold include anticipated changes to the UBC population (enrolment, employment, and residential), as well as other regional demographic changes. The future base conditions for UBC, however, assume that the existing transit route structure remains as it is today with improvements in service levels to accommodate increasing demands. Other major regional improvements planned within the timeframe of the future scenario – such as rapid transit services – are included. For this assignment, the future base scenario is used to identify the levels of transit service that will be needed to satisfy the demand for transit to and from UBC, given population growth and planned TDM strategies – such as U-Pass and parking management. These conditions are modelled in the regional transportation model to estimate their effects on future travel patterns to and from UBC.

3.1 Assumptions

To establish future base conditions, assumptions about population, land use, transportation pricing, and transit services must be made. These assumptions are documented below.

- **Land use.** The development of housing (market and rental) on campus according to the development plans of the CCP has already begun. It is anticipated that approximately 3,000 housing units will be developed by 2012. It was assumed for the purposes of this study that this level of development will be attained by the time enrolment reaches the identified threshold. It is also assumed that commercial development will occur along University Boulevard and in South Campus, as identified in the CCP.

- **Population.** As stated previously, the future base conditions are based on a threshold enrolment level of 44,000, which is expected to occur in approximately 2010. According to the Housing Needs Assessment recently completed for UBC, this level of enrolment will translate into

employment levels at UBC of approximately 3,500 faculty and 7,000 full-time staff. This compares to approximately 39,000 students, 3,100 faculty, and 6,300 staff at the present time.

The CCP developments throughout campus will result in an increasing population of campus residents, many of whom will work or study at UBC, but many of whom will work elsewhere. It was assumed for the future base conditions that approximately 8,000 people will live in non-UBC housing by the time enrolment reaches 44,000. This includes the residents of Hampton Place and the new CCP developments.

There will be additional development of UBC residences over the timeframe for the study, including a major new residence on the current Food Sciences Building site. It was assumed that 10,600 students and family members will live in UBC housing developments (including student residences, the Theological Colleges, student family housing, and staff/faculty housing) within the timeframe of the study.

- **Parking.** The strategy for U-Pass implementation includes a plan to index parking prices on campus to a one-zone round-trip transit fare. Upon implementation of U-Pass, the daily parking rate at the B-lots will increase to the equivalent of a one-zone round-trip transit fare (currently $4.00) and will increase over time at the same rate as transit fares.

  Parking supply is not included as an explicit variable within the regional transportation model, so the impacts of a reduction in parking supply cannot be fully evaluated using the model. This is an important fact considering that the parking supply at UBC will be reduced over time as several of the surface B-lots are developed into housing and other community facilities identified in the CCP. It is expected that approximately 2,000 stalls will be removed over the next 10 years.

- **Transit pricing** for trips to and from UBC will change dramatically upon implementation of U-Pass, which is anticipated for students in 2003. Although the U-Pass will cost students in the range of $20-25 per month, the marginal cost for students to ride transit will be near zero. In other words, transit will essentially be free for U-Pass holders. The transit prices in the model were updated to reflect this. It was also assumed that U-Pass would be extended to staff and faculty by 2011.

- **Regional transit improvements.** Major improvements to the regional transit system must be considered in establishing future conditions because they may cause changes in the travel patterns of automobile users and transit riders. The primary improvement that is anticipated within the timeframe for this study is the implementation of rail-based rapid transit between downtown Vancouver, central Richmond, and the airport.

Planned regional transit improvements that are not incorporated for this study include the Port Moody-Coquitlam rapid transit extension, and the westward extension of the Millennium SkyTrain line to Granville Street.

3.2 Base Case Conditions

The regional transportation model was calibrated for 1997 and 2002 conditions using transit ridership and traffic data collected during the annual screenline monitoring program at UBC. For 2002, changes to the transportation system (pricing, service levels, road and transit network) since 1997 were incorporated. Specifically, changes associated with the STP were included to reflect the impacts that the STP has had on transportation patterns to and from campus. Additionally, the 2002 model incorporates changes to the overall demographic characteristics of the region, and to the cost of transportation (such as vehicle operating costs and transit fares).

The model – which represents morning peak hour conditions – was calibrated particularly against westbound (peak direction) transit ridership between the hours of 8:00 and 9:00 AM. This time period was selected for calibration because the transit ridership data available prior to Fall 2002 was only available in hourly increments. In the following discussion, many of the ridership and volume forecasts presented are westbound morning peak period values, because this time period represents the critical period for transit planning purposes. As illustrated in Table 3.1, the model calibrates well against the observed transit ridership for both 1997 and 2002.

Table 3.1: Model Calibration Results (Westbound 8-9 AM Transit Ridership)

Year	Observed	Model
1997	2,190	2,200
2002	2,550	2,480

For future conditions, the assumptions described in the preceding section – corresponding to a total enrolment of 44,000 students in 2011 – were incorporated into the model. To estimate the incremental effects of different aspects of the STP, several future base scenarios were modelled.

A near-term future scenario (2004) was developed to estimate the short-term impacts of U-Pass implementation on transit ridership. For this scenario, it was assumed that U-Pass would only be available to students.

Several longer-term scenarios (44,000 student enrolment) were also developed. In particular, a future base scenario that does not incorporate U-Pass or changes to the parking charges at UBC was modelled to estimate the effects of population growth (residential, employment, and enrolment) on transit ridership. This scenario was developed to estimate the growth in

transit ridership that would occur as a direct result of population growth. This scenario incorporates incremental service improvements to accommodate the increasing demand. Two scenarios incorporating U-Pass were modelled. The first included a U-Pass available to students, staff, and faculty and UBC. The second U-Pass scenario also incorporated parking charge increases, reflecting the plan to index parking charges to transit fares upon implementation of U-Pass (to make daily parking charges equivalent to a one-zone round-trip transit fare). Both U-Pass scenarios consider incremental service improvements to accommodate increasing demand.

The forecasts indicate that transit ridership will increase significantly in future as a result of population growth, U-Pass implementation, and changes to the parking charges on campus. Table 3.2 below summarizes the westbound AM peak hour and AM peak period (7-10 AM) transit ridership and estimated daily ridership for each of the future scenarios that were modelled.

Daily two-way transit ridership was estimated by applying the existing ratio between daily two-way transit ridership and westbound morning peak hour (8-9 AM) transit ridership. It must be recognized that the implementation of U-Pass at other educational institutions resulted in significant increases in midday transit ridership versus peak period ridership (e.g., 43% increase in midday ridership at SAIT), likely as a result of an increase in discretionary midday trips to and from campus by students. For example, U-Pass holders may be more inclined to use transit to make short trips off-campus between classes. The daily ridership estimates in the following table have been adjusted upward to account for this pattern, using the data from SAIT as a guide.

Table 3.2: Forecast Transit Ridership to/from UBC

Scenario	WB AM Peak Hour Transit Ridership	WB AM Peak Period (7-10 AM) Transit Ridership	Daily Transit Ridership to/from UBC	Percent Change from 2002
2002 Base	2,970	7,580	29,700	
Future Base[1]	3,410	8,700	34,000	14%
2004 with U-Pass[2]	3,800	9,700	39,000	31%
Future with U-Pass[3]	4,690	11,970	49,000	65%
Future with U-Pass[3] and Increased Parking Charges	5,000	12,760	53,000	78%

1 Future base scenario includes service improvements to accommodate increased demand.
2 U-Pass assumed to be available to students only in 2004.
3 U-Pass assumed to be extended to staff and faculty by 2011.

The forecast mode shares for SOV, HOV, truck, and transit trips (excluding walk and bicycle trips) are shown below in Table 3.3 for the 2001 base scenario, the 2011 base scenario, and the 2011 scenario that includes U-Pass and increased parking charges.

Table 3.3: Forecast Non-Walk Mode Shares for UBC (24-Hour)

Mode	1997	2002 Base	2004 with U-Pass	2011 Base	2011 with U-Pass and Increased Parking Charges	Percent Change from 2002
Single-Occupant Vehicle	43%	46%	38%	45%	34%	-26%
Car/vanpool	34%	26%	23%	25%	20%	-23%
Truck	<1%	<1%	<1%	<1%	<1%	0%
Transit	18%	27%	38%	29%	45%	67%

Note: Totals may add to greater than 100% due to rounding.

The regional transportation model does not constrain transit ridership based on the capacity of buses serving a given destination. Therefore, the model assumes that those riders who wish to take transit to UBC will be able to board buses bound for campus. In this regard, these ridership forecasts are based on the assumption that service levels would be increased sufficiently to accommodate the anticipated demand.

The model forecasts indicate that transit ridership would increase approximately 14% as a direct result of population growth at UBC (enrolment, employment, and residential) over the next 10 years. This growth in ridership would result in the transit mode share increasing to approximately 29% on a daily basis.

The most significant increase in transit ridership in the future will result from the implementation of U-Pass. The forecasts indicate that the U-Pass and associated transit service improvements would attract approximately 28% more transit ridership in the short term, increasing daily ridership from 29,700 today to approximately 38,000 riders after implementation. This increase reflects U-Pass being made available only to students upon initial implementation.

The forecasts also indicate that, by approximately 2011, U-Pass would generate approximately 38% more ridership versus 2011 base conditions, increasing daily transit ridership to and from UBC to approximately 47,000 daily trips. This 38% increase reflects the assumption that U-Pass would be extended to staff and faculty by 2011. This forecast is comparable to results at other post-secondary institutions that have implemented U-Passes or similar programs (such as U-Vic, SAIT, and UWO). Ridership growth at these other institutions as a result of U-Pass implementation generally ranges between 40% and 50%. Although transit usage at these other institutions was not as high as the transit mode share at UBC prior to U-Pass, the quality and frequency of transit service elsewhere is also not as high as it is at UBC. These results suggest that, by offering quality transit connections to a concentrated location at a marginal cost to users near zero, TransLink and UBC will be able to increase ridership by an amount similar to that experienced at other post-secondary institutions.

Finally, Table 3.2 shows that additional parking management measures (increased parking fees to match a one-zone round-trip transit fare) would increase transit ridership by a further 6% to 7% (versus U-Pass alone) to over 12,000 westbound transit trips during the morning peak period and 53,000 trips daily.

Table 3.3 indicates that U-Pass will have a significant effect on the mode shares of automobiles and transit. The forecast shows that the daily mode share of SOVs will drop from approximately 46% to 34% in 2011 if parking charges are increased in conjunction with U-Pass implementation. The daily HOV mode share is also forecast to drop from 26% to 20%, indicating further shifts from ridesharing to transit. The shift from automobiles to transit will result in the transit mode share increasing to 45% on a 24-hour basis.

The forecasts shown in Table 3.2 should be considered within the context of the Lower Mainland. The transit share of non-walk trips to and from downtown Vancouver is approximately 39%. As shown in Table 3.3, the forecast growth in transit ridership at UBC would increase the transit mode share for non-walk trips to and from UBC to approximately 45%. Therefore, the U-Pass would increase transit ridership to a level comparable to downtown Vancouver.

Total vehicle traffic to and from UBC will also be affected by population growth, and by transportation demand management measures, such as U-Pass and parking fee increases. Table 3.4 below summarizes the westbound morning peak period vehicle volumes to UBC, as forecast by the regional transportation model, as well as the estimated daily two-way traffic volumes at the UBC screenline.

Table 3.4: Forecast Vehicle Volumes to/from UBC

Scenario	Total WB AM Peak Period Vehicle Volumes	Daily Two-Way Vehicle Volumes to/from UBC	Percent Change from 2002
2002 Base	10,900	65,000	
2011 Base	12,000	72,000	11%
2004 with U-Pass	10,400	61,000	-6%
Future with U-Pass	10,200	61,000	-6%
Future with U-Pass and Increased Parking Charges	9,900	59,000	-9%

The results suggest that, in the absence of any additional TDM measures, vehicle volumes will grow by approximately 10% to 11% over the next decade or so, simply as a result of increased enrolment and employment on campus.

Implementation of U-Pass and the associated transit improvements would reduce traffic demand by almost 15% (versus 2011 base conditions), from 12,000 total (westbound) vehicles to just over 10,000 total vehicles during the morning peak period. Daily traffic volumes at the UBC screenline are forecast to decline by 15% from 2011 base conditions or 6% from current levels to approximately 61,000 trips. The implementation of increased parking fees in association with U-Pass would further reduce vehicle demand by approximately 3.5%, to just under 10,000 westbound vehicles during the morning peak period, and 59,000 daily trips. As illustrated in Table 3.3, this drop in vehicle trips (SOV and HOV) corresponds with an expected decline in the total (SOV + HOV) automobile mode share from 72% today to approximately 54% by 2011.

4.0 SERVICE CONCEPTS

The following illustrations and accompanying descriptions represent the range of possible ways of operating transit services at UBC, using different combinations of transit "nodes" and services. The transit service concepts have been categorized into three groups depending on the number of transit nodes — one, two or several. For all concepts, the objectives are to:

- Maintain direct and efficient access to the academic core, which is the destination for the majority of trips to UBC
- Improve coverage of the campus, particularly the academic core and future development in the south campus
- Accommodate "internal" trips within UBC
- Locate and configure transit facilities in a manner compatible with UBC land use and design objectives
- Maximize the cost-effectiveness of transit services

All concepts reflect current development plans and associated road network changes, including a new bus-only or traffic-calmed access through South Campus between 16th Avenue and SW Marine Drive. Some concepts also reflect the recent proposal to open University Boulevard to transit vehicles and optionally to general traffic between East Mall and West Mall. It should be recognized that this section describes *conceptual* transit routings, stop locations, and layover facilities to allow for screening purposes in Section 5.3. The concepts that pass the screening stage are refined further to reflect land use constraints, operational feasibility, and current development plans.

Transit Nodes

Each concept incorporates one or more transit "nodes." A node is simply a location where buses arriving at UBC would stop and layover for a few minutes before departing from UBC. Because of UBC's geographic location at the "end of the line," buses on each route require a layover location. Time allocated for layover allows buses that arrive late due to traffic delays or other delays to depart the campus on time, and provides a brief break for bus operators who cannot take a break at any other point along the route.

Currently, all buses lay over at the bus loop on University Boulevard at East Mall. The bus loop is a large "off-street" transit node. The term "off-street" means that all platforms, bus bays and layover locations are separated from adjacent roadways.

New transit nodes developed at UBC could be entirely off-street like the existing bus loop, could be entirely on-street, or could be a combination of

off-street and on-street facilities. The term "on-street" means that platforms and bus bays are located along the curb of the roadway. In some cases, "sawtooth" bus bays could be developed along the curb to clearly delineate stops.

Nodes can also be spread out over an area, rather than being concentrated in a single facility as with the existing bus loop. A large on-street node might incorporate bus bays on two or more approaches to an intersection, for example.

Figure 4.1 through Figure 4.3 illustrate various types of on-street and off-street transit nodes.

Figure 4.1: Small On-Street Transit Node

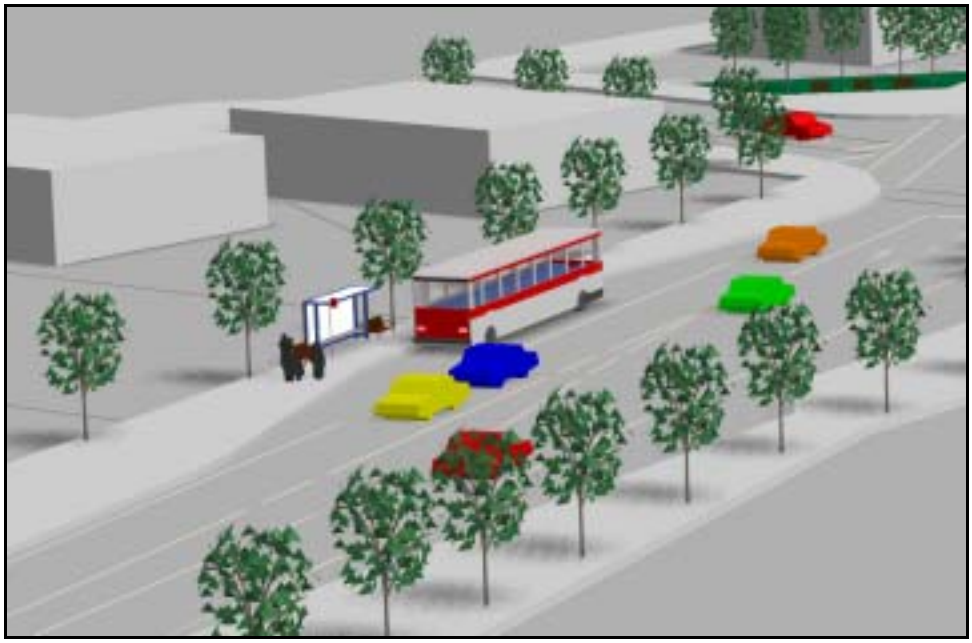


Figure 4.2: Large On-Street Transit Node

Figure 4.3: Off-Street Transit Node

It is important to note that the locations of transit nodes shown in the illustrations in this section are approximate. Each node could be on-street and/or off-street, and could be concentrated in a single facility or spread over an area. The locations and characteristics of each node are determined through the evaluation process in Section 5.0 for the preferred transit service concepts.

Bus Stops

Transit passengers would board and alight from buses at transit nodes, just as transit passengers board and alight from buses at the existing bus loop. Transit passengers would also be able to board and alight from buses at bus stops located along each route.

A bus stop could simply be a sign on a pole identifying the location of the bus stop. For locations with frequent passenger boardings, it is desirable to provide a bus shelter and seating. Bus stops with frequent transit service and large numbers of boarding passengers may require additional curb space so that two or more buses can stop at once, and may require a larger shelter or two shelters for waiting passengers. Other amenities such as bicycle racks, emergency telephones and transit service information can also be provided at bus stops.

Bus stops can be designed so that buses pull into a bay, out of the flow of traffic. Bus bays are typically used on roads with higher vehicle speeds. On lower-speed roads, buses typically stop in the roadway. Another possible bus stop configuration is a "bus bulge," which is used on streets with parking. With a bus bulge, the curb is extended into the roadway so that the bus stops in the travel lane rather than pulling to the side of the road. A bus bulge avoids buses being delayed in re-entering the roadway, as can happen with bus bays and with conventional bus stops on roads with parking. It also provides a larger sidewalk area for waiting passengers, and for passenger amenities.

Examples of different types of bus stops are illustrated in Figure 4.4 through Figure 4.7.

Figure 4.4: Bus Stop with No Amenities – Northbound Wesbrook Mall at RCMP Building

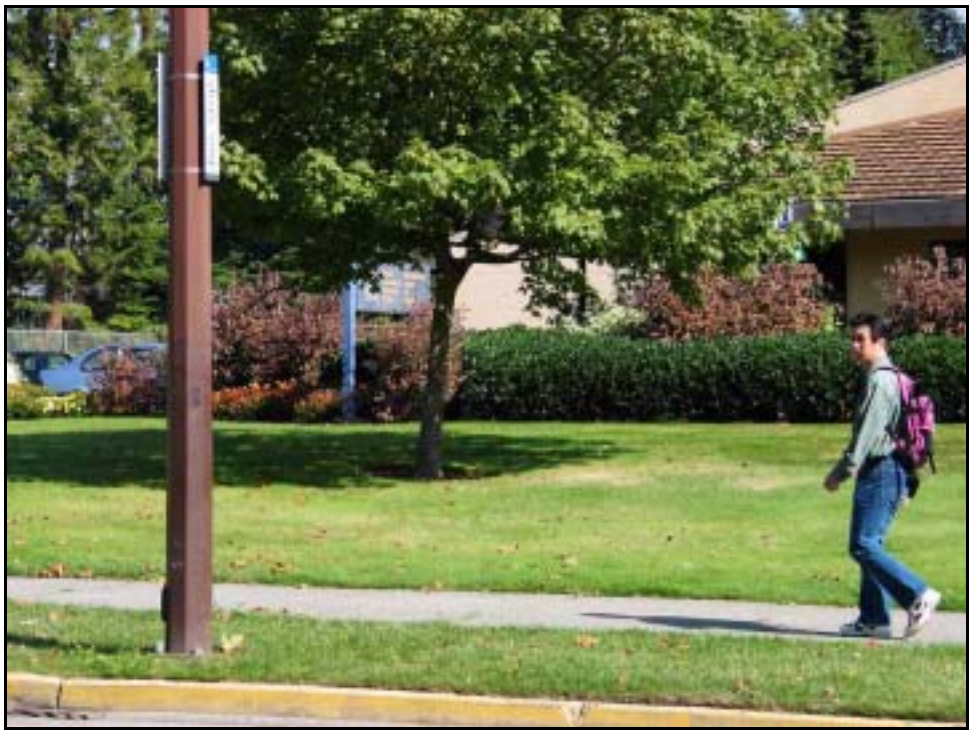


Figure 4.5: Bus Stop with Passenger Amenities – Eastbound University Boulevard at Wesbrook Mall

**Figure 4.6: Bus Stop with Bus Bay –
Westbound 16th Avenue west of Wesbrook Mall**

**Figure 4.7: Bus Stop with Bus Bulge –
Westbound 10th Avenue at Sasamat Street**

Specific bus stop locations have not been identified on the illustrations of transit service concepts in this section. For screening purposes, it was assumed that stops would be provided at regular intervals along each route, close to major destinations and at key intersections. Specific bus stop locations are determined in the evaluation process for the preferred transit service concepts.

Routes

Each transit service concept illustrated in this section incorporates different coloured "regional" transit routes. Regional transit routes are those that connect UBC to the City of Vancouver and other parts of the region. Each colour of route in the illustrations in this section represents a different group of regional routes, based on the roadway that these routes use to access the UBC campus — Chancellor Boulevard, University Boulevard, 16th Avenue and SW Marine Drive.

The illustrated regional routes are intended to be representative of routing possibilities associated with each transit service concept. In each case, there are many possible routing variations. For the preferred concepts that are evaluated in detail, routing variations are examined to identify the most suitable routing configurations for each concept.

For the purposes of screening, the service levels (route frequencies, hours of service) for each concept are assumed to be consistent. Appropriate service levels are determined for the preferred transit service concepts during the evaluation stage of the study.

Community Shuttle

Each transit service concept also includes community transit service in all or part of the campus, operating during the daytime and at night until approximately 1:00 p.m. Community Shuttle services are essentially mini-buses (Figure 4.8) and other small vehicles that operate throughout the campus, connecting to regional transit services at transit nodes and major bus stops.

Community Shuttle service would be intended primarily to provide mobility on campus for:

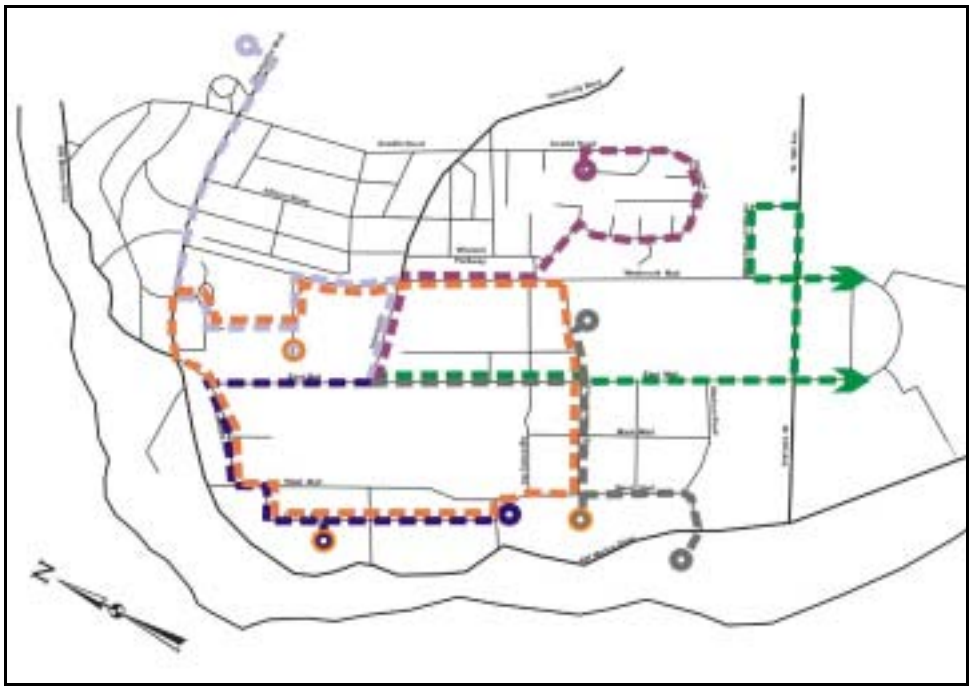
- Persons with disabilities.
- Persons travelling alone at night, for whom personal security is a concern.
- Persons making long trips across campus, which are too far to walk in a timely manner. An example would be a trip from South Campus to the Chan Centre.
- Persons travelling with objects that are too large or heavy to walk with.

Community Shuttle services would not be intended to carry large numbers of people short distances on campus. Almost all of these trips are currently made by walking, and it would not be the intent to convert existing walking trips to community shuttle trips. Rather, the intent is to accommodate trips which cannot be made by walking.

Figure 4.8: Community Shuttle Bus

Service would be provided at frequencies of up to 15 minutes on several routes, depending on the coverage of regional bus routes on campus. In the following discussion on service concepts, Community Shuttle routes are not shown for clarity. However, Figure 4.9 illustrates conceptual routes to show the potential coverage of the services, as well as the key locations on campus that could be served by Community Shuttle.

Figure 4.9: Conceptual Community Shuttle Routes



Actual routes and service levels will be determined through further detailed work undertaken by TransLink and UBC. Consequently, for the purposes of the evaluation, the hours of service and numbers of buses indicated for each service concept are considered reasonable and representative of the different levels of Community Shuttle service that would be provided.

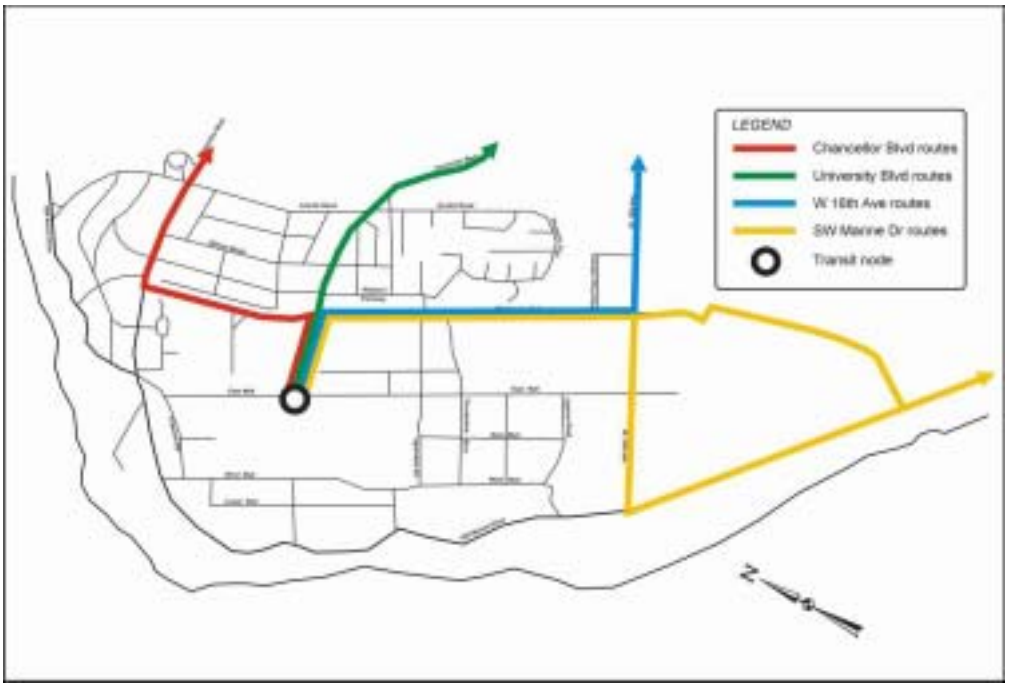
4.1 Single Node Concepts

In these service concepts, regional transit services all terminate at a single node on campus, as at present. Locations of the node vary from concept to concept, as do routes to and from the node.

Concept 1 — Existing Node, Existing Routes

This concept reflects a continuation of the existing service and facility configuration. Buses would terminate at a single node located on the site of or in the vicinity of the existing bus loop. The bus loop would be expanded, reconfigured, relocated and/or grade-separated to accommodate increased levels of transit service. All bus routes would remain the same, with the option of routing some local services operating on SW Marine Drive via the planned new bus-only connection through South Campus.

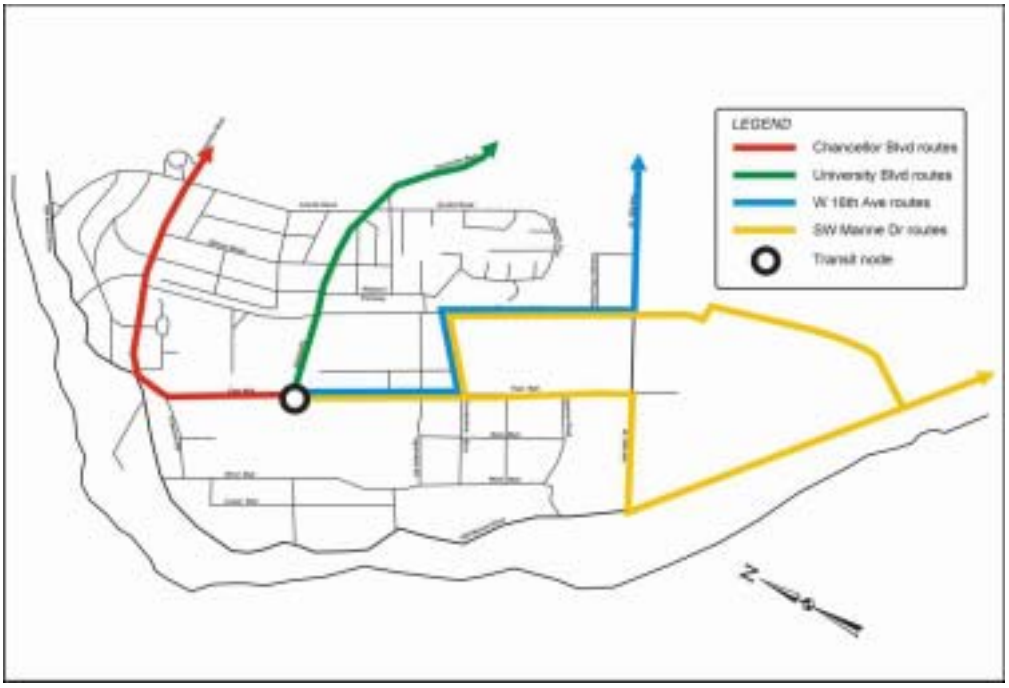
Figure 4.10: Concept 1 – Existing Node, Existing Routes



Concept 2 — Existing Node, Modified Routes

In this concept, a single node would be retained on the site of or in the vicinity of the existing bus loop, which would be expanded and reconfigured to accommodate increased levels of transit service. Transit routes throughout the campus would be modified to increase coverage and reduce walking distances. Half the routes would access the node via East Mall, which would mean that access to and egress from the node would need to be configured to accommodate turning movements to and from East Mall, or the node could be partially on-street.

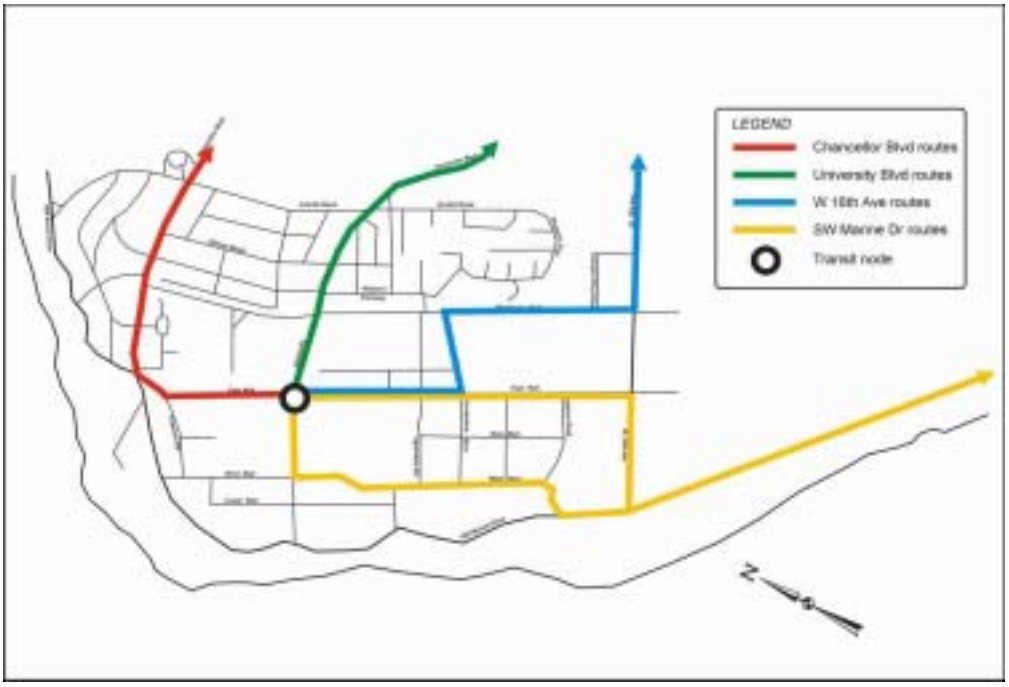
Figure 4.11: Concept 2 – Existing Node, Modified Routes



Concept 3 — Existing Node, Transit Access via University Boulevard

In this concept, a single node would be retained on the site of or in the vicinity of the existing bus loop, which would be expanded and reconfigured to accommodate increased levels of transit service. University Boulevard west of East Mall would be open to transit vehicles (and optionally, to general traffic). This would enable buses on some routes to access the node via University Boulevard west of East Mall, as a means of minimizing travel time and operating costs on these routes and increasing coverage. Buses on some SW Marine Drive routes would access the node via East Mall, as a means of further increasing coverage. Access to and egress from the node would need to be configured to accommodate turning movements to and from East Mall and from University Boulevard west of East Mall.

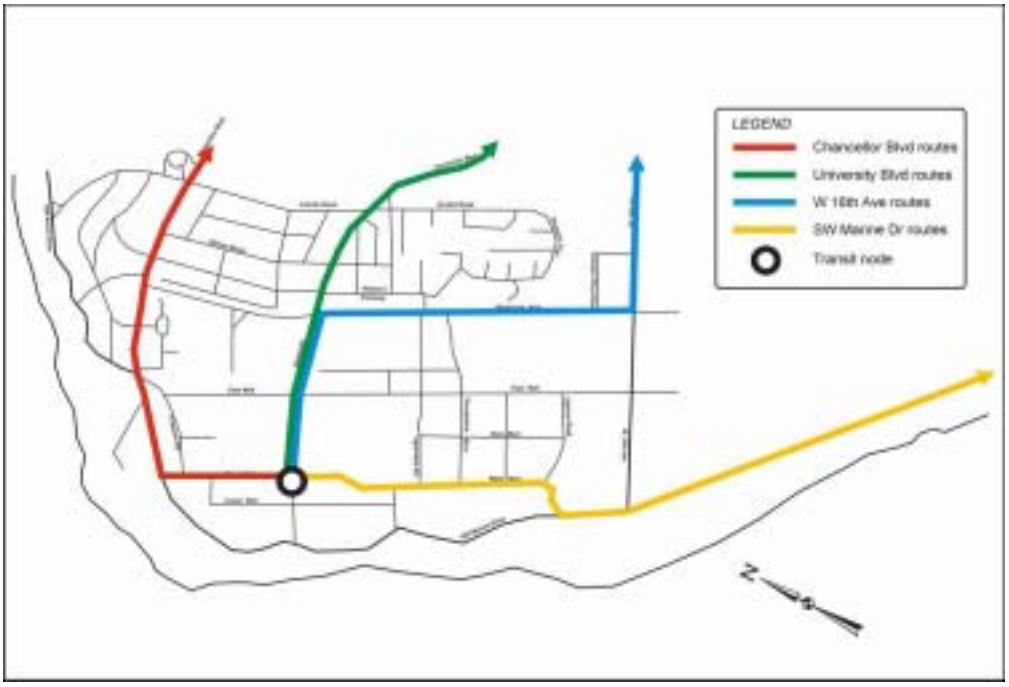
Figure 4.12: Concept 3 – Existing Node, Transit Access via University Boulevard



Concept 4 — New Node on University Boulevard

University Boulevard west of East Mall would be open to transit vehicles in this concept, and optionally to general traffic. A single node would be located on or in the vicinity of University Boulevard, between Lower Mall and West Mall. Half the transit routes would operate via University Boulevard (including trolley routes), and the other half via West Mall, so as to minimize travel times and operating costs, while increasing coverage.

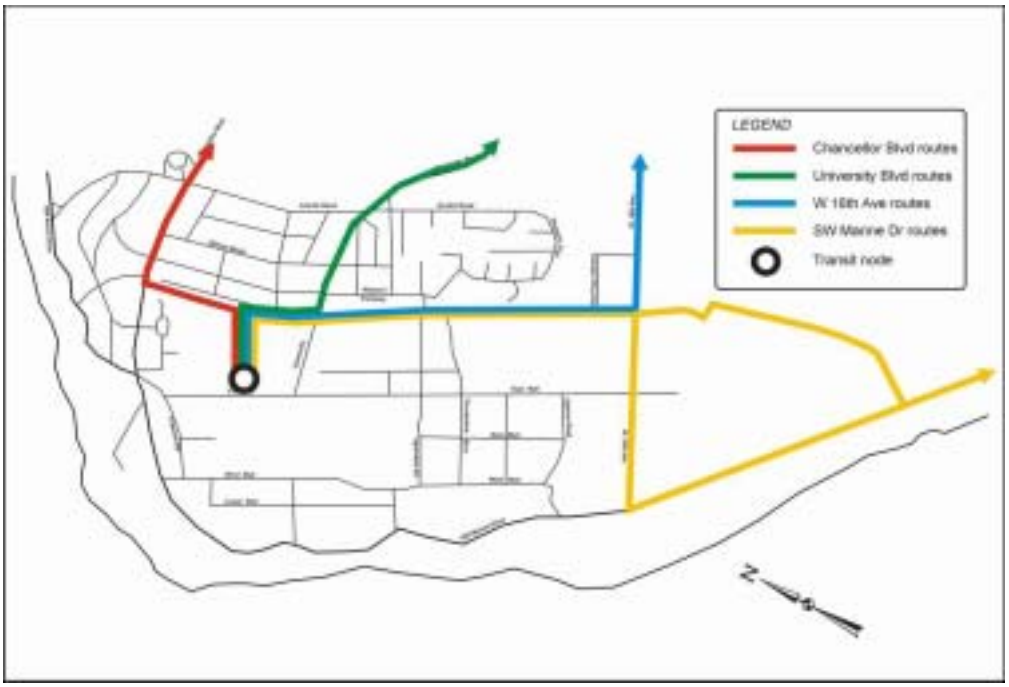
Figure 4.13: Concept 4 – New Node on University Boulevard



Concept 5 — New Node near SUB

In this concept, a single node would be located in the vicinity of the Student Union Building, with access via Student Union Boulevard. All bus routes would remain essentially the same as at present, with the concept of routing some local services operating on SW Marine Drive via the new bus-only connection through South Campus.

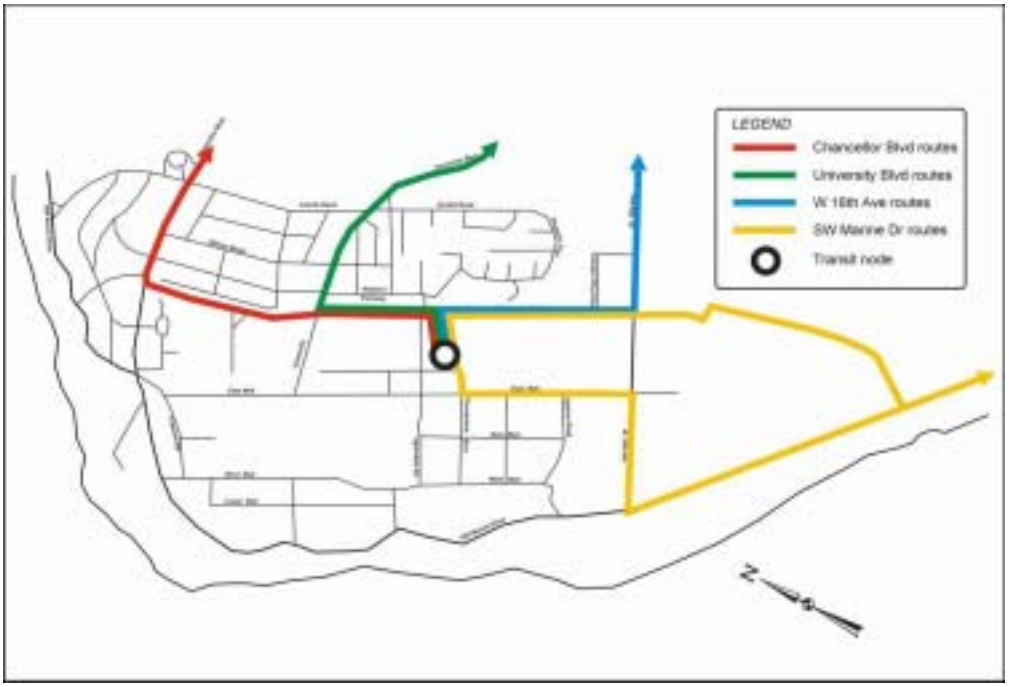
Figure 4.14: Concept 5 – New Node Near SUB



Concept 6 — New Node near Thunderbird Boulevard

In this concept, a single node would be located on or in the vicinity of Thunderbird Boulevard between East Mall and Wesbrook Mall. Most routes would access the node via Wesbrook Mall. Some SW Marine Drive routes would access the node via East Mall.

Figure 4.15: Concept 6 – New Node near Thunderbird Boulevard



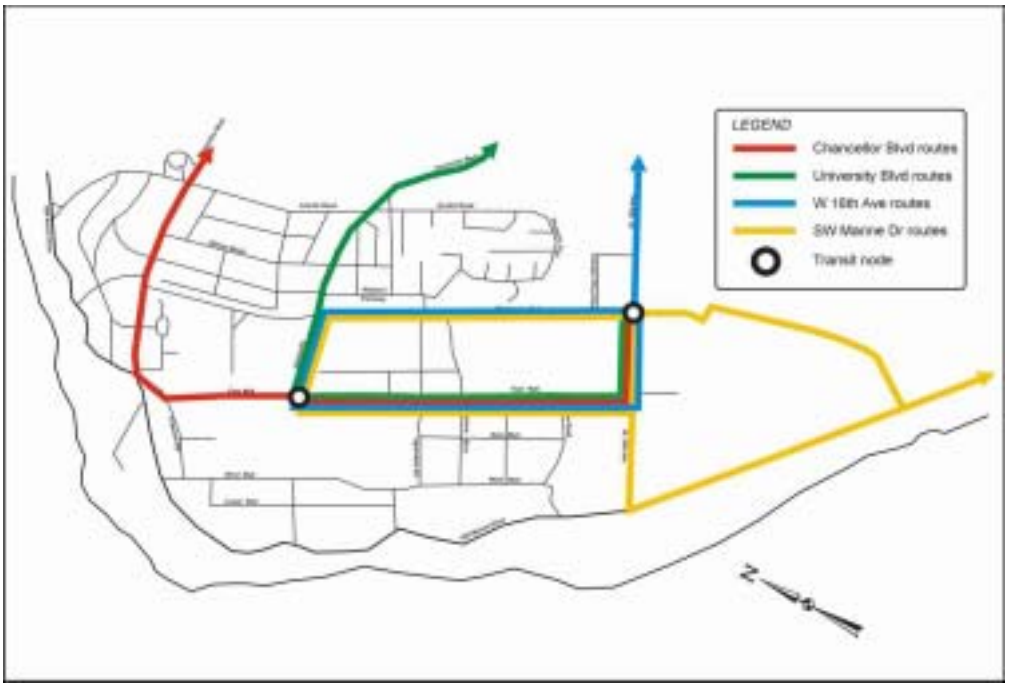
4.2 Dual Node Concepts

These service concepts incorporate two transit nodes on campus. Each regional route terminates at one node, and may serve the other node enroute. Community Shuttle routes may terminate at one or both nodes.

Concept 7 — Second Node at 16th / Wesbrook

This concept reflects the proposed configuration of transit services and facilities in the current Comprehensive Community Plan. One node is located on the site of or in the vicinity of the existing bus loop on University Boulevard. A second node is located in the vicinity of the Wesbrook Boulevard/16th Avenue intersection. All regional routes would terminate at one of the nodes, and some routes would serve the second node enroute. For example, a local route operating via University Boulevard might terminate at the University Boulevard node, while an express route operating via University Boulevard might stop at the University Boulevard node, and then continue via East Mall to the Wesbrook/16th node, where it would terminate. This overlap between the two nodes would optimize coverage and accommodate some "internal" trips within the campus.

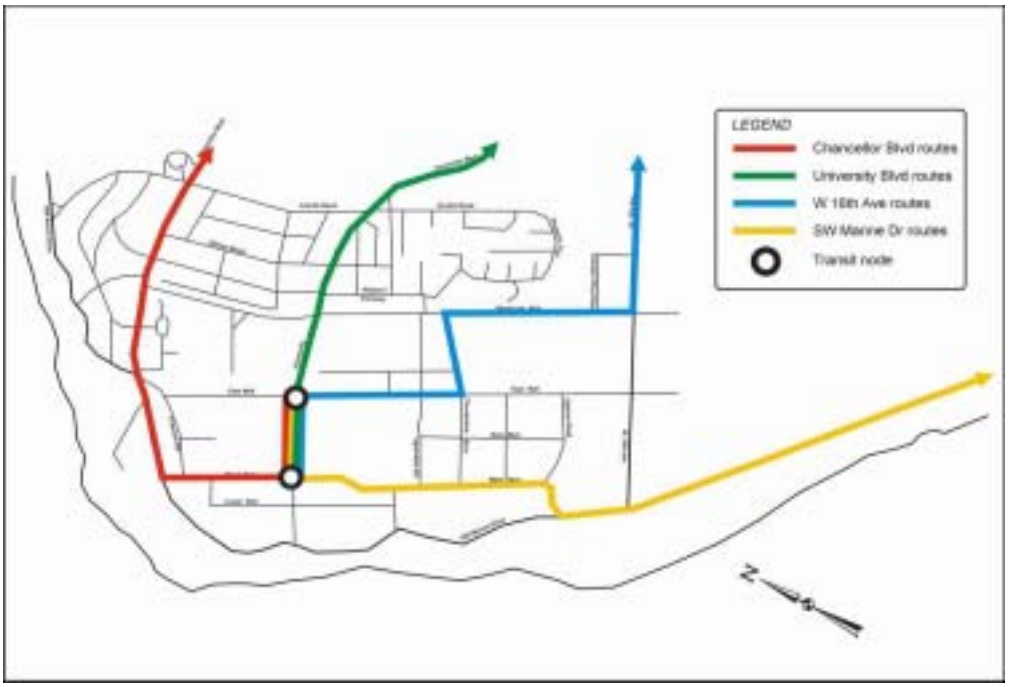
Figure 4.16: Concept 7 – Second Node at 16th / Wesbrook



Concept 8 — Second Node on University Boulevard

In this concept, one node is located on the site of or in the vicinity of the existing bus loop on University Boulevard. A second node is located on or in the vicinity of University Boulevard, near West Mall or Lower Mall. Half the regional routes would terminate at each node, serving the other node enroute. University Boulevard would be open to transit vehicles (and optionally to general traffic). Routes via 16th Avenue would access the eastern node via East Mall, to increase coverage.

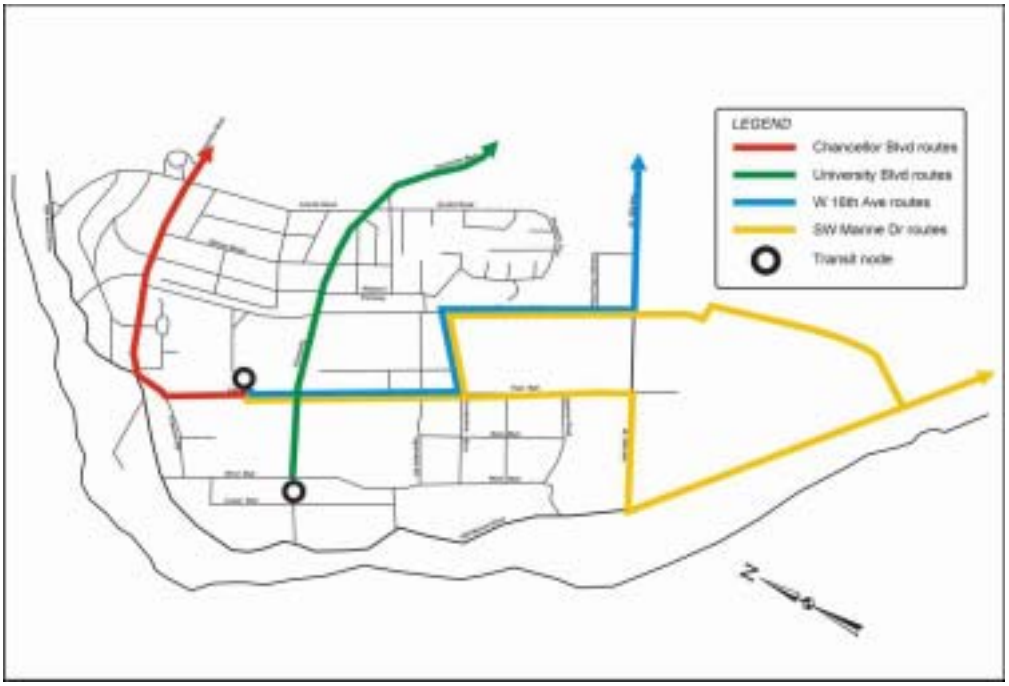
Figure 4.17: Concept 8 – Second Node on University Boulevard



Concept 9 — Nodes at SUB and University Boulevard West

In this concept, one node would be located on or in the vicinity of University Boulevard, near West Mall or Lower Mall. University Boulevard would be open to transit vehicles (and optionally to general traffic), and University Boulevard routes (including trolley routes) would terminate at this node. A second node would be located in the vicinity of the Student Union Building, with access via East Mall. All other bus routes would terminate at this node.

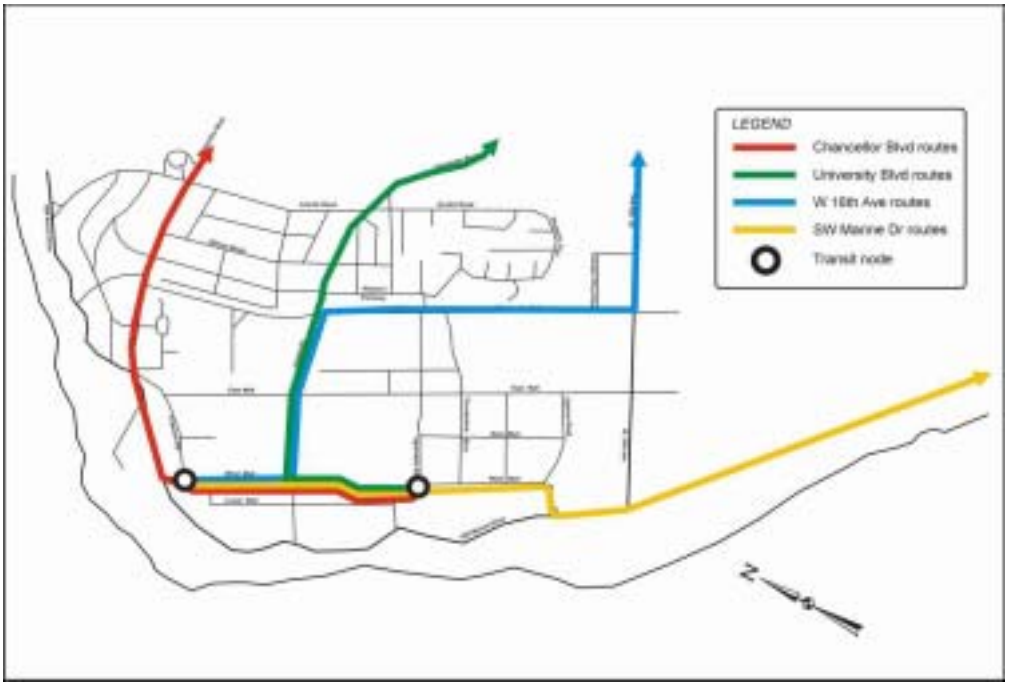
Figure 4.18: Concept 9 – Nodes at SUB and University Boulevard West



Concept 10 — Two Nodes on West Mall

In this concept, both nodes would be located on or in the vicinity of West Mall — one to the north of University Boulevard and one to the south. University Boulevard would be open to transit vehicles (and optionally to general traffic). University Boulevard and Chancellor Boulevard routes would terminate at the south node, and 16th Avenue and Marine Drive services would terminate at the north node.

Figure 4.19: Concept 10 – Two Nodes on West Mall



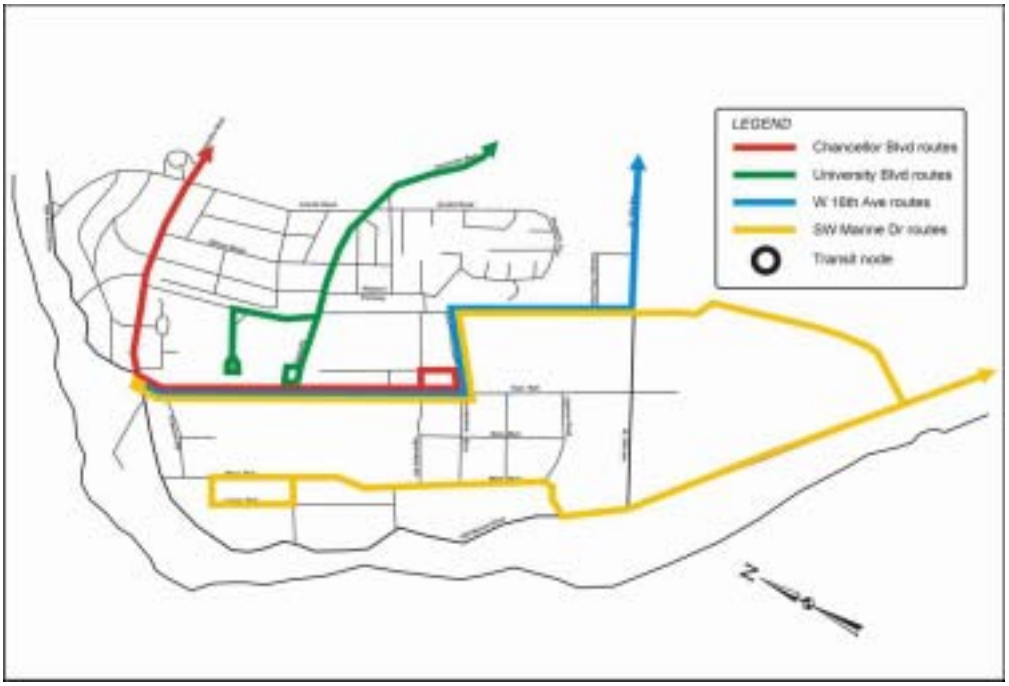
4.3 Multi-Node (Dispersed) Concepts

In these service concepts, there are no large nodes where several routes converge. Instead, buses on each route are accommodated at small nodes dispersed throughout the campus. It should be noted again that the nodes could consist of on-street or off-street layover facilities, or a combination of both.

Concept 11 — Most Buses on East Mall

In this concept, buses would use East Mall and West Mall, in addition to roads currently used by buses. On East Mall, routes would overlap between nodes in the vicinity of Gate 3 and Thunderbird Boulevard, in order to increase coverage and reduce walking distances. Trolley routes on University Boulevard would continue to terminate at a reconfigured node at the existing site, while University Boulevard routes served with diesel buses would terminate at a new node near the Student Union Boulevard. Some SW Marine Drive routes would serve West Mall, but not overlap with the other routes on East Mall.

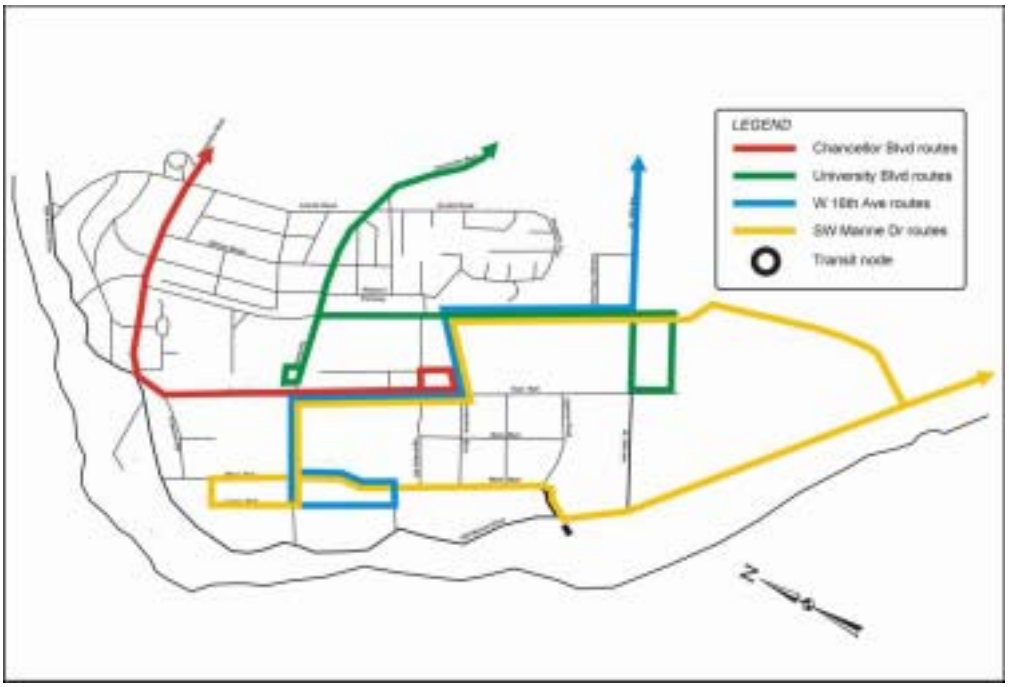
Figure 4.20: Concept 11 – Most Buses on East Mall



Concept 12 — University Boulevard Open To Buses

University Boulevard would be open to transit vehicles (and optionally to general traffic). University Boulevard routes served by trolley buses would continue to use the existing node at University Boulevard/East Mall, although the loop would be reduced in size. Diesel buses using University Boulevard to access campus would route via Wesbrook Mall and terminate at South Campus. Buses on other routes would use East Mall and West Mall. On East Mall, routes would overlap between University Boulevard and Thunderbird Boulevard, in order to increase coverage and reduce walking distances. The SW Marine Drive and W. 16th Avenue routes would terminate at small nodes in the vicinity of West Mall and University Boulevard.

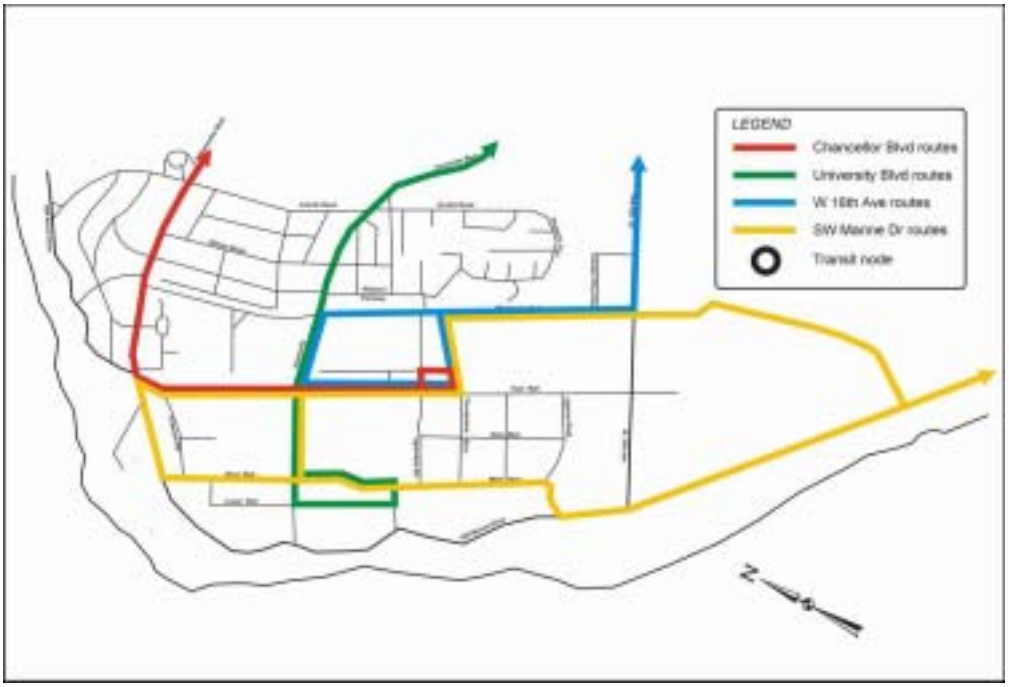
Figure 4.21: Concept 12 – University Boulevard Open to Buses



Concept 13 — Most Buses on University Boulevard

University Boulevard would be open to transit vehicles (and optionally to general traffic). All University Boulevard routes (including trolley routes) and 16th Avenue routes would use University Boulevard to terminate at nodes located on or in the vicinity of University Boulevard, near West Mall or Lower Mall. Some SW Marine Drive routes operating via West Mall would use University Boulevard to access nodes located in the vicinity of the Student Union Building. On East Mall, routes would overlap between Chancellor Boulevard and Thunderbird Boulevard, in order to increase coverage and reduce walking distances.

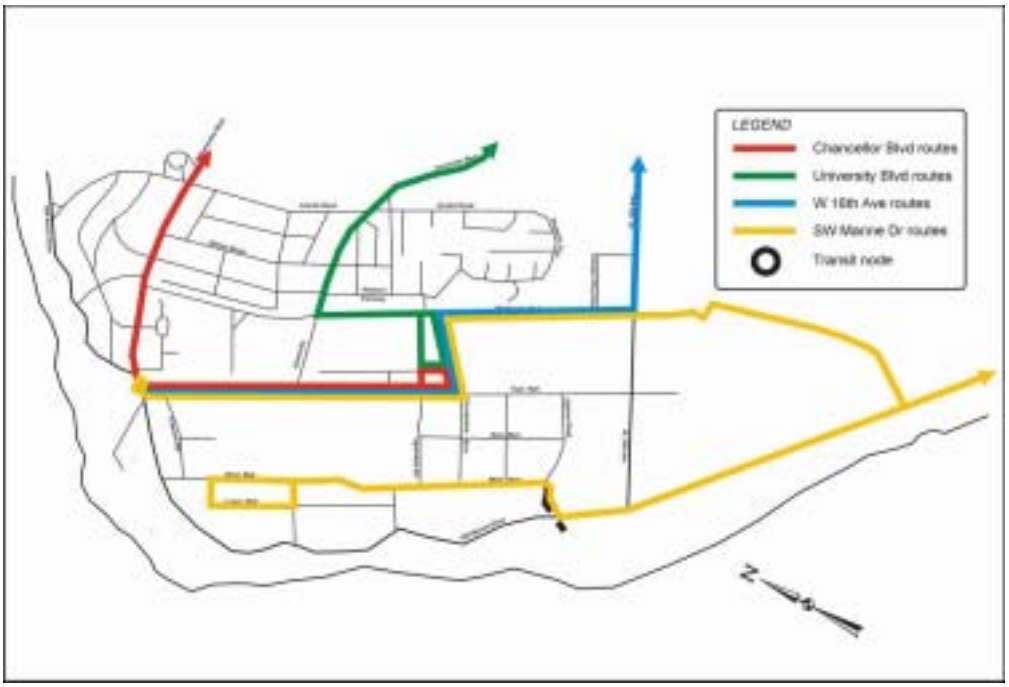
Figure 4.22: Concept 13 – Most Buses on University Boulevard



Concept 14 — No Buses on University Boulevard

In this concept, no routes would operate via University Boulevard. Buses would use East Mall, West Mall, and Thunderbird Boulevard, in addition to roads currently used by buses. On East Mall, routes would overlap between Chancellor Boulevard and Thunderbird Boulevard, in order to increase coverage and reduce walking distances. Some SW Marine Drive routes would operate along West Mall and terminate in the vicinity of the West Mall/University Boulevard intersection.

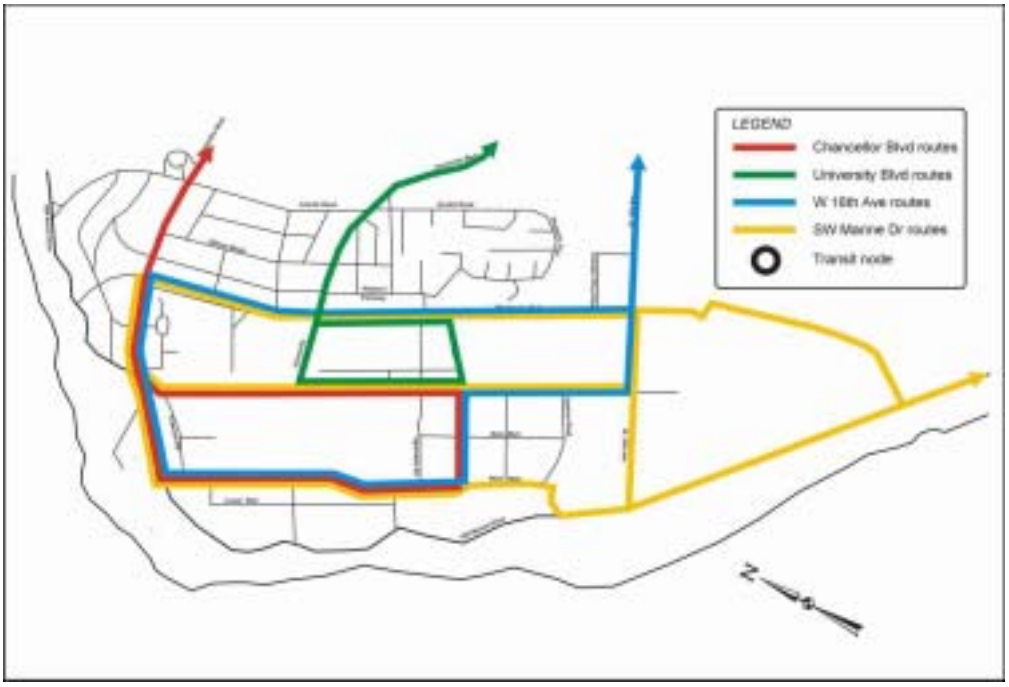
Figure 4.23: Concept 14 – No Buses on University Boulevard



Concept 15 — One-Way Loops Throughout Campus

In this concept, all routes would operate in one-way loops through campus, with nodes at points along each route. There would not be a node on University Boulevard, and only University Boulevard routes would operate on University Boulevard between Wesbrook Mall and East Mall. Buses would use East Mall, West Mall, and Thunderbird Boulevard, in addition to roads currently used by buses.

Figure 4.24: Concept 15 – One-way Loops Throughout Campus



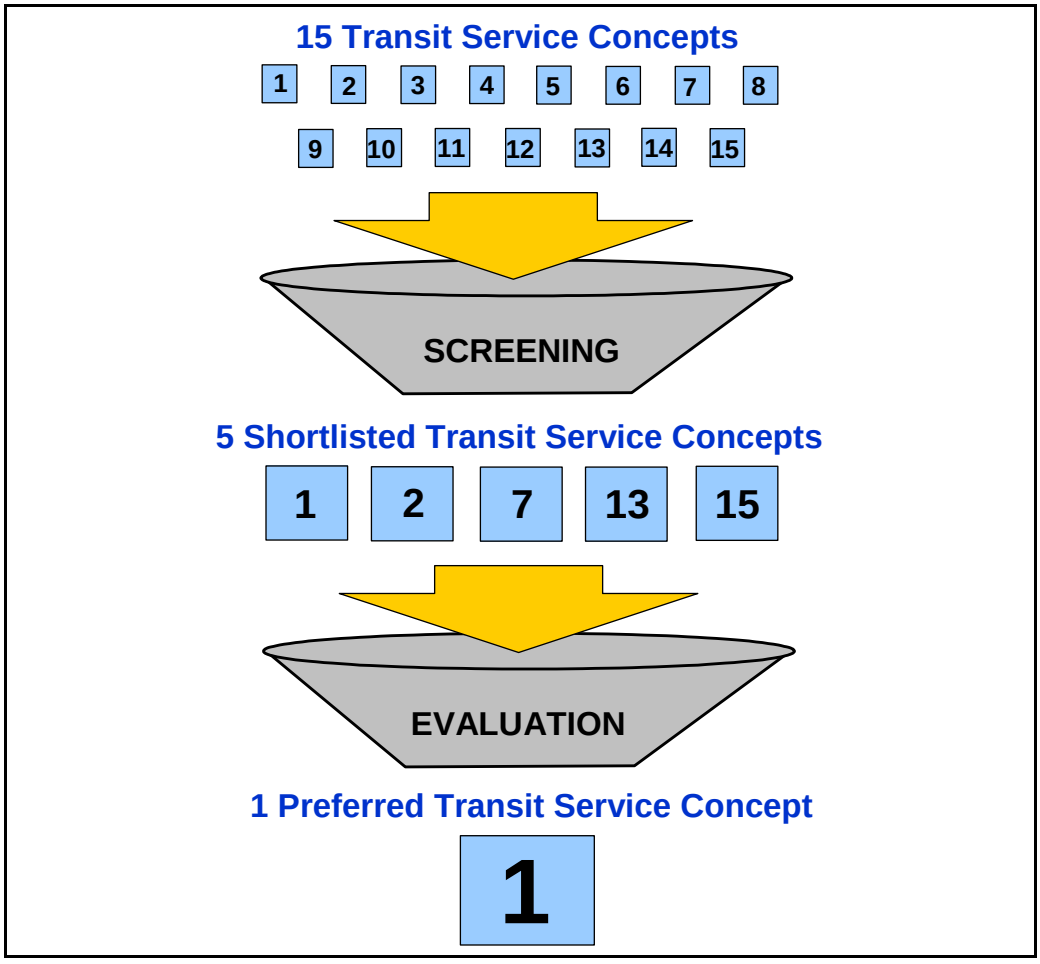
5.0 EVALUATION

As described in Section 4.0, a total of 15 transit service concepts were developed, representing a range of different ways in which the UBC campus could be served by transit. This section describes how those 15 service concepts were evaluated, and a single preferred concept identified.

5.1 Evaluation Process

A two-stage process was used to evaluate the transit service concepts. As illustrated in Figure 5.1, the first stage involved screening out 10 of the 15 concepts to reduce the number of concepts to five best "shortlisted" concepts. These five concepts were then refined to ensure operational feasibility and evaluated in detail in the second stage. Based on the results of the evaluation, a single preferred concept was identified. The first-stage screening process is described in Section 5.3, and the second-stage evaluation process is described in Section 5.4.

Figure 5.1: Evaluation Process



Considerable analysis was undertaken of existing and future conditions at UBC as part of the evaluation. The key tools used to conduct the analysis were VISSIM and emme/2, which are described below.

- **VISSIM** is a microscopic computer simulation model that generates a graphical simulation of vehicles on a road network, including buses, bicycles, pedestrians, trucks, and automobiles. In addition, the model allows the collection of analytical data, including travel times, vehicle and passenger delays, traffic volumes and speeds, and transit-specific delays. It allows for detailed modelling of transit operations through the modelling of bus-only facilities, transit stops, and layovers.

  For the Campus Transit Plan, a full 2.5-hour model of UBC campus was developed, including all major roadways from 16th Avenue northward and from Wesbrook Mall westward. Three corridors – University Boulevard, East Mall, West Mall – were modelled with additional detail, including bicycle lanes and crosswalks. The model was calibrated in two ways. First, existing operations around the University Boulevard/East Mall intersection were replicated in the model using travel time and queue length data observed in the field. This was completed to ensure that delays through the intersection associated with pedestrian, vehicle, and bus conflicts were accurate. As illustrated in the chart, the VISSIM model replicates actual conditions quite well. Figure 5.3, which shows similar observed and simulated views, also illustrates that VISSIM calibrates well against actual traffic conditions on University Boulevard. The second calibration method involved the comparison of simulated traffic volumes against observed counts to ensure that sufficient traffic was coded into the network.

  The calibrated model was subsequently used to simulate a range of potential future scenarios, including different options for the operation of the University Boulevard/East Mall intersection, which was identified as a key constraint in the campus network. More importantly, the five shortlisted transit service concepts were modelled for comparative evaluation purposes. The output used for evaluation included travel times and delays, a summary of which is included in Appendix B.

Figure 5.2: VISSIM Calibration Based on Queue Length

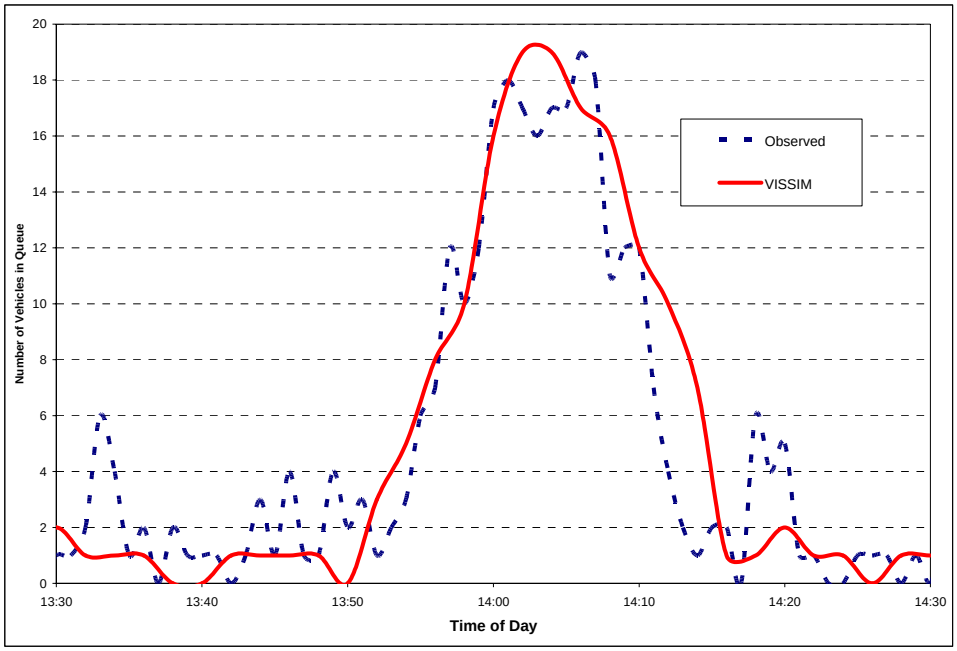


Figure 5.3: Observed and Simulated Congestion on University Boulevard

- **emme/2** is the foundation of the regional transportation model, which is used by all municipalities in the Lower Mainland, as well as TransLink, the GVRD, and Ministry of Transportation. The model uses region-wide demographic data (primarily population and employment) to forecast morning peak hour traffic and transit passenger volumes throughout the region based on a coded network of roadway facilities and transit routes. The model is used to forecast the impacts of transportation network improvements, land use (demographic) changes, and generalized transportation cost changes (such as increased parking charges and operating costs), among other factors. The results can generally only be used to estimate impacts at a broad scale, rather than at the scale of a specific transportation facility. For example, it can be used at UBC to estimate the impact of increased parking charges on total peak hour transit ridership to and from campus.

The regional model was updated and re-calibrated for this study to reflect 1997 and 2001 observed transit ridership. This update included modifications to parking charges on campus, demographic characteristics on campus (enrolment, employment, residential), road and transit networks to ensure accuracy, and vehicle operating costs and transit fares. The re-calibrated model was then used throughout the preparation of this study to generate ridership forecasts. Some of the model forecasts were previously described in Section 3.0. For example, the model was used to estimate the impact that U-Pass will have on transit ridership over the longer term.

For the evaluation of the five shortlisted service concepts described in this section, the model's mode split module was used in isolation. This was accomplished by adjusting the in-vehicle travel time and walking time within the model for each of the concepts. Adjustment of these factors using the mode split formulae indicated the impact that increased in-vehicle or walking time would have on overall ridership.

5.2 Evaluation Criteria

Reducing the 15 potential transit service concepts to a single preferred concept is a two-stage process. In the first stage, the screening criteria described below were applied in order to identify five preferred concepts for subsequent detailed evaluation. The results of the screening are described in Section 5.3. The preferred concepts are evaluated in Section 5.4, by applying the multiple account evaluation criteria described in this section.

5.2.1 Screening Criteria

The screening criteria summarized in Table 5.1 are intended to provide a measure of the general suitability, feasibility and effectiveness of each potential transit service concept. The intent is that these criteria identify concepts for which there are significant obstacles or disadvantages, which can be eliminated from consideration as a result, and to identify concepts with significant advantages, which can be considered as preferred concepts.

Table 5.1: Screening Criteria

Category	Criteria	Measure	Qualitative / Quantitative
Feasibility	Physical feasibility of constructing transit facilities	Availability of site (available land or redevelopment opportunity) of required size	Qualitative
Customer Service and Ridership Potential	Coverage of regional transit service within academic core	Proportion of built space (academic) within 100m, 200m, & 400m	Quantitative
	Coverage of regional transit service elsewhere on campus	Proportion of built space (non-academic) within 100m, 200m, & 400m	Quantitative
	Clarity of service	Ease of customer understanding of routes, connections and stop locations	Qualitative
	Support for 'internal' travel	Relative potential to accommodate 'internal' (on-campus) trips based on improved service coverage	Qualitative
	Potential ridership to/from campus	Relative potential ridership to/from campus based on above criteria	Qualitative
Community Benefits and Impacts	Land availability for transit exchange(s)	Quantity and availability of land for transit exchange(s) and layover facilities, including potential expansion	Qualitative
	Compatibility of routes with existing & planned land uses	Relative support or impact on existing & planned uses	Qualitative
Cost Implications	Travel distance for transit within Campus	Total transit travel distance within Campus	Quantitative
	New transit facilities	Cost for developing new transit facilities	Qualitative

5.2.2 Evaluation Criteria

The evaluation criteria described in Table 5.2 are used in a multiple account evaluation to assess all benefits and impacts associated with each preferred transit service concept at a more detailed level.

Table 5.2: Evaluation Criteria

Category	Criteria	Measure	Qualitative / Quantitative
Customer Service	Passenger travel time	Average walk time + in-bus travel time on campus	Quantitative
	Coverage	Regional bus coverage of campus	Qualitative
	Clarity of service	Ease of customer understanding routes, connections and stop locations	Qualitative
Safety	Conflicts with vulnerable road users	Potential conflicts with pedestrians and cyclists	Qualitative
	Traffic conflicts	Potential bus-motor vehicle conflicts	Qualitative
	Personal security	Issues associated with personal safety, visibility at night and access to assistance	Qualitative
Community	Land use	Property impacts of modifications to transit facilities and roadways	Qualitative
	Traffic and parking	Effects on traffic circulation and parking on campus	Qualitative
Environmental	Noise	Relative noise levels on campus	Qualitative
	Air quality	Relative bus emissions on campus	Qualitative
	Appearance	Visual impact of transit services on campus	Qualitative
Transit operations	Delays	Average round trip travel time	Quantitative
	Operations	Operational flexibility and issues	Qualitative
Ridership	'External' transit trips	Potential AM peak hour ridership entering and leaving campus	Quantitative
	'Internal' transit trips	Ability to accommodate internal campus travel	Qualitative
Cost	Total annual costs	Relative operating and capital costs (including annual operating, debt service, and amortized infrastructure costs)	Quantitative
Implementation	Transit facilities	Timing and ease of implementation	Qualitative
	Roadway changes and transit priority	Timing and ease of implementation	Qualitative

For each evaluation criterion, the concepts are assigned ratings based on a one to five scale, where one represents a poorer rating and five represents the highest rating. Based on the rating for each criterion, an overall rating for each evaluation category (customer service, safety, and so forth) is determined also using a one through five scale. These category ratings are then weighted according to Table 5.3 below.

Table 5.3: Category Weightings

Evaluation Category	Weighting
Customer service	4
Safety	4
Community	2
Environmental	2
Transit operations	2
Ridership	2
Cost	4
Implementation	1

The weightings reflect the relative importance of each evaluation category and tend to emphasize the differences between the concepts for those categories with high weightings. For example, customer service, safety, and cost are considered to be the most important categories for evaluation of the transit service concepts and are therefore assigned weightings of four. Lower weightings are used for the other categories, generally because there are smaller differences between the concepts for those categories and over-emphasizing those differences is not desirable. For example, a lower weighting was selected for the ridership category to reflect the fact that the range of ridership estimates generated for the shortlisted concepts is relatively small and is within the margin of error inherent in the emme/2 model used for the forecasts. For this reason, the "Ridership" category was not weighted as high as other categories in the evaluation, to avoid over-emphasizing the reliability and effect of the ridership forecasts.

The weighted ratings for each evaluation category are then added together to give a total 'score' for each service concept. These weighted scores are used to identify the overall preferred concept.

5.3 Screening

This section provides a summary of the screening of potential transit service concepts. Of the 15 concepts described in Section 4.0, five are identified as preferred concepts to be evaluated in detail. These preferred concepts are:

- **Concept 1** — A single-node concept that incorporates a transit node in the vicinity of the existing bus loop, and existing routes operating via Wesbrook Mall and University Boulevard between Wesbrook Mall and East Mall.

- **Concept 2** — A single-node concept that retains the transit node in the vicinity of the existing bus loop, but re-routes some services via East Mall. Concept 3, which included bus services on University Boulevard between West Mall and East Mall had a similar screening result, but was not selected because of its similarity to Concept 2.

- **Concept 7** — A dual-node concept with one node in the vicinity of the existing bus loop, and the second in the vicinity of the 16th Avenue/Wesbrook Mall intersection. Buses would be routed along East Mall, Wesbrook Mall and University Boulevard.

- **Concept 13** — A dispersed concept, with University Boulevard and 16th Avenue routes operating through campus via University Boulevard, and other routes operating through campus via East Mall and West Mall. In this concept, University Boulevard would be open to transit buses (and optionally to general traffic) between East Mall and West Mall.

- **Concept 15** – A dispersed concept with all routes operating in one-way loops within the campus. North-south service would be focussed on West Mall, East Mall, and Wesbrook Mall. Bus routes would terminate at many locations throughout campus.

Table 5.4 on the following page summarizes how each of the 15 potential service concepts were screened according to the various criteria described in Section 5.2.1. Concepts with at least one red 'x' in the left side of the table were identified as having at least one characteristic considered to be poor in relation to the other concepts. These concepts are therefore not carried forward for detailed evaluation.

Those concepts that do not have one or more relatively poor characteristics are screened in the right side of the table based on the desire to evaluate a wide range of concepts and design attributes (routings). For example, at least one concept from each of the three categories (single node, dual nodes, multiple nodes) is selected. Additionally, the evaluation includes one concept that provides service along University Boulevard between East Mall and West Mall. Other design attributes that were considered include service coverage on Wesbrook Mall and East Mall. The five concepts to be carried forward to detailed evaluation represent a range of these attributes.

Table 5.4: Screening of Transit Service Concepts

Concept	Customer Service		Community Benefits/Impacts		Cost Implications		Evaluation Factors					
	Coverage of Academic Core	Coverage of Remainder of Campus	Compatibility with Land Uses	Land Available for Transit Facilities	Travel Distance and Time	New Transit Facilities	Single Node	Dual Nodes	Multiple Nodes	University Blvd Open to Buses (East Mall to West Mall)	Regional Bus Service on Wesbrook Mall N of University Blvd	Regional Bus Service on East Mall N of University Blvd
1							✓				✓	
2							✓					✓
3							✓			✓		✓
4		✗										
5				✗		✗						
6	✗											
7								✓				✓
8		✗	✗									
9				✗		✗						
10		✗				✗						
11	✗		✗									
12	✗											
13								✓		✓		✓
14	✗											
15								✓			✓	✓

The following discussion identifies the concepts that have been screened from further evaluation and why:

- **Concept 3** – This option does not have any 'poor' characteristics in relation to the other concepts, but was eliminated because it is very similar to Concept 2. To maintain the number of concepts to be evaluated within a manageable range, and to ensure that a representative range of concepts are evaluated, this concept was eliminated.

- **Concept 4** – This concept was eliminated because it does not provide adequate coverage to areas of the campus beyond the academic core. In particular, there would be very little service to and from South Campus with this concept.

- **Concept 5** – This concept was eliminated because of the difficulties associated with developing a new bus loop in the vicinity of the Student Union Building. Construction of a loop at this location would require the removal of a mature grove of trees and elimination of a large pedestrian area of campus. In addition, the cost of developing a new bus loop at this location is estimated to be significantly higher than elsewhere on campus.

- **Concept 6** – Relative to other concepts, this concept would provide very little coverage of the academic core with transit service, and walking distances to the relocated bus loop would be much higher from many parts of campus than they are today. For these reasons, this concept was eliminated from further evaluation.

- **Concept 8** – This concept would provide relatively poor service coverage to areas of campus outside the academic core, with Wesbrook Mall and South Campus accommodating very little transit service. In addition, the construction of a new, relatively large, bus loop around the University Boulevard/West Mall intersection is considered incompatible with surrounding academic and administrative campus buildings.

- **Concept 9** – This concept was eliminated because of the extent of new transit facilities required to accommodate it. Two new bus loops would be required, one of which would require removal of mature trees, and one of which would be located in an academic area of campus. The cost of constructing two relatively large bus loops is also considered high.

- **Concept 10** – This concept would require construction of two new bus loops in central locations on campus, which would be costly. In addition, the concept provides relatively poor coverage to areas outside the academic core, such as East Mall and South Campus.

- **Concept 11** – In this concept, many of the core University Boulevard bus routes would be relocated to Student Union Boulevard, increasing walking distances for many riders. In addition, service coverage to the west of East Mall would remain relatively poor. Because of this relatively poor coverage of the academic core, this concept was eliminated from further evaluation.

- **Concept 12** – Similar to the preceding concept, Concept 12 was eliminated because it provides relatively poor coverage to the academic core. Most importantly, the core University Boulevard routes would be removed from central campus and re-routed along Wesbrook Mall to South Campus. This would increase walking distances for many users. The academic core would instead be served by the less frequent routes that access campus along SW Marine Drive and W. 16th Avenue.

- **Concept 14** – This concept would re-route all University Boulevard routes to Wesbrook Mall and Thunderbird Boulevard, increasing walking distances for most transit riders or imposing transfers on those wishing to minimize their walking distance. In addition, coverage to the west of East Mall would remain relatively poor with this concept, with only a few routes serving West Mall.

5.4 Evaluation

As described previously, five transit service concepts were shortlisted in the screening process. Following the screening process, these concepts were refined to account for land use constraints (ability to accommodate layover facilities, conflicts with adjacent buildings), operational considerations (such as routing, turnarounds, and bus stop locations), and ongoing development planning initiatives to ensure that feasible solutions are evaluated. This section describes the evaluation process, and the results of the evaluation.

5.4.1 Shortlisted Service Concepts

The five shortlisted transit service concepts are illustrated in Figure 5.4 through Figure 5.8. Each of these illustrations identifies:

- **Regional bus routes** are indicated in four colours. A separate colour is used for each group of routes determined by which road is used to reach the UBC campus. It is important to note that there are no changes to regional bus routes beyond the UBC campus, east of Wesbrook Mall.

- **Community Shuttle routes** are illustrated conceptually with coloured, dashed lines. Each concept includes coverage of the campus with Community Shuttle services. Concepts in which regional bus routes are extended through the campus require a lower level of Community Shuttle

service than Concept 1, where regional bus routes remain the same as at present.

- **Transit facilities** are indicated on each concept. In total, it will be necessary to provide layover facilities for up to 40 buses on campus in the future.

- **Regional bus stops.** Changes to existing bus stops and new bus stops for regional bus services are indicated for each concept. Many of the changes to existing bus stops involve extending the length of the bus zone to accommodate two or more buses at once.

- **Roadway changes** are indicated where these are necessary to accommodate buses or to avoid operational problems. The most significant roadway change is the restriction of access to East Mall to transit buses only during weekday daytime periods, in all concepts except Concept 1. This is necessary to avoid significant congestion and delays on East Mall.

Figure 5.4: Shortlisted Concept 1

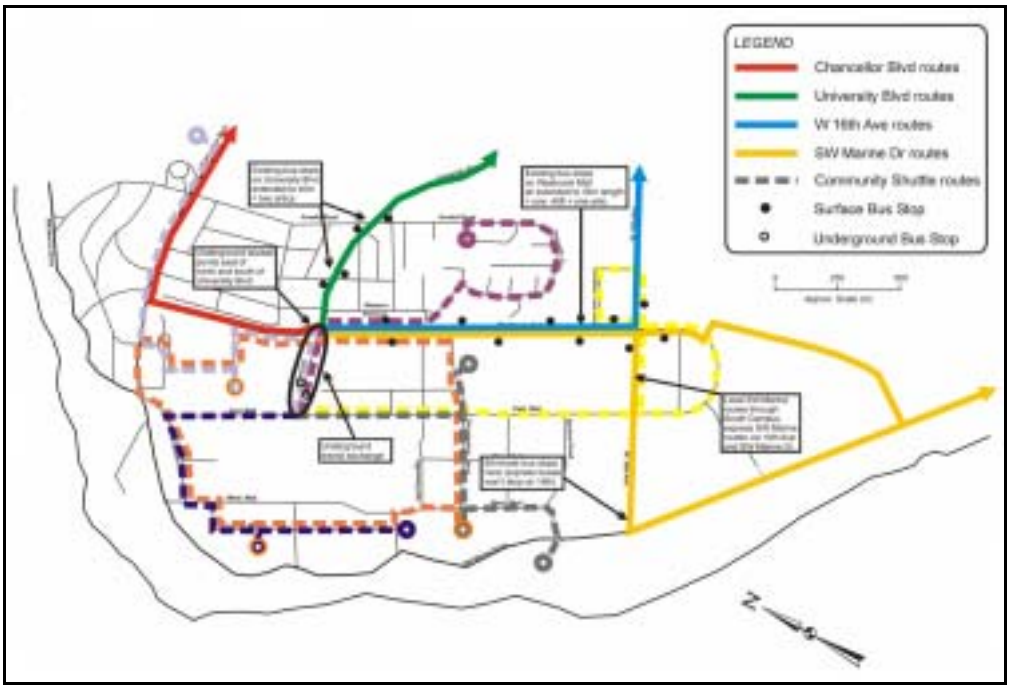


Figure 5.5: Shortlisted Concept 2

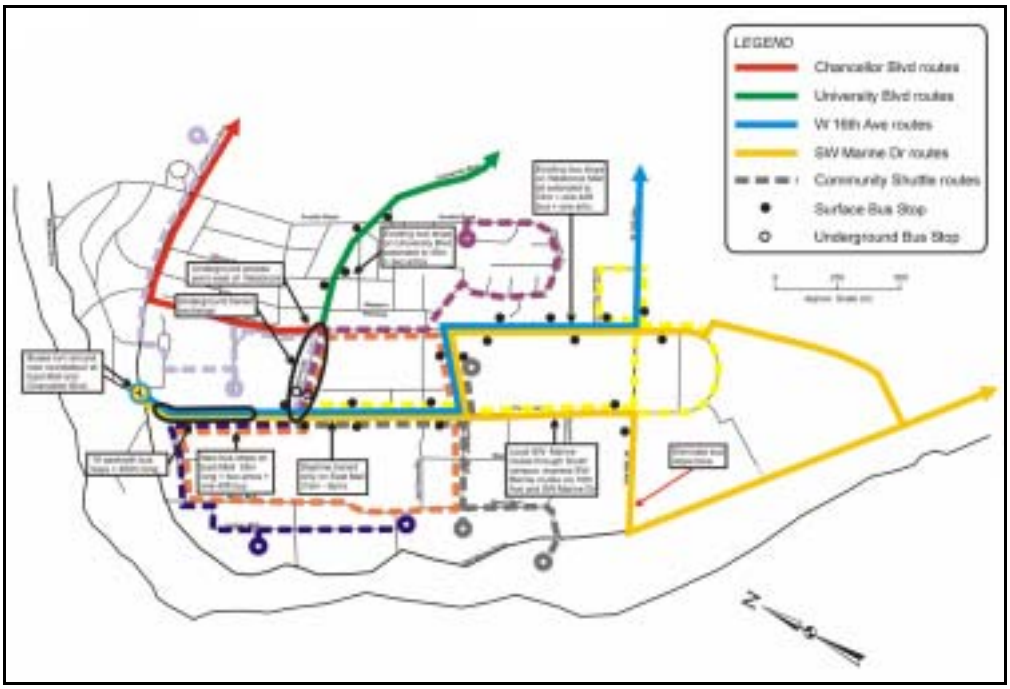


Figure 5.6: Shortlisted Concept 7

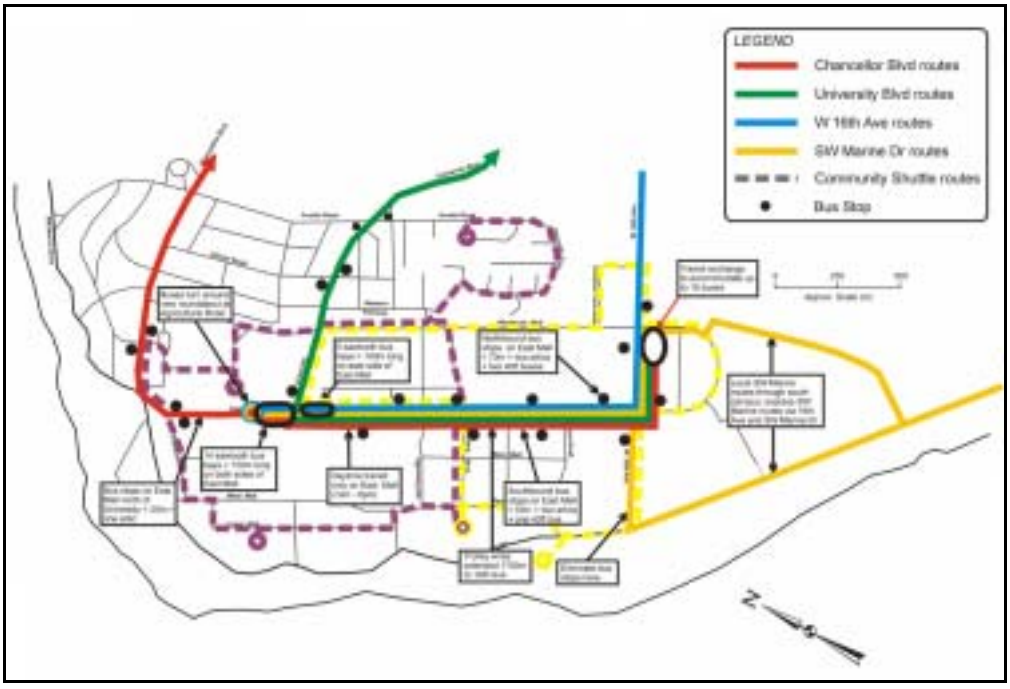


Figure 5.7: Shortlisted Concept 13

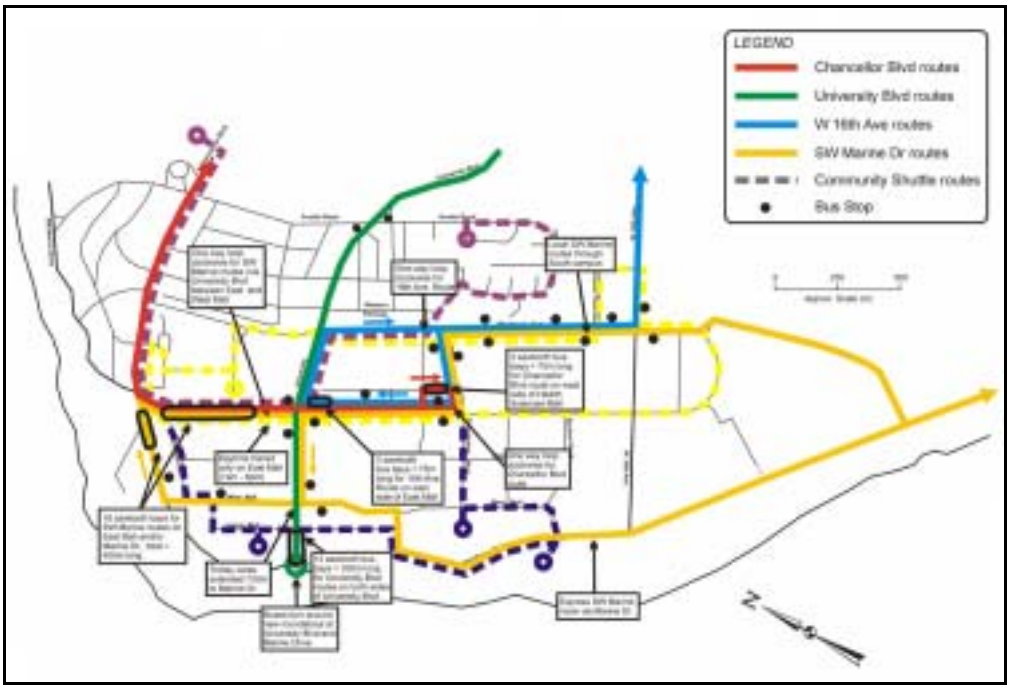
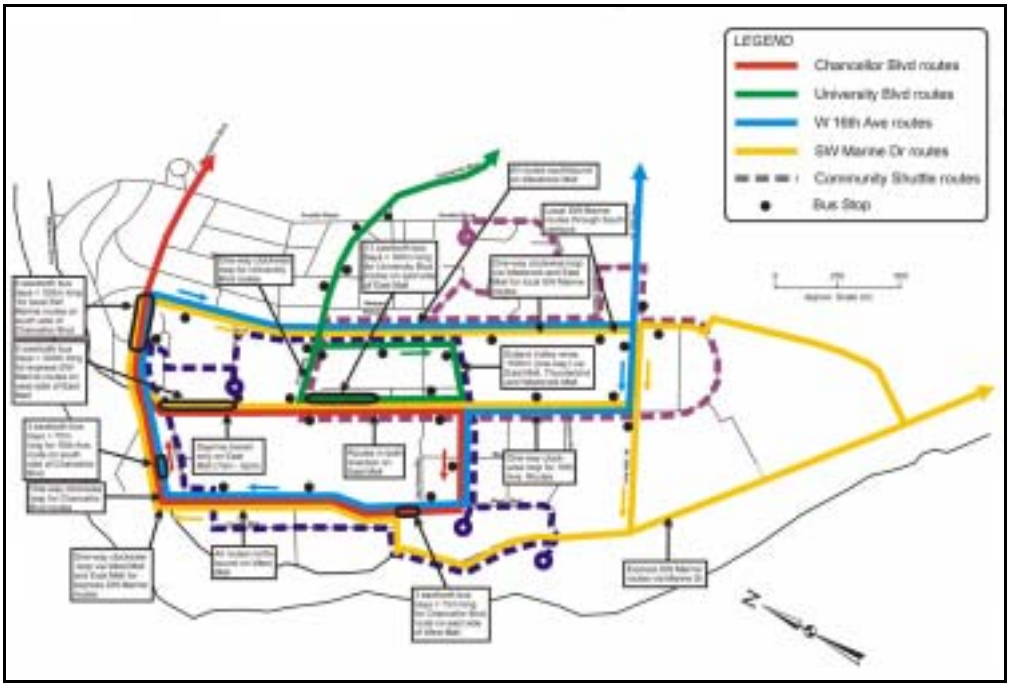


Figure 5.8: Shortlisted Concept 15



5.4.2 Evaluation Results

The results of the evaluation are summarized in Table 5.5 and Table 5.6, and are discussed in detail in this section. Summary results from the micro-simulation model are included in Appendix B and an evaluation summary for

each shortlisted concept is included in Appendix C. Concept 1 is the preferred transit service concept. As indicated in Table 5.5, it has a total score of 78, which is 25% higher than the scores for the two second-place concepts.

Table 5.5: Evaluation Summary – Numerical

Category	Weight	Concept				
		1	**2**	**7**	**13**	**15**
Customer service	4	**1**	3	4	4	3
Safety	4	**5**	3	3	2	2
Community	2	**5**	3	1	2	2
Environmental	2	**5**	3	1	1	1
Transit Operations	2	**5**	3	1	2	4
Ridership	2	**1**	3	5	4	4
Cost	4	**5**	3	1	1	4
Implementation	1	**2**	2	2	5	5
Totals		**78**	62	50	51	63
Ranking		**1st**	2nd	3rd	3rd	2nd

Individual scores reflect a comparative evaluation of each concept relative to other concepts, on a scale of 1 (worst) to 5 (best)

Table 5.6: Evaluation Summary — Symbolic

Category	Concept				
	1	**2**	**7**	**13**	**15**
Customer service	○	◓	●	●	◓
Safety	●	◒	◒	●	●
Community	●	◒	●	●	●
Environmental	●	◒	●	●	●
Transit Operations	●	◒	●	●	◒
Ridership	○	◓	◓	◓	◓
Cost	◓	○	●	●	○
Implementation	◒	◒	◒	●	●
Overall	●	○	●	●	○

Comparison with Existing

● Better ◓ ○ Neutral ◒ ● Worse

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June 2003

The evaluation is based on a scoring system using a scale of one to five, where one is the lowest score and five is the highest. In the evaluation summary in Table 5.5, each concept was assigned a score that reflects how it compares to other concepts. For example, Concept 1 was assigned a score of five in the "Cost" category, because it has the lowest annualized cost of the five concepts. Concepts 7 and 13 have the highest annualized costs, and consequently were each assigned a score of one in the "Cost" category. It is important to note that the one-to-five scale does not indicate the magnitudes of the differences between concepts — for some criteria, the difference between the lowest-scored and highest-scored concept is greater than for other criteria.

It should be noted that the final evaluation results presented in Table 5.5 have been revised slightly from those presented at the community open house on April, 2003. These revisions reflect updated estimates of the cost of constructing the below-grade transit stations in Concepts 1 and 2, as well as revisions to the methodology used to asses "Transit Operations" issues. The overall results of the evaluation are unchanged from the results presented at the open house.

Table 5.6 presents the evaluation results using symbols rather than numbers. The symbols indicate how each concept compares to existing conditions. Green circles indicate that a concept is better than existing conditions, and red circles indicate that it is worse than existing conditions. An open black circle (O) indicates that a concept does not represent a significant change from existing conditions. For example, Concept 1 was assigned an open circle in the "Customer Service" category, because regional bus routes and the location of the transit station are the same as at present. Other concepts were assigned green circles in the "Customer Service" category because these concepts improve coverage of the campus and reduce on-campus travel times as compared with existing conditions.

Table 5.7 through Table 5.11 provide a detailed summary of the evaluation of each transit service concept. All criteria are evaluated in comparison to the same criteria for other concepts. The evaluation is based on a scale of one through five, where one is the lowest score and five is the highest. Quantitative values are included for those criteria that could be measured or estimated, such as passenger walk times and bus travel times on campus, delays to buses, ridership and costs. These quantitative values reflect forecast 2011 conditions. Costs are in 2003 dollars.

Table 5.7: Evaluation of Concept 1

Criteria	Measure	Value	Scores	
Customer service				
Passenger travel time	Average walk + in-bus travel time	6.9+3.2 min	1	**1**
Coverage	Regional bus coverage of campus		1	
Clarity of service	Ease of understanding routes		5	
Safety				
Conflicts	Potential conflicts with peds and cyclists		5	**5**
Traffic conflicts	Potential bus–motor vehicle conflicts		5	
Personal security	Personal safety and access to assistance		5	
Community				
Land use	Sites affected by bus routes and facilities		5	**5**
Traffic and parking	Effects on circulation and parking		5	
Environmental				
Noise	Change in noise levels on campus		5	**5**
Air quality	Change in bus emissions on campus		5	
Appearance	Visual benefits and impacts		5	
Transit operations				
Delays	Average round trip travel time	13.5 min	5	**5**
Operations	Scheduling and operational flexibility		5	
Ridership				
"External" trips	AM peak hour ridership to/from UBC	4250 trips	1	**1**
"Internal" trips	Ability to accommodate internal trips		1	
Cost				**5**
Cost	Total annualized costs	$10.6 M	5	
Implementation				
Transit facilities	Timing and ease of implementation		2	**2**
Roadway changes and transit priority	Timing and ease of implementation		2	

Note: Individual scores reflect a comparative evaluation of each criterion relative to other concepts, on a scale of 1 (worst) to 5 (best)

Table 5.8: Evaluation of Concept 2

Criteria	Measure	Value	Scores	
Customer service				
Passenger travel time	Average walk + in-bus travel time	6.0+4.0 min	2	**3**
Coverage	Regional bus coverage of campus		3	
Clarity of service	Ease of understanding routes		3	
Safety				
Conflicts	Potential conflicts with peds and cyclists		3	**3**
Traffic conflicts	Potential bus–motor vehicle conflicts		3	
Personal security	Personal safety and access to assistance		4	
Community				
Land use	Sites affected by bus routes and facilities		3	**3**
Traffic and parking	Effects on circulation and parking		3	
Environmental				
Noise	Change in noise levels on campus		3	**3**
Air quality	Change in bus emissions on campus		4	
Appearance	Visual benefits and impacts		3	
Transit operations				
Delays	Average round trip travel time	17.3 min	4	**3**
Operations	Scheduling and operational flexibility		1	
Ridership				
"External" trips	AM peak hour ridership to/from UBC	4400 trips	3	**3**
"Internal" trips	Ability to accommodate internal trips		2	
Cost				**3**
Cost	Total annualized costs	$12.0 M	3	
Implementation				
Transit facilities	Timing and ease of implementation		1	**2**
Roadway changes and transit priority	Timing and ease of implementation		2	

Note: Individual scores reflect a comparative evaluation of each criterion relative to other concepts, on a scale of 1 (worst) to 5 (best)

UBC Campus Transit Plan

Table 5.9: Evaluation of Concept 7

Criteria	Measure	Value	Scores	
Customer service				
Passenger travel time	Average walk + in-bus travel time	5.2+4.9 min	3	**4**
Coverage	Regional bus coverage of campus		4	
Clarity of service	Ease of understanding routes		4	
Safety				
Conflicts	Potential conflicts with peds and cyclists		3	**3**
Traffic conflicts	Potential bus–motor vehicle conflicts		2	
Personal security	Personal safety and access to assistance		3	
Community				
Land use	Sites affected by bus routes and facilities		1	**1**
Traffic and parking	Effects on circulation and parking		2	
Environmental				
Noise	Change in noise levels on campus		1	**1**
Air quality	Change in bus emissions on campus		2	
Appearance	Visual benefits and impacts		1	
Transit operations				
Delays	Average round trip travel time	22.2 min	1	**1**
Operations	Scheduling and operational flexibility		2	
Ridership				
"External" trips	AM peak hour ridership to/from UBC	4550 trips	5	**5**
"Internal" trips	Ability to accommodate internal trips		5	
Cost				**1**
Cost	Total annualized costs	$13.4 M	1	
Implementation				
Transit facilities	Timing and ease of implementation		3	**2**
Roadway changes and transit priority	Timing and ease of implementation		1	

Note: Individual scores reflect a comparative evaluation of each criterion relative to other concepts, on a scale of 1 (worst) to 5 (best)

UBC Campus Transit Plan

Table 5.10: Evaluation of Concept 13

Criteria	Measure	Value	Scores	
Customer service				
Passenger travel time	Average walk + in-bus travel time	5.0+4.8 min	5	4
Coverage	Regional bus coverage of campus		4	
Clarity of service	Ease of understanding routes		2	
Safety				
Conflicts	Potential conflicts with peds and cyclists		2	2
Traffic conflicts	Potential bus–motor vehicle conflicts		1	
Personal security	Personal safety and access to assistance		2	
Community				
Land use	Sites affected by bus routes and facilities		3	2
Traffic and parking	Effects on circulation and parking		2	
Environmental				
Noise	Change in noise levels on campus		1	1
Air quality	Change in bus emissions on campus		2	
Appearance	Visual benefits and impacts		1	
Transit operations				
Delays	Average round trip travel time	22.2 min	1	2
Operations	Scheduling and operational flexibility		4	
Ridership				
"External" trips	AM peak hour ridership to/from UBC	4550 trips	5	4
"Internal" trips	Ability to accommodate internal trips		3	
Cost				1
Cost	Total annualized costs	$13.2 M	1	
Implementation				
Transit facilities	Timing and ease of implementation		5	5
Roadway changes and transit priority	Timing and ease of implementation		4	

Note: Individual scores reflect a comparative evaluation of each criterion relative to other concepts, on a scale of 1 (worst) to 5 (best)

Table 5.11: Evaluation of Concept 15

Criteria	Measure	Value	Scores	
Customer service				
Passenger travel time	Average walk + in-bus travel time	5.9+3.8 min	3	**3**
Coverage	Regional bus coverage of campus		5	
Clarity of service	Ease of understanding routes		1	
Safety				
Conflicts	Potential conflicts with peds and cyclists		1	**2**
Traffic conflicts	Potential bus–motor vehicle conflicts		3	
Personal security	Personal safety and access to assistance		1	
Community				
Land use	Sites affected by bus routes and facilities		3	**2**
Traffic and parking	Effects on circulation and parking		1	
Environmental				
Noise	Change in noise levels on campus		1	**1**
Air quality	Change in bus emissions on campus		1	
Appearance	Visual benefits and impacts		2	
Transit operations				
Delays	Average round trip travel time	18.4 min	3	**4**
Operations	Scheduling and operational flexibility		4	
Ridership				
"External" trips	AM peak hour ridership to/from UBC	4400 trips	3	**4**
"Internal" trips	Ability to accommodate internal trips		4	
Cost				**4**
Cost	Total annualized costs	$11.0 M	4	
Implementation				
Transit facilities	Timing and ease of implementation		5	**5**
Roadway changes and transit priority	Timing and ease of implementation		5	

Note: Individual scores reflect a comparative evaluation of each criterion relative to other concepts, on a scale of 1 (worst) to 5 (best)

The key results of the evaluation are discussed below.

- **Passenger travel time** is one measure of "Customer Service." Table 5.12 provides a summary of the average calculated travel times on campus for each concept. These times are comprised of the amount of time it takes a person to walk to or from the nearest bus stop, plus the travel time in a bus on campus. Average bus travel times were determined from VISSIM simulations of each transit service concept, as described in Section 5.1. Wait times were not included, as the amount of time a passenger would spend waiting for a particular bus would be the same in all concepts. In some concepts where there are several transit routes at the same node — particularly Concept 1 — the average wait time would be

lower for some passengers who have a choice of two or more routes and could choose the first bus to depart.

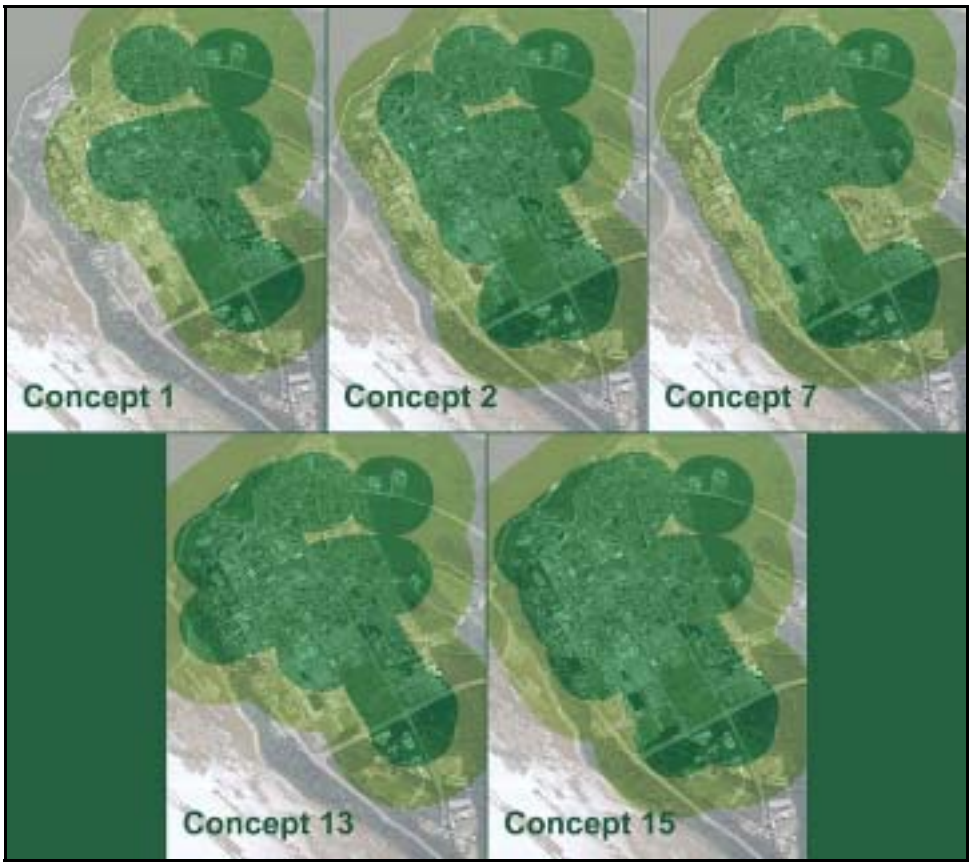
Table 5.12: Passenger Travel Times

Concept	Average Walk Time (min)		Average In-Bus Travel Time (min)		Average Total Travel Time on Campus (min)
1	6.9	+	3.2	=	10.1
2	6.0	+	4.0	=	10.0
7	5.2	+	4.9	=	10.1
13	5.0	+	4.8	=	9.8
15	5.9	+	3.8	=	9.7

Although walk and in-bus travel times vary significantly between concepts, the total travel times are almost the same — there is a difference of only 0.4 minutes between the longest travel time of 10.1 minutes for Concept 1 and the shortest travel time of 9.7 minutes for Concept 15. This is because the higher walk times in Concept 1 are largely negated by the lower in-bus travel times.

- **Coverage** is another important component of the "Customer Service" category. Figure 5.9 illustrates the coverage of campus for each concept, based on walking distances of 400 m and 800 m to the nearest transit node or bus stop. Concept 1 was assigned a score of 1 as coverage of campus is lowest for Concept 1. Concept 15 was assigned a score of 5 to reflect the highest coverage of campus.

Figure 5.9: Regional Bus Coverage of Campus
(does not illustrate coverage of Community Shuttle services)



It is important to note that a higher level of coverage does not equate directly with better transit service or reduced walking distances to transit. Concept 15 has the highest level of coverage, but because each bus follows a different route through campus, not all routes serve all parts of campus. For example, a person at the Chan Centre would have a choice of several different routes very close to the Chan Centre on East Mall and on Marine Drive. However, if this person wished to use Route 99, he or she would either board a bus at the Chan Centre, travel to University Boulevard and transfer to a Route 99 bus, or walk to the University Boulevard/East Mall intersection. Even though the coverage of campus is greatest with Concept 15, the additional coverage of campus does not provide as great a benefit for the transit passenger in the above example as for other passengers.

- **Clarity of service** is another measure of "Customer Service," and indicates how easy it would be for transit users to understand the regional bus and Community Shuttle routes and schedules on campus. Concept 1 was assigned a score of five, as this would be the simplest service concept for transit passengers to understand. All that most passengers would need to know is to walk to the transit station at the University Boulevard/East

Mall intersection. On the other hand, Concept 15 was assigned a score of 1, indicating that it would be the most difficult service concept for passengers to understand, due to the complexity of routes. Not only do different routes operate along different roads on campus, but in Concept 15 buses follow one-way loops, which means that a bus arriving on campus operates along a different road than when it leaves campus.

- **Conflicts** are a measure of "Safety." Each option was evaluated with respect to the potential for conflicts with other road users on campus — pedestrians, cyclists and motorists. Concept 1 was assigned a score of five, indicating that it has the lowest potential for conflicts. This is because buses would only operate at-grade along Wesbrook Mall and 16th Avenue, and would be below grade on University Boulevard where there are greater numbers of pedestrians and cyclists. Concepts in which buses are routed through campus — particularly along University Boulevard and East Mall, where there are the highest concentrations of pedestrians and cyclists — were assigned the lowest scores.

- **Personal security** is another measure of the "Safety" of each concept. This criterion reflects the real and perceived exposure to an assault, and access to assistance in the event of a threat. This is particularly a concern for persons travelling alone at night, when there are far less people on campus and visibility is reduced.

  Concept 1 was assigned a score of five, as it provides the highest level of personal security. The below-grade transit station would be secure, well-illuminated and patrolled by security staff, and would be located in the centre of campus where there would be a relatively high level of activity. In comparison, Concept 15 was assigned the lowest score of one, because many transit passengers would wait for buses at locations in more remote areas of campus with lower numbers of pedestrians and less on-street activity.

- **Land use** implications are a measure of the effects of each concept on the UBC "Community." Concept 1 was assigned the highest score of five as it would not negatively affect existing land uses on campus or future development. Other concepts would involve layover facilities adjacent existing buildings (such as on East Mall adjacent the Wesbrook Building and adjacent the Buchanan Building), and future development sites such as the B1 lot, the Theological Precinct and the future commercial centre at the 16th Avenue/Wesbrook Mall intersection.

- **Traffic circulation and parking** is another measure of the "Community" implications of each concept. Concept 1 was assigned a score of five as it would have no significant effect on traffic circulation and parking. Other concepts were assigned lower scores as they would affect traffic circulation and parking due to restrictions on access to East

Mall during weekday daytime, and layover facilities that would affect access to existing and proposed new parking facilities.

- **Noise** is an important "Environmental" consideration, which in this case refers to the noise created by buses travelling through campus. It is important to note that, for the purposes of the evaluation, it was assumed that bus routes on which diesel buses currently operate would continue to be served by diesel buses for at least 10 to 15 years. Converting these routes to quieter trolley buses would not be an option — the cost would be in the hundreds of millions of dollars, as every bus along the entire route would have to be replaced by a trolley bus, and trolley overhead wires and electrical substations would have to be installed along the entire route. Hybrid and fuel cell buses are promising technologies that have not yet been developed to the point where they can be used as alternatives to diesel buses. TransLink is interested in these new bus technologies, but has not made specific commitments to purchase them, as they are not yet proven in the transit market. Because the average age of a bus is 20 years, even when TransLink begins purchasing fuel cell or hybrid buses, it will take 20 years to fully replace the diesel buses in the fleet. Consequently, for at least 10 to 15 years, the majority of regional bus routes at UBC will continue to be served by diesel buses.

  Concept 1 was assigned a score of five because it has least amount of regional bus routes through campus, and because buses would be below-grade on University Boulevard. In comparison, Concepts 7, 13 and 15 were assigned scores of one, because each would involve routing regional buses through campus, where the noise of buses would affect academic and other uses. Concept 2 was assigned a score of three because half the buses would be rerouted through campus, and half would be in a below-grade transit station.

- **Air quality** is another important "Environmental" consideration. Scores for this criterion reflect the lengths of routes on campus — the more a diesel bus travels though the campus, the more pollution it emits. Concept 1 was assigned a score of five, as the length of regional bus routes through campus is shortest. Concept 15 has the greatest length of regional bus routes through campus, and was therefore assigned a score of one.

- **Appearance and aesthetics** is another measure of the "Environmental" implications of each concept. The highest score of five was assigned to Concept 1, as all transit facilities would be located below grade on University Boulevard, and there would be no other new transit facilities on campus. In comparison, Concepts 7 and 13 were assigned the lowest score of one, as these concepts would involve several new and substantial transit facilities on campus, as well as extension of trolley overhead wires and electrical infrastructure into campus.

- **Transit operations** describes how each concept would affect transit services — both in terms of dealing with unexpected problems that affect service, as well as scheduling and planning services. In addition to a subjective assessment of operational flexibility and the potential for operational problems to arise, the average round trip time was calculated from VISSIM simulations of each service concept. The round trip time is the amount of time a bus is on campus, including layover time. Calculated round trip times are summarized in Table 5.13.

Table 5.14: Round Trip Times

Concept	Average Round Trip Time (min)
1	13.5
2	17.3
7	22.2
13	22.2
15	18.4

Concept 1 was assigned a score of five, which reflects the lowest average round trip time, a low potential for operational problems, and high operational flexibility as a result of having all buses lay over in one location. Concepts that extend bus routes through the campus were scored lower, as round trip times are higher and buses would be more susceptible to operational problems caused by pedestrians, traffic, construction and other activities on campus roads. Concepts with two or more transit nodes (layover locations) were scored lower as there would be less operational flexibility in routing and scheduling, as well as less efficient use of layover facilities.

- **External trips** indicate the "Ridership" potential of each concept. External trips are trips made by transit to and from UBC. The number of trips to and from campus during the morning peak hour in 2011 was estimated using the emme/2 regional transportation model, as described in Section 5.1. The forecasts show a difference of 300 trips between Concept 1 (the lowest ridership estimate of 4,250 trips) and Concepts 7 and 13 (the highest ridership estimate of 4,550 trips). It is important to remember, however, that this difference of 300 trips is less than the inherent margin of error in the emme/2 model. For this reason, the "Ridership" category was not weighted as high as other categories in the evaluation, to avoid over-emphasizing the reliability and effect of the ridership forecasts.

- **Internal trips** is another measure of the "Ridership" potential of each concept. In this case, each concept was evaluated in terms of its ability to accommodate internal trips on campus, particularly longer-distance trips such as from Hampton Place to the Chan Centre, or from South Campus to the Aquatic Centre, for example.

Concept 7 was assigned the highest score for this criterion, as the configuration of regional transit routes would provide a high-frequency connection between South Campus and the academic core. Concepts 13 and 15 were assigned slightly lower scores, as some but not all regional routes would provide direct service for longer-distance trips across the campus. Concept 1 was assigned the lowest score in comparison to the other concepts.

- **Costs.** Estimates of costs include ongoing operating costs for transit services and facilities, and financing costs for capital expenditures on transit facilities and vehicles. These include all costs incurred by UBC, TransLink and other participating agencies. The cost estimates for regional transit services represent only the UBC portions of these routes (the portions of routes west of and including Wesbrook Mall).

  Tables 5.14 through 5.18 provide a summary of the estimated costs for each transit service concept. All capital costs have been converted to annualized costs to provide an "apples-to-apples" comparison. Annualized vehicle costs are based on current costs provided by TransLink. Other capital costs have been annualized based on a 25-year amortization period at 5% interest.

Table 5.14: Costs of Concept 1

		Estimated Annualized Costs
Operating costs		
Regional buses [1]	77,600 hours	$5,200,000/yr
Community Shuttles	46,100 hours	$2,300,000/yr
Vehicles		
Regional buses [1]	23 buses	$1,330,000/yr
Community Shuttles	8 buses	$250,000/yr
Infrastructure		
Transit facilities	$17 million [2]	$1,206,000/yr
Trolley overhead	1.0 km = $380,000	$27,000/yr
Roadway changes and transit priority	$100,000	$7,000/yr
Operations and maintenance		$300,000/yr
Total estimated annualized cost		**$10,600,000**

1 — UBC portion of regional transit services
2 — Estimated cost of below-grade transit station as of May 30, 2003

It is important to note that the operating cost figures for regional buses reflect only the portions of regional routes on the UBC campus. Total

operating costs for the ten regional routes which serve UBC are much greater than the cost figures in Tables 5.14 through 5.18, and amount to more than $25 million per year.

Table 5.15: Costs of Concept 2

		Estimated Annualized Costs
Operating costs		
Regional buses [1]	98,800 hours	$6,600,000/yr
Community Shuttles	46,100 hours	$2,300,000/yr
Vehicles		
Regional buses [1]	29 buses	$1,680,000/yr
Community Shuttles	8 buses	$250,000/yr
Infrastructure		
Transit facilities	$12.0 million [2]	$850,000/yr
Trolley overhead	1.0 km = $380,000	$27,000/yr
Roadway changes and transit priority	$100,000	$7,000/yr
Operations and maintenance		$250,000/yr
Total estimated annualized cost		**$12,000,000**

1 — UBC portion of regional transit services
2 — Estimated cost of below-grade transit station as of May 30, 2003

Table 5.16: Costs of Concept 7

		Estimated Annualized Costs
Operating costs		
Regional buses [1]	127,200 hours	$8,500,000/yr
Community Shuttles	40,300 hours	$2,000,000/yr
Vehicles		
Regional buses [1]	38 buses	$1,680,000/yr
Community Shuttles	7 buses	$250,000/yr
Infrastructure		
Transit facilities	$4.0 million	$280,000/yr
Trolley overhead	3.7 km = $1,000,000	$72,000/yr
Roadway changes and transit priority	$100,000	$7,000/yr
Operations and maintenance		$100,000/yr
Total estimated annualized cost		**$13,400,000**

1 — UBC portion of regional transit services

Table 5.17: Costs of Concept 13

		Estimated Annualized Costs
Operating costs		
Regional buses [1]	127,200 hours	$8,500,000/yr
Community Shuttles	40,300 hours	$2,000,000/yr
Vehicles		
Regional buses [1]	38 buses	$1,680,000/yr
Community Shuttles	7 buses	$250,000/yr
Infrastructure		
Transit facilities	$3.0 million	$610,000/yr
Trolley overhead	1.6 km = $480,000	$27,000/yr
Roadway changes and transit priority		$0/yr
Operations and maintenance		$50,000/yr
Total estimated annualized cost		**$13,200,000**
1 — UBC portion of regional transit services		

Table 5.18: Costs of Concept 15

		Estimated Annualized Costs
Operating costs		
Regional buses [1]	105,200 hours	$7,000,000/yr
Community Shuttles	34,600 hours	$1,700,000/yr
Vehicles		
Regional buses [1]	31 buses	$1,800,000/yr
Community Shuttles	6 buses	$190,000/yr
Infrastructure		
Transit facilities	$3.0 million	$210,000/yr
Trolley overhead	1.9 km = $570,000	$40,000/yr
Roadway changes and transit priority		$0/yr
Operations and maintenance		$50,000/yr
Total estimated annualized cost		**$11,000,000**
1 — UBC portion of regional transit services		

The most significant component of the costs of each concept is operating cost. This explains why the annualized cost for Concept 1 is lowest, even though Concept 1 includes an estimated $10 million capital expenditure for a below-grade transit station. The annual operating cost for Concept 1 is estimated to be $7.5 million. This is $1.2 million to $3.0 million less

than the annual operating costs for the other concepts. In comparison, the annualized cost of the below-grade transit station in Concept 1 is $0.7 million. The savings in operating costs with Concept 1 is greater than the cost of constructing a below-grade transit station.

The hours of service and numbers of buses estimated for each concept reflect services provided on the UBC campus only. Regional transit routes beyond the UBC campus (east of Wesbrook Mall) are the same in all concepts, and reflect no change from existing routes. Consequently, for the purposes of comparing the costs of each concept, it is only necessary to consider routes and services on campus. This means, for example, that the hours, numbers of buses and costs of the Route 99 B-Line service are calculated from the time a westbound bus to UBC crosses Wesbrook Mall to the time the same bus leaves campus crossing Wesbrook Mall in an eastbound direction.

Each concept includes estimated hours of service and numbers of buses for Community Shuttle service on campus. Concepts 1 and 2 include the most hours of service and the greatest number of Community Shuttle buses, as coverage of campus by regional bus routes is lowest in those concepts. In comparison, Concept 15 includes the lowest level of Community Shuttle service, as regional bus routes provide extensive coverage of campus. It is important to note that the Community Shuttle routes illustrated in the diagrams of the transit service concepts are conceptual. Actual routes and service levels will be determined through further detailed work undertaken by TransLink and UBC. Consequently, for the purposes of the evaluation, the hours of service and numbers of buses indicated for each service concept are considered reasonable and representative of the different levels of Community Shuttle service that would be provided. Although actual service levels and costs may be slightly higher or lower than those estimated in the evaluation, the difference in costs would not be significant and would not affect the results of the evaluation of costs.

Facility costs are estimated based on preliminary work undertaken by UBC to determine the costs of constructing a below-grade transit station, as well as current construction costs for various types of transit facilities. The estimated $10 million cost for the below-grade transit station in Concept 1 reflects the extra cost over and above costs associated with redevelopment of University Boulevard and upgrading of utilities and other infrastructure on University Boulevard.

- **Ease of implementation** provides an indication of the complexity of implementing each transit service concept. Concept 1 was assigned a score of two to reflect the fact that it would be necessary to reroute buses and create a temporary bus loop during the time that a below-grade transit station was being constructed. In addition, the University Boulevard/

Wesbrook Mall intersection would require significant reconfiguration to accommodate bus stops and exclusive bus movements.

Concepts 13 and 15 would be relatively easy to implement, as new layover facilities and bus stops could be constructed prior to changing regional bus routes on campus. Concepts 2 and 7 both involve large transit facilities and roadway changes that would require rerouting and relocation of some or all transit services during construction.

5.5 Community Input

The results of the evaluation of transit service concepts were presented to the community at an open house on April 23, 2003. Approximately 100 persons attended the open house, including students, staff, faculty and residents at UBC, as well as UEL and Vancouver residents. Attendees provided comments verbally as well as using comment sheets, a copy of which is included in Appendix D.

Overall, the input from the community was positive. Almost all attendees responded positively to the preferred transit service concept. Key features of the preferred transit concept cited by attendees include:

- Central location.
- Below-grade transit station.
- Better transit service.
- Lowest cost.
- Avoids impacts elsewhere on campus — noise, air quality, congestion, buses on University Boulevard west of East Mall

Several attendees identified concerns regarding the preferred transit service concept, including some attendees who had indicated overall support for the concept. The key concern was the below-grade transit station. Many attendees who expressed concerns regarding the below-grade transit station revised their opinion of a below-grade transit station after they had an opportunity to view photographs of other similar facilities, and discussed the issue with staff. Others remained concerned, specifically regarding:

- **Appearance and aesthetics.** Many attendees expressed a desire to review and comment on proposals for the design of the entrance to the bus tunnel and the below-grade transit station, as part of the design process.
- **Location of bus entrance to station.** Some attendees suggested that the bus entrance would be better located east of Wesbrook Mall and south of University Boulevard, rather than on University Boulevard west of Wesbrook Mall.

- **Ventilation.** Several attendees expressed concerns regarding ventilation, both in terms of the need to maintain good air quality in the station, and in terms of minimizing the effects on air quality outdoors above the station.
- **Security.** Some persons were sceptical that security patrols would actually be implemented in and around the transit station.

Other concerns identified by open house attendees include:

- **Other concepts preferred.** A few attendees indicated that they preferred other concepts than Concept 1. Generally, their preferences for other concepts were because other concepts provided greater coverage of campus than Concept 1.
- **Public information.** Several attendees expressed a desire to see more detailed information, and requested that a report of the Campus Transit Plan be available via the World Wide Web once the report has been completed.
- **Implementation.** Several attendees asked how implementation of a below-grade transit station would be managed, specifically with respect to maintaining transit service in the interim and minimizing the impacts of construction.

The Campus Transit Plan responds to much of the community input. Specific issues regarding the design of the transit station, the location of the bus entrance and implementation of the transit station will be addressed in subsequent detailed planning and design work undertaken by UBC and TransLink. A preliminary evaluation of the below-grade transit station and examination of similar facilities in other communities (which are described in Section 6) indicates that a below-grade transit station can be implemented in a manner which addresses these issues.

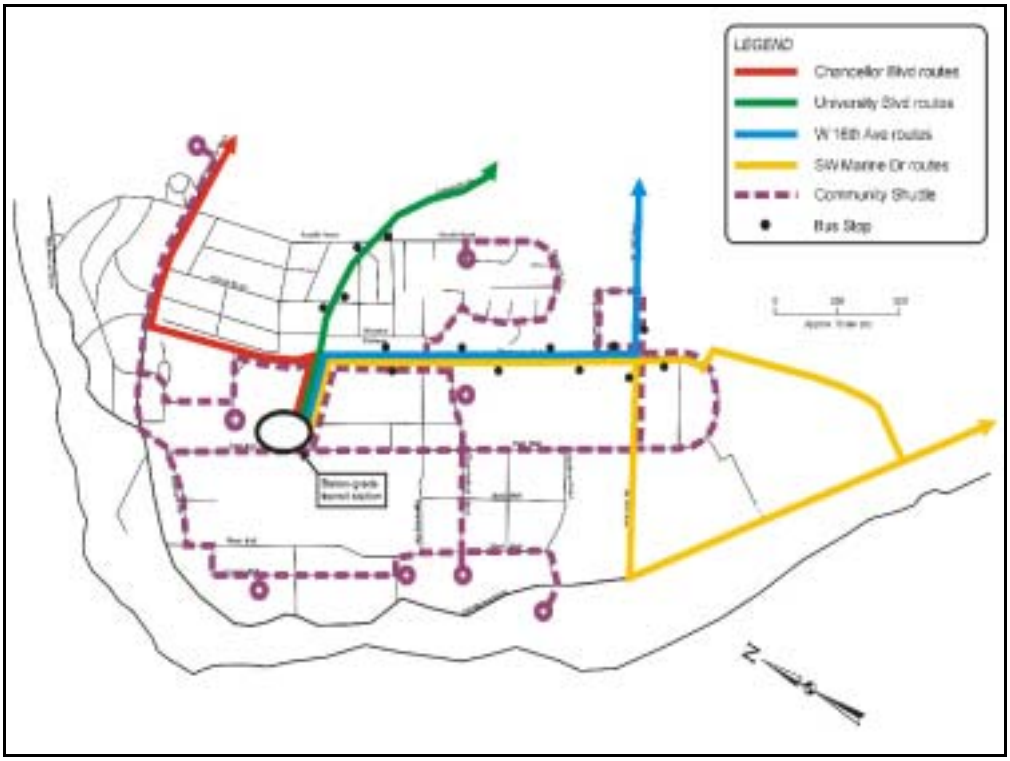
6.0 CONCLUSIONS AND RECOMMENDATIONS

This section describes the recommended transit service concept, which was identified through a screening and evaluation of 15 service concepts, as described in Section 5.0. This section also identifies changes required to UBC's Official Community Plan and Strategic Transportation Plan in order to incorporate the recommended transit service concept.

6.1 Recommended Transit Service Concept

The recommended transit service concept is illustrated in Figure 6.1. A total of 15 concepts were screened and evaluated, as described in Section 5.0, and Concept 1 was identified as the best overall concept by a wide margin. The total score in the evaluation for Concept 1 is 78, which is 25% higher than the next-highest scoring concepts.

Figure 6.1: Recommended Transit Service Concept



The key features of the recommended transit service concept include:

- **Existing regional bus routes are maintained.** All regional buses would follow existing routes, with the exception of Routes 41 and 49, which would eventually travel through South Campus via a new road (with transit-only access or traffic calming measures to discourage motorists from short-cutting through South Campus).

A key benefit of maintaining existing regional bus routes is that buses are not routed through campus, avoiding potential noise, air quality and visual impacts. Instead, coverage of campus is provided by smaller Community Shuttle buses, as described below.

- **A new Community Shuttle service expands coverage of campus.** A key feature of the recommended transit service plan is a Community Shuttle service operating throughout campus during the daytime and evening. Community Shuttle services would extend coverage of campus within 300 m walking distance. As illustrated in Figure 6.2, Community Shuttle services would eventually provide coverage of campus within a 300 m walking distance.

Figure 6.2: Community Shuttle Bus Coverage (shaded areas represent 300-m walking distance)

Community shuttle services would be implemented in phases, with incremental expansion of coverage and service frequencies as development on campus continues, particularly in outlying areas such as South Campus. Eventually, several buses would operate along a number of routes, providing service as frequently as every 15 minutes. Smaller buses would be used, as illustrated in Figure 6.3. Eventually, these could be fuelled by natural gas, hydrogen or other alternative fuels in order to minimize noise and air quality impacts.

Figure 6.3: Community Shuttle Bus

Community Shuttle service would be intended primarily to provide mobility on campus for:

- Persons with disabilities.
- Persons travelling alone at night, for whom personal security is a concern.
- Persons making long trips across campus, which are too far to walk in a timely manner. An example would be a trip from South Campus to the Chan Centre.
- Persons travelling with objects that are too large or heavy to walk with.

- **A single centrally-located transit station.** All regional bus routes and Community Shuttle routes would converge at a single transit station, located where the existing bus loop is located. This provides several benefits:

  - *Direct and convenient access to buses.* The transit station would be located close to the centre of the academic core, which is the destination for most transit passengers. Any location within the academic core would be less than a 10-minute walk to the transit station.

- *A choice of routes at one location reduces waiting times.* Many transit passengers can use two or more bus routes to travel from UBC to their destination. For example, a student who lives in Kitsilano on 6th Avenue near Macdonald Street would have a choice of up to five different routes to travel home. With a single transit station served by all routes, this student could board the first bus leaving the station on any of these routes, which reduces the waiting time for a bus.

- *Easy to understand.* A common departure point for all buses leaving campus is easy for passengers to understand. Passengers know they are able to catch a bus on any route at a single location. With a more dispersed system, transit users would need to be familiar with the on-campus routings to be sure that they walk to the correct stop when they want to leave campus.

- **A below-grade transit station.** The transit station would be located below-grade, below where the existing bus loop is located. Buses would enter and exit the below-grade station on University Boulevard west of Wesbrook Mall. The transit station would have a capacity of 40 or more buses, which is sufficient to accommodate increased transit service at UBC over the next 25 years or more.

  The primary benefit of a below-grade transit station is faster transit service and fewer delays to buses. A key feature of the transit station would be a "fare-paid zone," which could only be entered by paying a transit fare. Because everyone inside the fare-paid zone would have already paid the fare, passengers would be able to board buses through all doors. This means that an articulated bus could be loaded in 60 to 90 seconds, as compared with as much as five minutes without a fare-paid zone. Faster bus loading means faster transit service.

  A below-grade transit station also means that buses would avoid traffic congestion and delays at pedestrian crosswalks on University Boulevard. As a result, transit service would be faster and there would be fewer delays to buses.

  Locally, a good example of a below-grade transit station is the Burrard SkyTrain station, which is illustrated in Figures 6.4 through 6.6. Below-grade bus transit stations operate in several other communities, as illustrated in Figures 6.7 through 6.15.

  Key features of the below-grade transit station at UBC would include:

  - *Safe.* The station would be well-illuminated, would incorporate a secure fare-paid zone, and would be patrolled by security personnel.
  - *Accessible.* The station would be accessible by ramps, escalators and/or elevators to accommodate persons with disabilities.

- *Attractive.* The station would be integrated with a plaza at surface level and adjacent buildings. It would be illuminated by natural light, supplemented with a high level of lighting. The bus entrance on University Boulevard would be landscaped and designed as a feature of the roadway.
- *Comfortable.* The below-grade transit station would be weather-protected, heated and climate controlled. Seating, telephones and other amenities would be provided.
- *Ventilated.* Passengers would be separated from buses by glass doors, as illustrated in Figures 6.9 and 6.14. When buses are ready to depart, the doors would slide open and passengers would walk directly onto the bus. Exhaust from buses would be vented from the transit station, and could be filtered and cleaned so as to maximize air quality in the station and outdoors.
- *Efficient.* Real-time information displays — such as in Figures 6.7 and 6.9 — would provide timely and accurate information regarding bus departures for transit passengers. Bus circulation, loading and unloading would minimize bus travel times and emissions.

Figure 6.4: Burrard SkyTrain Station

Figure 6.5: Burrard SkyTrain Station

Figure 6.6: Burrard SkyTrain Station

Figure 6.7: Below-Grade Bus Transit Station – Denver, Colorado

Figure 6.8: Below-Grade Bus Transit Station – Denver, Colorado

Figure 6.9: Below-Grade Bus Transit Station – Denver, Colorado

Figure 6.10: Below-Grade Bus Transit Station – Seattle, Washington

Figure 6.11: Below-Grade Bus Transit Station – Seattle, Washington

Figure 6.12: Below-Grade Bus Transit Station – Seattle, Washington

Figure 6.13: Below-Grade Bus Transit Station – Toronto, Ontario

Figure 6.14: Below-Grade Bus Transit Station – Brisbane, Australia

Figure 6.15: Below-Grade Transit Station – Munich, Germany

6.2 Other Plans

In conjunction with implementation of the recommended transit service concept, some existing plans should be amended to reflect the recommended concept. In particular, changes should be made to UBC's Official Community Plan and Strategic Transportation Plan, as described below.

6.2.1 Official Community Plan

UBC's Official Community Plan was adopted in July 1997, and is planned to be updated in Fall 2003. Changes that should be made to the plan to reflect the recommended transit service concept include:

- **Section 4.2.1 c)** should be reworded to indicate that "all transit services will continue to be focused on the central transit station. A combination of regional services and Community Shuttle services will ensure convenient access to, from and within the campus."

- **Section 4.2.3 g)** should be deleted, as this section refers to an earlier concept for regional transit services on campus similar to Concept 7 evaluated in this study.

- **Section 4.2.3.** A new sub-section should be added indicating that "all roads on campus should be designed to accommodate Community Shuttle buses or similar transit vehicles, to ensure that transit service can be provided to the entire campus."

- **Section 4.2.3.** A new sub-section should be added indicating that "priority should be given to transit vehicles at traffic signals and elsewhere on the road network where this will result in a significant time savings and improved reliability for transit services."

- **Section 5.1.1 d)** should be modified to read "planning and provision of new transit facilities, particularly a new below-grade transit station on University Boulevard."

- **Schedule B** should be modified to reflect "regional transit routes" on University Boulevard, 16th Avenue and SW Marine Drive, as well as a future regional transit route through South Campus.

6.2.2 Strategic Transportation Plan

UBC's Strategic Transportation Plan was adopted in November 1999. The Strategic Transportation Plan describes how the transportation component of Official Community Plan vision will be achieved. Following the update of the Official Community Plan, it is anticipated that the Strategic Transportation Plan will be updated. Changes that should be made to the

"Transit" section of the Strategic Transportation Plan to reflect the recommended transit service concept include:

- **Issues.** The list of issues in the "Transit" section of the Strategic Transportation Plan should be revised to remove those issues that have been addressed, to update those that have changed or still remain issues, and to add new issues. With respect to the recommended transit service concept, the two issues under the "On-Campus Transit" heading should be removed.

- **Policy 16.** Many of these improvements have been achieved, and consequently no longer need to be referenced. Others are beyond UBC's ability to affect, such as accelerating bus orders. The reference to integrating campus shuttles with the Cambie Consortium shuttle system should be removed, as the two services are geographically separate, may use different vehicles and may operate under different service parameters.

- **Policy 17** should be removed, as it is currently not anticipated that rapid transit would be provided to UBC within the next 20 or more years. This is consistent with the basis for developing the Campus Transit Plan. If desired, Policy 17 could be replaced with a statement that "a new bus transit station at UBC should be designed to allow for the implementation of rapid transit at a future date."

- **Figure 12** should be modified to remove references to three options for the "central campus bus loop." The "Campus Major Transit Routes" inset should be modified to reflect regional transit routes as in the recommended transit service concept. The "future bus loop" at 16th Avenue/Wesbrook Mall should be deleted. As well, references to future LRT to UBC should be removed from Figure 12.

Other changes that should be made to the Strategic Transportation Plan include:

- **Policy 34** should be revised to refer to partnerships with TransLink in implementing a Community Shuttle service throughout the campus. The reference to "destination/demand-oriented routes" should be removed, as it is anticipated that Community Shuttles would generally operate on fixed routes and fixed schedules.

- **Figure 16** should be removed, or modified to reflect plans for campus shuttle services that will be developed by UBC and TransLink.

- **Policy 46.** Transit priority should be identified as another objective of a "Campus Traffic Management System."

6.3 Next Steps

Implementation of the recommended transit service concept will require that the following actions be undertaken:

- Confirmation of regional bus routes, particularly the routing of Route 41 buses at night. As well, opportunities to adjust regional routes to improve coverage of campus should be considered.
- Confirmation of bus stop locations on regional bus routes. Design of expansions to existing bus stops and design of new bus stops.
- Planning of Community Shuttle services — including routes, bus stop locations, hours and frequencies of service and numbers of buses — and subsequent phased implementation of community shuttle services as development on campus continues.
- Design of new and modified Community Shuttle bus stops.
- Design of the below-grade transit station, and bus entrance on University Boulevard.
- Re-design of the University Boulevard/Wesbrook Mall intersection, including transit-actuated signals and priority for transit vehicles.
- Development of a plan to relocate and manage transit services during construction of the below-grade transit station.
- Development of communications materials to inform transit passengers and others of changes and enhancements to transit service.
- Estimates of the operating costs for regional and Community Shuttle services, and negotiation of cost-sharing agreements.
- Estimates of the capital costs of transit facilities, including the below-grade transit station, and negotiation of cost-sharing agreements.

UBC Campus Transit Plan

APPENDIX A

Average Screenline Loads (1998, 1999, 2002) for UBC Routes

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June 2003

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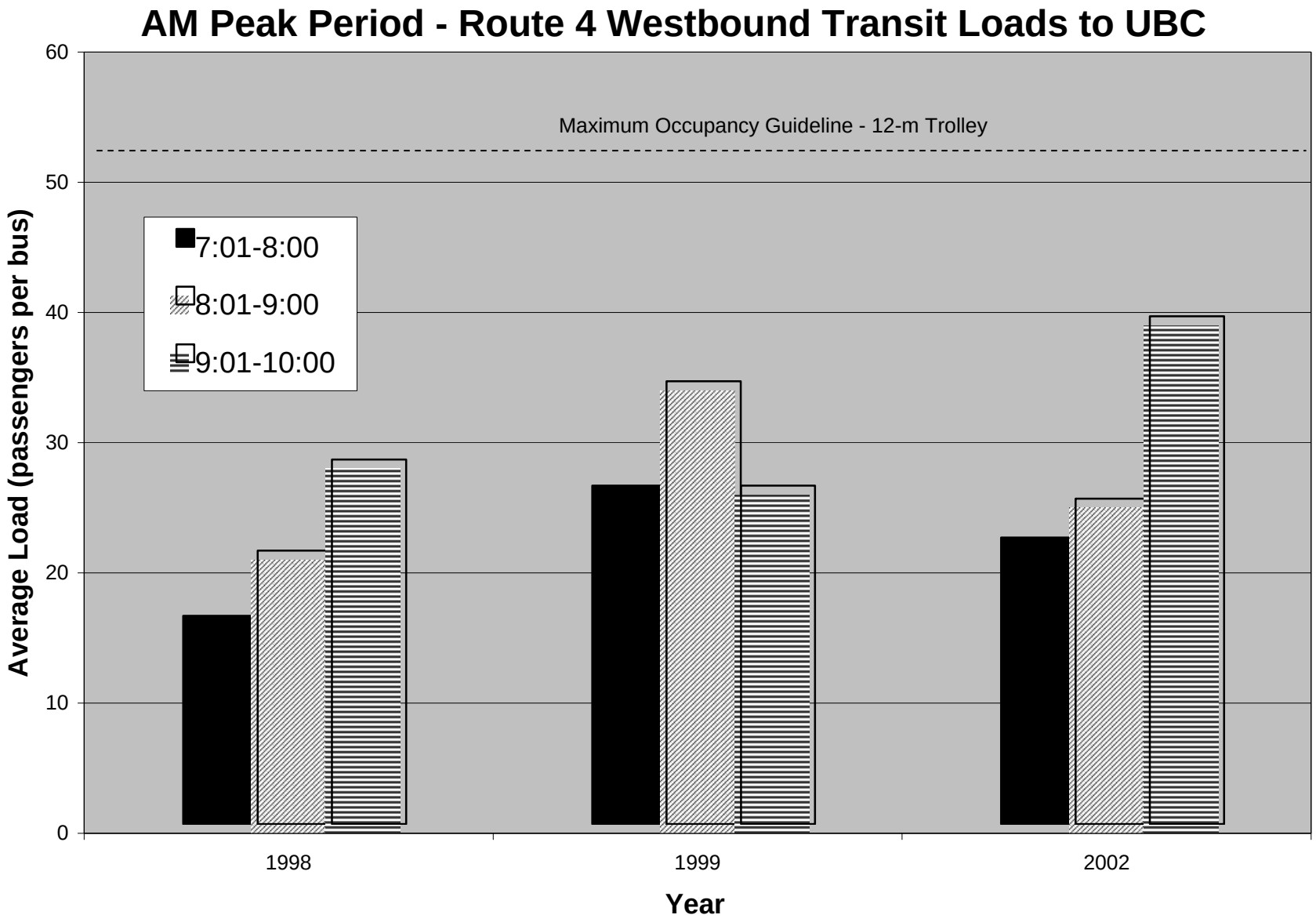
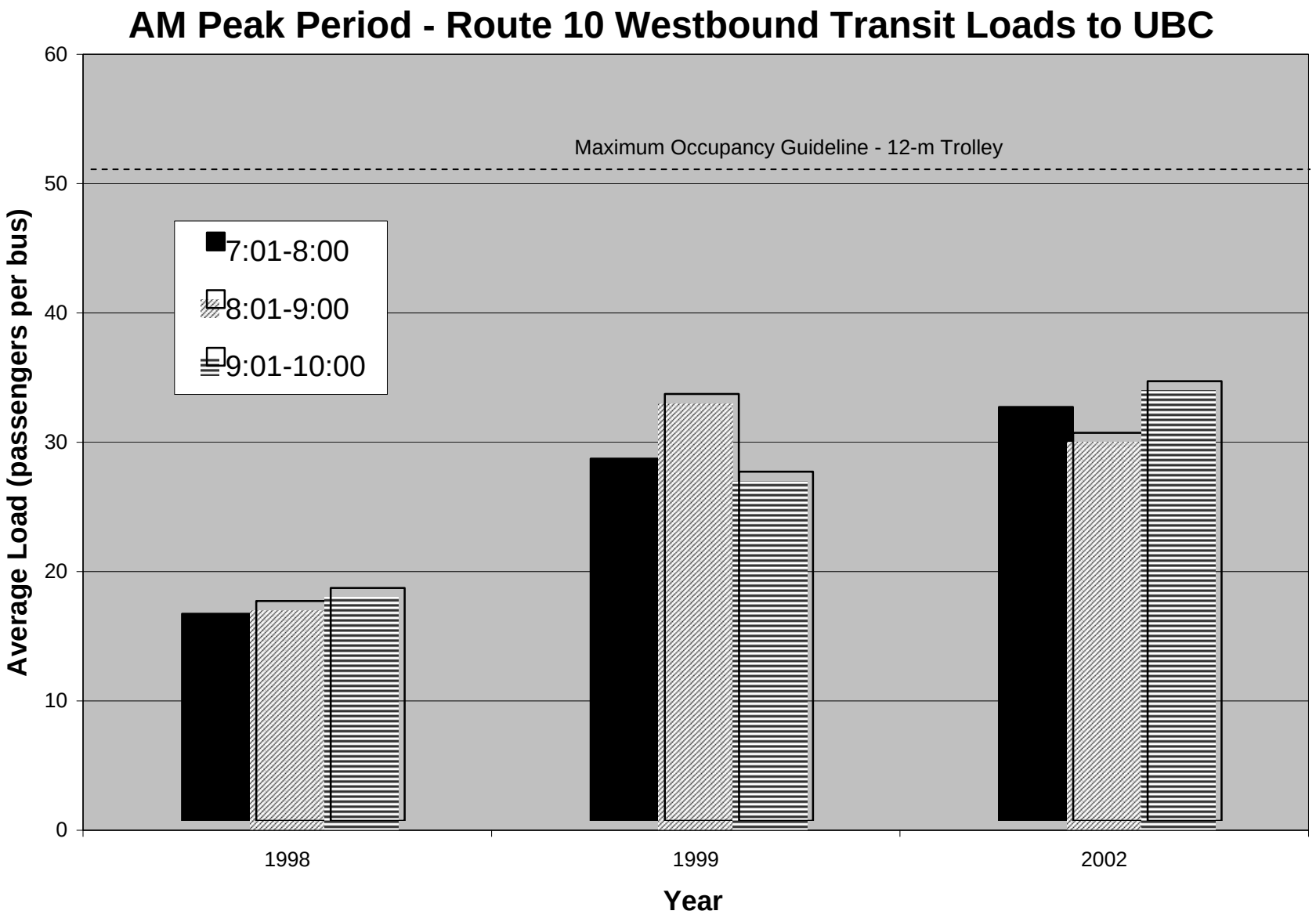
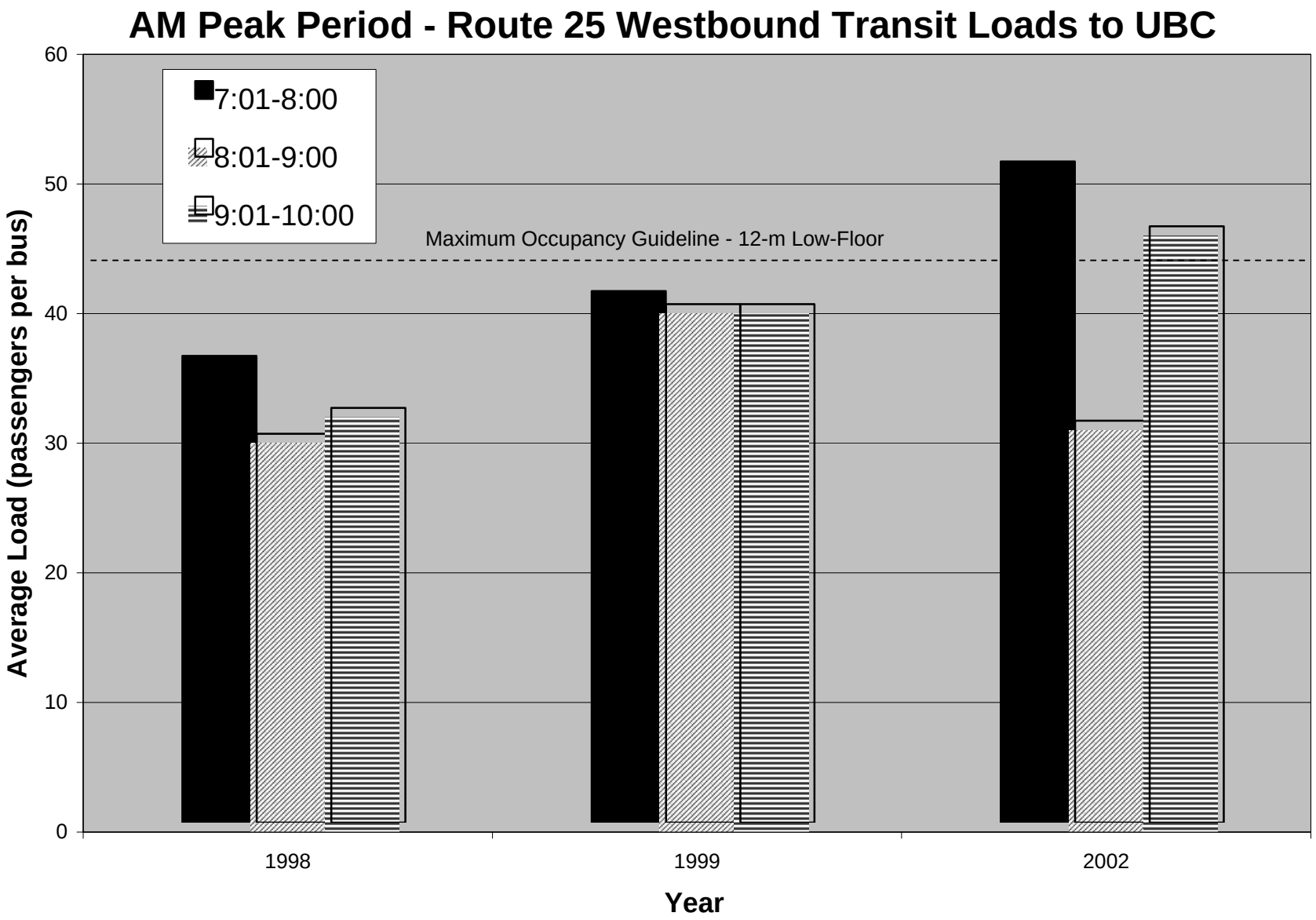
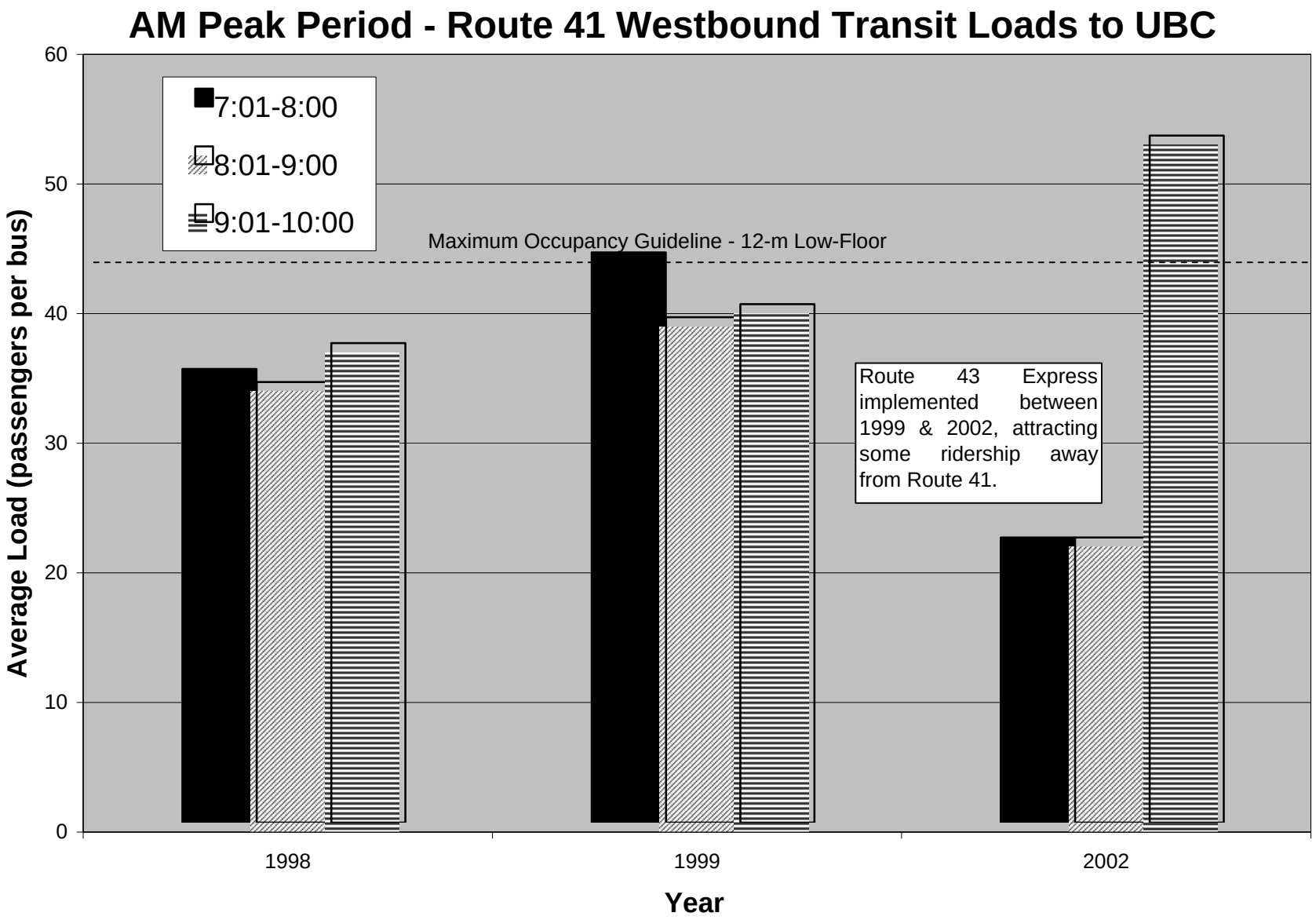
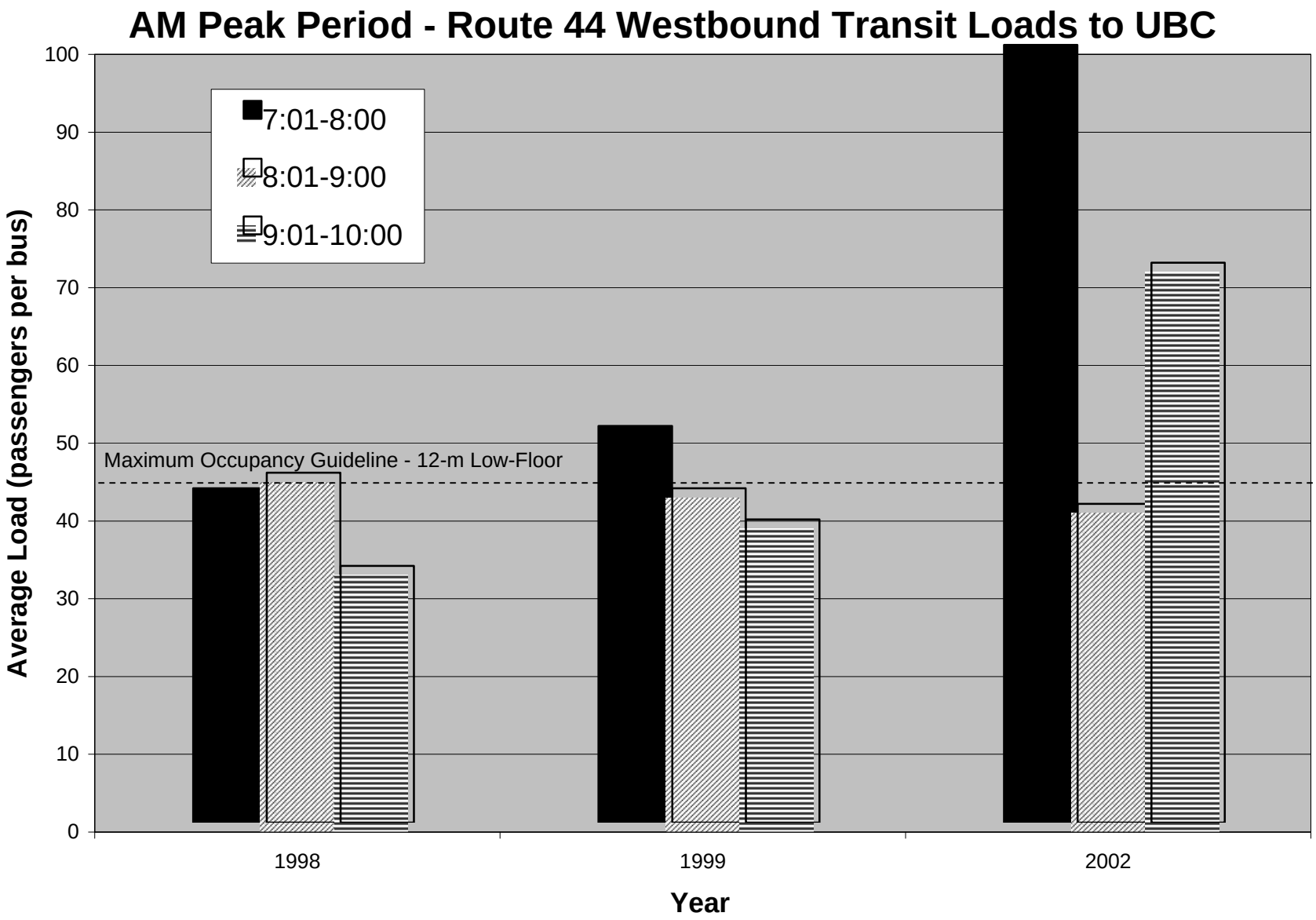
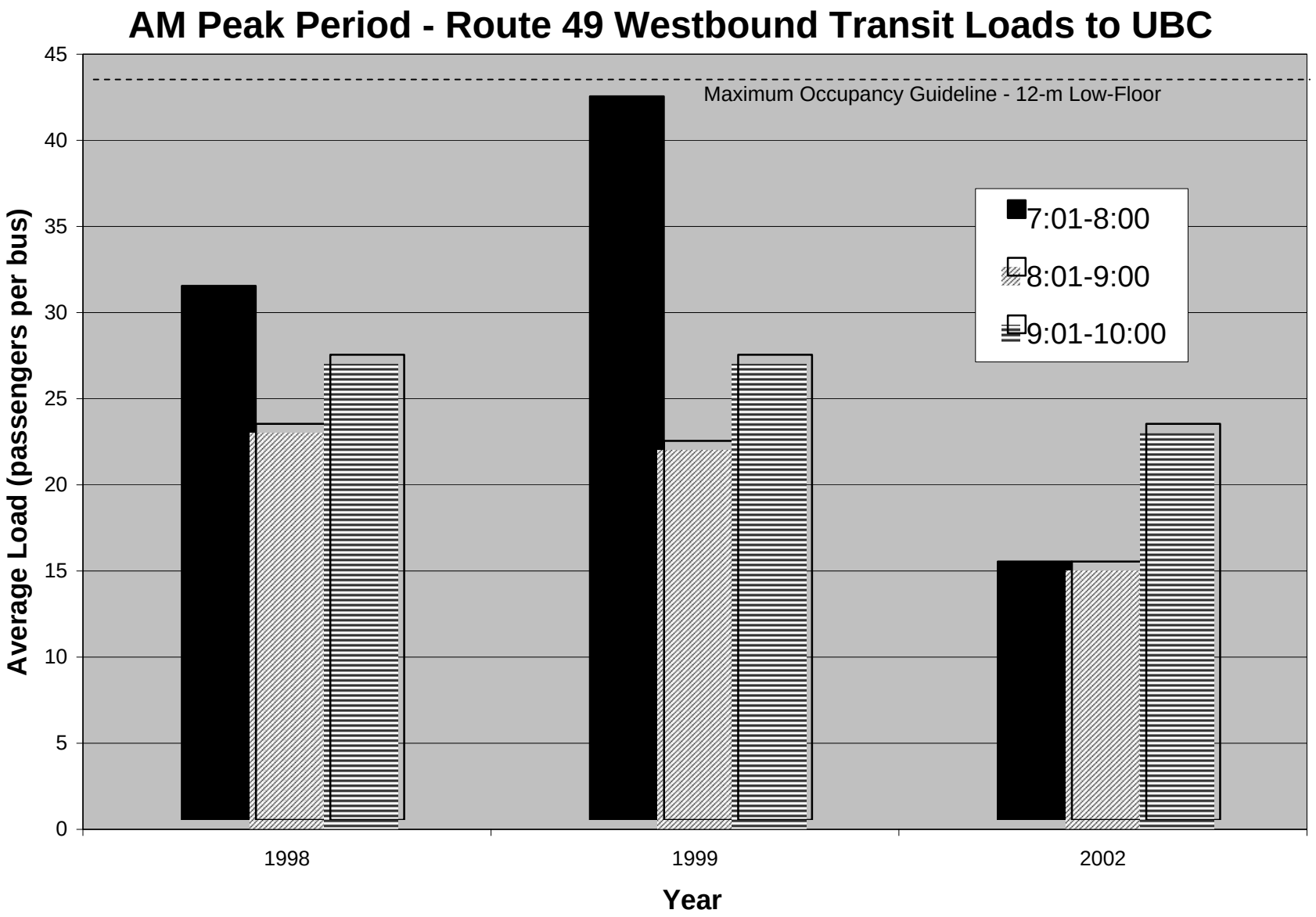

AM Peak Period - Route 4 Westbound Transit Loads to UBC
Maximum Occupancy Guideline - 12-m Trolley
7:01-8:00
8:01-9:00
9:01-10:00
Average Load (passengers per bus)
60
50
40
30
20
10
0
1998
1999
2002
Year

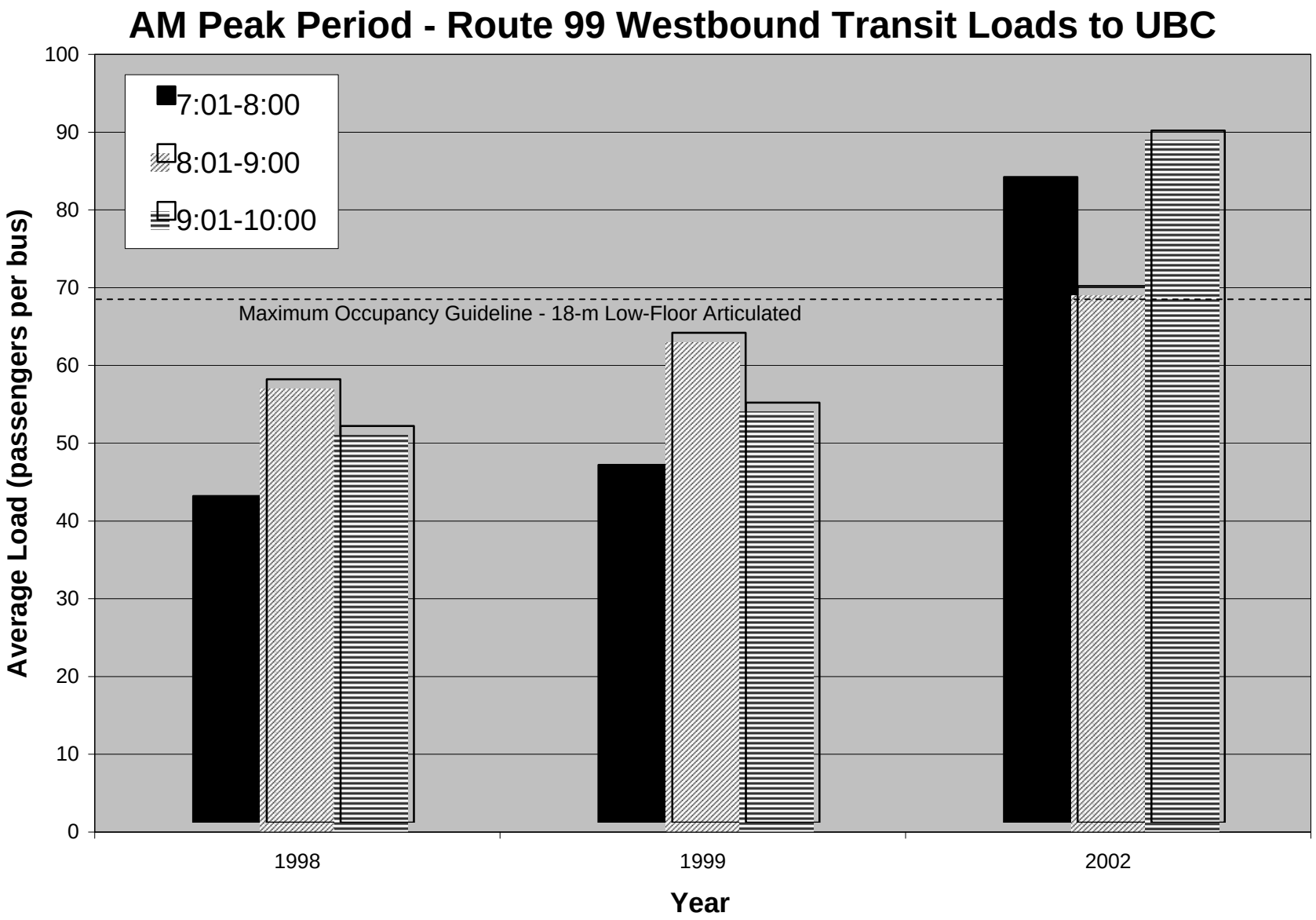

AM Peak Period - Route 10 Westbound Transit Loads to UBC
Maximum Occupancy Guideline - 12-m Trolley
7:01-8:00
8:01-9:00
9:01-10:00
Average Load (passengers per bus)
60
50
40
30
20
10
0
1998
1999
2002
Year

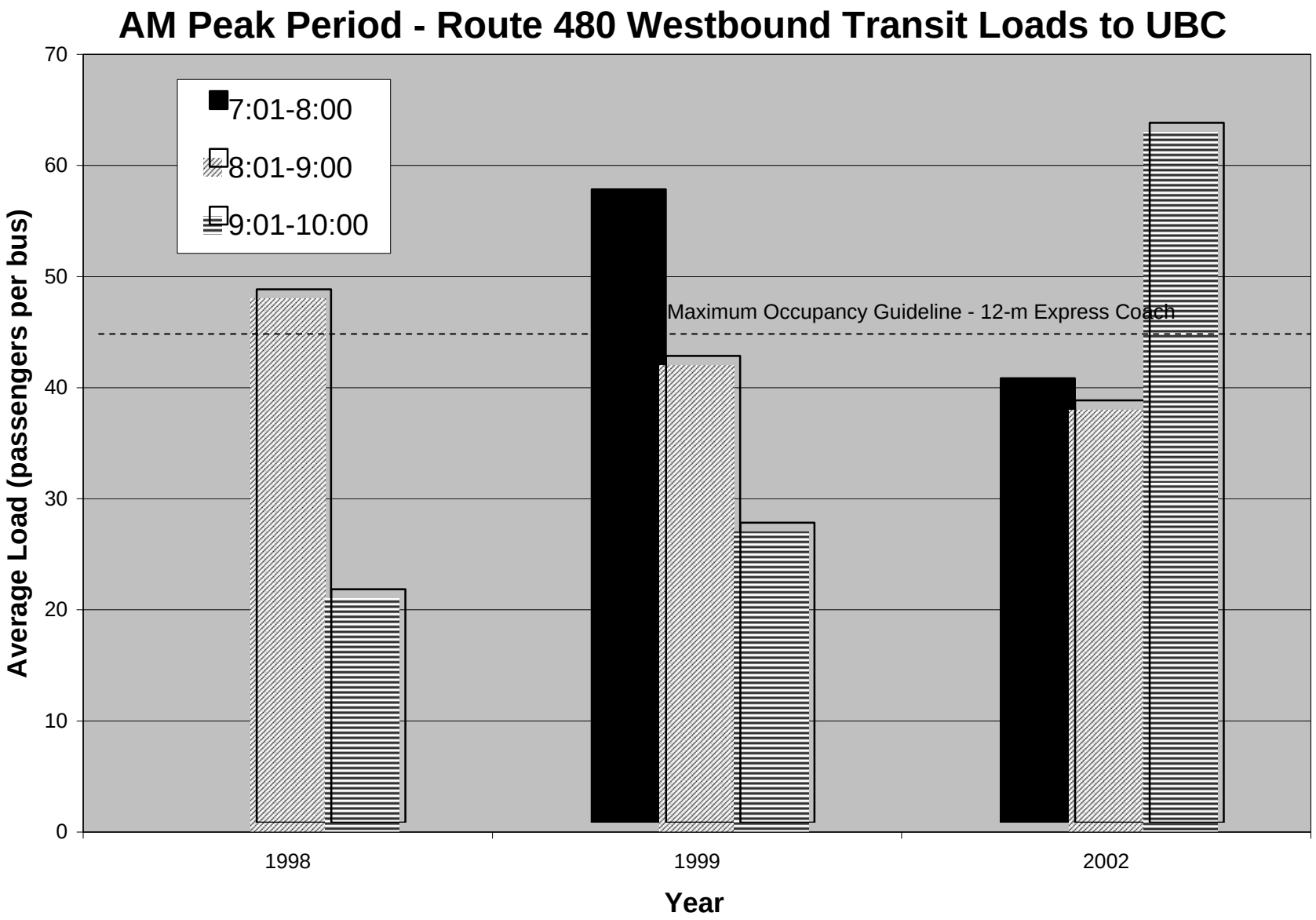

AM Peak Period - Route 25 Westbound Transit Loads to UBC
Average Load (passengers per bus)
60
50
40
30
20
10
0
7:01-8:00
8:01-9:00
9:01-10:00
Maximum Occupancy Guideline - 12-m Low-Floor
1998
1999
2002
Year


AM Peak Period - Route 41 Westbound Transit Loads to UBC
Average Load (passengers per bus)
60
50
40
30
20
10
0
7:01-8:00
8:01-9:00
9:01-10:00
Maximum Occupancy Guideline - 12-m Low-Floor
Route 43 Express implemented between 1999 & 2002, attracting some ridership away from Route 41.
1998
1999
2002
Year


AM Peak Period - Route 44 Westbound Transit Loads to UBC
Average Load (passengers per bus)
100
90
80
70
60
50
40
30
20
10
0
7:01-8:00
8:01-9:00
9:01-10:00
Maximum Occupancy Guideline - 12-m Low-Floor
1998
1999
2002
Year


AM Peak Period - Route 49 Westbound Transit Loads to UBC
Maximum Occupancy Guideline - 12-m Low-Floor
7:01-8:00
8:01-9:00
9:01-10:00
Average Load (passengers per bus)
45
40
35
30
25
20
15
10
5
0
1998
1999
2002
Year


AM Peak Period - Route 99 Westbound Transit Loads to UBC
Average Load (passengers per bus)
100
90
80
70
60
50
40
30
20
10
0
7:01-8:00
8:01-9:00
9:01-10:00
Maximum Occupancy Guideline - 18-m Low-Floor Articulated
1998
1999
2002
Year


AM Peak Period - Route 480 Westbound Transit Loads to UBC
Average Load (passengers per bus)
70
60
50
40
30
20
10
0
7:01-8:00
8:01-9:00
9:01-10:00
Maximum Occupancy Guideline - 12-m Express Coach
1998
1999
2002
Year

UBC Campus Transit Plan

APPENDIX B

Micro-simulation (VISSIM) Evaluation Results

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June 2003

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VISSIM Simulation Results

Regional Transit Services

Route			Midday Frequency (min)	Number of Buses in 2.5 Hours	Status Quo: Midday Number of Buses	Total Stopped Delay (sec)	Average Stopped Delay per Bus (sec)	Average Round Trip Travel Time per Bus (sec, incl. layover)	Total Operating Time (hours)	Concept 1: Midday Number of Buses
Chancellor Blvd.		94	10	15	1.3	1105	74	784	3.3	1.2
University Blvd.		4	15	10		524	52			
		10	15	10		381	38			
		258	30	5		369	74			
		99	5	30		1620	54			
		Subtotal		*55*	*4.4*	*2894*	*53*	*719*	*11.0*	*2.7*
16th Ave.		25	12	12.5	1.9	811	65	1350	4.7	1.3
SW Marine Dr.	Local	41	9	16.67		990	59			
		49	10	15		605	40			
		Subtotal		*31.67*	*4.1*	*1595*	*50*	*1165*	*10.2*	*3.4*
	Express	93	15	10		655	66			
		480	15	10		517	52			
		Subtotal		*20*	*2.9*	*1172*	*59*	*1325*	*7.4*	*2.7*
Totals				134.17	14.6	7577	**56 sec**	981	36.5	11.2
					28 Peak buses			**16.3 min**	**$2,400 Simulation period operating cost**	**21 Peak buses**
					$1,620,000 Annual debt				**$20,000 Weekday operating cost**	**$1,220,000 Annual debt**
									$6,300,000 Annual operating cost	

-- Tunnel Entry East of Wesbrook and South of University Boulevard					Concept 1 -- Tunnel Entry West of Wesbrook					
Total Stopped Delay (sec)	**Average Stopped Delay per Bus (sec)**	**Average Round Trip Travel Time per Bus (sec, incl. layover)**	**Total Operating Time (hours)**	**Midday Number of Buses**	Total Stopped Delay (sec)	**Average Stopped Delay per Bus (sec)**	**Average Round Trip Travel Time per Bus (sec, incl. layover)**	**Total Operating Time (hours)**	**Midday Number of Buses**	Total Stopped Delay (sec)
0	0	713	3.0	1.3	701	47	760	3.2	1.3	323
0	0				340	34				834
0	0				496	50				692
0	0				325	65				49
0	0				1160	39				1092
0	*0*	*439*	*6.7*	*2.9*	*2321*	*42*	*481*	*7.3*	*3.0*	*2667*
2	0	950	3.3	1.4	1103	88	1038	3.6	2.2	281
5	0				1210	73				543
27	2				1011	67				662
32	*1*	*953*	*8.4*	*3.6*	*2221*	*70*	*1022*	*9.0*	*5.6*	*1205*
21	2				725	73				459
2	0				732	73				284
23	*1*	*1216*	*6.8*	*2.9*	*1457*	*73*	*1288*	*7.2*	*3.4*	*743*
57	**0 sec**	754	28.1	12.1	7803	**58 sec**	812	30.3	15.4	5219
		12.6 min	**$1,900 Simulation period operating cost**	**23 Peak buses**			**13.5 min**	**$2,000 Simulation period operating cost**	**29 Peak buses**	
			$15,000 Weekday operating cost	**$1,330,000 Annual debt**				**$16,000 Weekday operating cost**	**$1,680,000 Annual debt**	
			$4,800,000 Annual operating cost					**$5,200,000 Annual operating cost**		

Concept 2					Concept 7					Conc
Average Stopped Delay per Bus (sec)	**Average Round Trip Travel Time per Bus (sec, incl. layover)**	**Total Operating Time (hours)**	**Midday Number of Buses**	Total Stopped Delay (sec)	**Average Stopped Delay per Bus (sec)**	**Average Round Trip Travel Time per Bus (sec, incl. layover)**	**Total Operating Time (hours)**	**Midday Number of Buses**	Total Stopped Delay (sec)	**Average Stopped Delay per Bus (sec)**
22	783	3.3	2.7	932	62	1638	6.8	2.2	475	32
83				1110	111				683	68
69				1802	180				1142	114
10				249	50				339	68
36				2922	97				2664	89
48	*483*	*7.4*	*8.3*	*6083*	*111*	*1352*	*20.7*	*6.9*	*4828*	*88*
22	1551	5.4	1.6	811	65	1144	4.0	1.5	199	16
33				837	50				537	32
44				753	50				556	37
38	*1599*	*14.1*	*4.7*	*1590*	*50*	*1347*	*11.8*	*5.9*	*1093*	*35*
46				296	30				333	33
28				488	49				518	52
37	*1531*	*8.5*	*2.6*	*784*	*39*	*1159*	*6.4*	*3.4*	*851*	*43*
39 sec	1036	38.6	19.9	10200	**76 sec**	1335	49.7	19.9	7446	**55 sec**
	17.3 min	**$2,600 Simulation period operating cost**	**38 Peak buses**			**22.2 min**	**$3,300 Simulation period operating cost**	**38 Peak buses**		
		$21,000 Weekday operating cost	**$2,200,000 Annual debt**				**$27,000 Weekday operating cost**	**$2,200,000 Annual debt**		
		$6,600,000 Annual operating cost					**$8,500,000 Annual operating cost**			

ept 13				Concept 15		
Average Round Trip Travel Time per Bus (sec, incl. layover)	**Total Operating Time (hours)**	**Midday Number of Buses**	Total Stopped Delay (sec)	**Average Stopped Delay per Bus (sec)**	**Average Round Trip Travel Time per Bus (sec, incl. layover)**	**Total Operating Time (hours)**
1346	5.6	2.2	325	22	1299	5.4
			799	80		
			379	38		
			284	57		
			1749	58		
1130	*17.3*	*4.9*	*3211*	*58*	*804*	*12.3*
1069	3.7	2.0	293	23	1408	4.9
			752	45		
			862	57		
1664	*14.6*	*4.4*	*1614*	*51*	*1240*	*10.9*
			163	16		
			242	24		
1526	*8.5*	*3.0*	*405*	*20*	*1367*	*7.6*
1334	49.7	16.4	5848	**44 sec**	1102	41.1
22.2 min	**$3,300 Simulation period operating cost**	**31 Peak buses**			**18.4 min**	**$2,800 Simulation period operating cost**
	$27,000 Weekday operating cost	**$1,800,000 Annual debt**				**$22,000 Weekday operating cost**
	$8,500,000 Annual operating cost					**$7,000,000 Annual operating cost**

UBC Campus Transit Plan

APPENDIX C

Evaluation Results for Shortlisted Service Concepts

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June 2003

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Campus Transit Plan

Evaluation of Service Concepts

Summary

Category	Weight	Concept				
		1	**2**	**7**	**13**	**15**
Customer Service	4	**1**	3	4	4	3
Safety	4	**5**	3	3	2	2
Community	2	**5**	3	1	2	2
Environmental	2	**5**	3	1	1	1
Transit Operations	2	**5**	3	1	2	4
Ridership	2	**1**	3	5	4	4
Cost	4	**5**	3	1	1	4
Implementation	1	**2**	2	2	5	5
Total		**78**	62	50	51	63
Ranking		**1st**	2nd	3rd	3rd	2nd

UBC Campus Transit Plan

Evaluation of Service Concepts

Annualized Costs

Costs		Concept				
		1	**2**	**7**	**13**	**15**
Transit operating costs	Regional buses	$5,200,000/yr	$6,600,000/yr	$8,500,000/yr	$8,500,000/yr	$7,000,000/yr
	Community shuttle	$2,300,000/yr	$2,300,000/yr	$2,000,000/yr	$2,000,000/yr	$1,700,000/yr
Vehicle capital costs	Regional buses	$1,330,000/yr	$1,680,000/yr	$2,200,000/yr	$2,200,000/yr	$1,800,000/yr
	Community shuttle	$250,000/yr	$250,000/yr	$220,000/yr	$220,000/yr	$190,000/yr
Transit facility capital costs		$1,240,000/yr	$890,000/yr	$360,000/yr	$250,000/yr	$250,000/yr
Transit facility operating costs		$300,000/yr	$250,000/yr	$100,000/yr	$50,000/yr	$50,000/yr
Totals		$10.6 million/yr	$12.0 million/yr	$13.4 million/yr	$13.2 million/yr	$11.0 million/yr

Evaluation — Concept 1

Category	Criteria	Measure	Rating							Overall
			Quantitative					Qualitative		
Customer service	Passenger travel time	Average walk time + in-bus travel time on campus	✓	6.9 min	+ 3.2 min	= 10.1 min	1			
	Coverage	Regional bus coverage of campus						✓	1	**1**
	Clarity of service	Ease of understanding						✓	5	
Safety	Traffic conflicts	Potential bus-motor vehicle conflicts						✓	5	
	Conflicts with vulnerable road users	Potential conflicts with peds and cyclists						✓	5	**5**
	Personal security	Personal safety, visibility at night, access to assistance						✓	5	
Community	Land use	Sites affected by transit facilities/roadway changes						✓	5	
	Traffic circulation and parking	Effects on traffic circulation and parking on campus						✓	5	**5**
Environmental	Noise	Relative noise levels on campus						✓	5	
	Air quality	Relative bus emissions on campus						✓	5	**5**
	Appearance and aesthetics	Visual benefits/impacts						✓	5	
Transit operations	Operations	Operational flexibility and issues						✓	5	
		Average round trip time	✓	13.5 min			5			**5**
Ridership	"External" trips to/from UBC	AM peak hour ridership to UBC	✓	4,250 trips						
	Mode share	AM peak hour transit mode share of trips to/from UBC	✓	39%			1			**1**
	"Internal" trips within UBC	Ability to accommodate internal trips						✓	1	
Cost	Service costs	2.5-hour simulation period operating costs	✓			$3,000				
		• *Regional buses*	✓	*30.3 hr*		*$2,000*				
		• *Community shuttle*	✓	*20 hr*		*$1,000*				
		Weekday operating costs	✓			$23,400				
		• *Regional buses*	✓			*$16,200*				
		• *Community shuttle*	✓			*$7,200*				
		Annual operating costs	✓			$7,500,000				
		• *Regional buses*	✓	*77,600 hr*		*$5,200,000*				
		• *Community shuttle*	✓	*46,100 hr*		*$2,300,000*				**5**
	Vehicle costs	Annual debt service costs	✓			$1,580,000				
		• *Regional buses*	✓	*23 buses*		*$1,330,000*				
		• *Community shuttle*	✓	*8 buses*		*$250,000*				
	Infrastructure costs	Transit terminals/layover facilities	✓		$17,000,000	$1,206,000				
		Trolley overhead	✓	1.0 km	$380,000	$27,000				
		Transit priority measures	✓		$100,000	$7,000				
		Annual operating/maintenance cost	✓			$300,000				
	Total annual costs		✓			$10,600,000	5			
Implementation	Timing and ease of implementation	Transit terminals/layover locations						✓	2	**2**
		Transit priority measures and roadway changes						✓	2	

Overall and qualitative scores are rated from 1 (worst) to 5 (best)

Evaluation — Concept 2

Category	Criteria	Measure	Rating						Overall
			Quantitative				Qualitative		
Customer service	Passenger travel time	Average walk time + in-bus travel time on campus	✓	6.0 min	+ 4.0 min	= 10.0 min	2		
	Coverage	Regional bus coverage of campus					✓	3	**3**
	Clarity of service	Ease of understanding					✓	3	
Safety	Traffic conflicts	Potential bus-motor vehicle conflicts					✓	3	
	Conflicts with vulnerable road users	Potential conflicts with peds and cyclists					✓	3	**3**
	Personal security	Personal safety, visibility at night, access to assistance					✓	4	
Community	Land use	Sites affected by transit facilities/roadway changes					✓	3	
	Traffic circulation and parking	Effects on traffic circulation and parking on campus					✓	3	**3**
Environmental	Noise	Relative noise levels on campus					✓	3	
	Air quality	Relative bus emissions on campus					✓	4	**3**
	Appearance and aesthetics	Visual benefits/impacts					✓	3	
Transit operations	Operations	Operational flexibility and issues					✓	1	
		Average round trip time	✓	17.3 min			4		**3**
Ridership	"External" trips to/from UBC	AM peak hour ridership to UBC	✓	4,400 trips					
	Mode share	AM peak hour transit mode share of trips to/from UBC	✓	40%			3		**3**
	"Internal" trips within UBC	Ability to accommodate internal trips					✓	2	
Cost	Service costs	2.5-hour simulation period operating costs	✓			$3,600			
		• *Regional buses*	✓	*38.6 hr*		*$2,600*			
		• *Community shuttle*	✓	*20 hr*		*$1,000*			
		Weekday operating costs	✓			$27,900			
		• *Regional buses*	✓			*$20,700*			
		• *Community shuttle*	✓			*$7,200*			
		Annual operating costs	✓			$8,900,000			
		• *Regional buses*	✓	*98,800 hr*		*$6,600,000*			
		• *Community shuttle*	✓	*46,100 hr*		*$2,300,000*			**3**
	Vehicle costs	Annual debt service costs	✓			$1,930,000			
		• *Regional buses*	✓	*29 buses*		*$1,680,000*			
		• *Community shuttle*	✓	*8 buses*		*$250,000*			
	Infrastructure costs	Transit terminals/layover facilities	✓		$12,000,000	$851,000			
		Trolley overhead	✓	1.0 km	$380,000	$27,000			
		Transit priority measures	✓		$100,000	$7,000			
		Annual operating/maintenance cost	✓			$250,000			
	Total annual costs		✓			$12,000,000	2		
Implementation	Timing and ease of implementation	Transit terminals/layover locations					✓	1	
		Transit priority measures and roadway changes					✓	2	**2**

Overall and qualitative scores are rated from 1 (worst) to 5 (best)

Evaluation — Concept 7

Category	Criteria	Measure	Rating						Overall
			Quantitative				Qualitative		
Customer service	Passenger travel time	Average walk time + in-bus travel time on campus	✓	5.2 min	+ 4.9 min	= 10.1 min 3			
	Coverage	Regional bus coverage of campus					✓	4	**4**
	Clarity of service	Ease of understanding					✓	4	
Safety	Traffic conflicts	Potential bus-motor vehicle conflicts					✓	3	
	Conflicts with vulnerable road users	Potential conflicts with peds and cyclists					✓	2	**3**
	Personal security	Personal safety, visibility at night, access to assistance					✓	3	
Community	Land use	Sites affected by transit facilities/roadway changes					✓	1	
	Traffic circulation and parking	Effects on traffic circulation and parking on campus					✓	2	**1**
Environmental	Noise	Relative noise levels on campus					✓	1	
	Air quality	Relative bus emissions on campus					✓	2	**1**
	Appearance and aesthetics	Visual benefits/impacts					✓	1	
Transit operations	Operations	Operational flexibility and issues					✓	2	
		Average round trip time	✓	22.2 min		1			**1**
Ridership	"External" trips to/from UBC	AM peak hour ridership to UBC	✓	4,550 trips					
	Mode share	AM peak hour transit mode share of trips to/from UBC	✓	42%		5			**5**
	"Internal" trips within UBC	Ability to accommodate internal trips					✓	5	
Cost	Service costs	2.5-hour simulation period operating costs	✓			$4,200			
		• *Regional buses*	✓	*49.7 hr*		*$3,300*			
		• *Community shuttle*	✓	*17.5 hr*		*$900*			
		Weekday operating costs	✓			$32,900			
		• *Regional buses*	✓			*$26,600*			
		• *Community shuttle*	✓			*$6,300*			
		Annual operating costs	✓			$10,500,000			
		• *Regional buses*	✓	*127,200 hr*		*$8,500,000*			
		• *Community shuttle*	✓	*40,300 hr*		*$2,000,000*			**1**
	Vehicle costs	Annual debt service costs	✓			$2,420,000			
		• *Regional buses*	✓	*38 buses*		*$2,200,000*			
		• *Community shuttle*	✓	*7 buses*		*$220,000*			
	Infrastructure costs	Transit terminals/layover facilities	✓		$4,000,000	$284,000			
		Trolley overhead	✓	3.7 km	$1,020,000	$72,000			
		Transit priority measures	✓		$100,000	$7,000			
		Annual operating/maintenance cost	✓			$100,000			
	Total annual costs		✓			$13,400,000 1			
Implementation	Timing and ease of implementation	Transit terminals/layover locations					✓	3	
		Transit priority measures and roadway changes					✓	1	**2**

Overall and qualitative scores are rated from 1 (worst) to 5 (best)

Evaluation — Concept 13

Category	Criteria	Measure	Rating							Overall
			Quantitative					Qualitative		
Customer service	Passenger travel time	Average walk time + in-bus travel time on campus	✓	5.0 min	+ 4.8 min	= 9.8 min	5			
	Coverage	Regional bus coverage of campus						✓	4	**4**
	Clarity of service	Ease of understanding						✓	2	
Safety	Traffic conflicts	Potential bus-motor vehicle conflicts						✓	2	
	Conflicts with vulnerable road users	Potential conflicts with peds and cyclists						✓	1	**2**
	Personal security	Personal safety, visibility at night, access to assistance						✓	2	
Community	Land use	Sites affected by transit facilities/roadway changes						✓	3	**2**
	Traffic circulation and parking	Effects on traffic circulation and parking on campus						✓	2	
Environmental	Noise	Relative noise levels on campus						✓	1	
	Air quality	Relative bus emissions on campus						✓	2	**1**
	Appearance and aesthetics	Visual benefits/impacts						✓	1	
Transit operations	Operations	Operational flexibility and issues						✓	4	**2**
		Average round trip time	✓	22.2 min			1			
Ridership	"External" trips to/from UBC	AM peak hour ridership to UBC	✓	4,550 trips			5			
	Mode share	AM peak hour transit mode share of trips to/from UBC	✓	42%						**4**
	"Internal" trips within UBC	Ability to accommodate internal trips						✓	3	
Cost	Service costs	2.5-hour simulation period operating costs	✓			$4,200				
		• *Regional buses*	✓	*49.7 hr*		*$3,300*				
		• *Community shuttle*	✓	*17.5 hr*		*$900*				
		Weekday operating costs	✓			$32,900				
		• *Regional buses*	✓			*$26,600*				
		• *Community shuttle*	✓			*$6,300*				
		Annual operating costs	✓			$10,500,000				
		• *Regional buses*	✓	*127,200 hr*		*$8,500,000*				
		• *Community shuttle*	✓	*40,300 hr*		*$2,000,000*				**1**
	Vehicle costs	Annual debt service costs	✓			$2,420,000				
		• *Regional buses*	✓	*38 buses*		*$2,200,000*				
		• *Community shuttle*	✓	*7 buses*		*$220,000*				
	Infrastructure costs	Transit terminals/layover facilities	✓		$3,000,000	$213,000				
		Trolley overhead	✓	1.6 km	$480,000	$34,000				
		Transit priority measures	✓		$0	$0				
		Annual operating/maintenance cost	✓			$50,000				
	Total annual costs		✓			$13,200,000	1			
Implementation	Timing and ease of implementation	Transit terminals/layover locations						✓	5	**5**
		Transit priority measures and roadway changes						✓	4	

Overall and qualitative scores are rated from 1 (worst) to 5 (best)

Evaluation — Concept 15

Category	Criteria	Measure	Rating							Overall
			Quantitative					Qualitative		
Customer service	Passenger travel time	Average walk time + in-bus travel time on campus	✓	5.9 min	+ 3.8 min	= 9.7 min	3			
	Coverage	Regional bus coverage of campus						✓	5	**3**
	Clarity of service	Ease of understanding						✓	1	
Safety	Traffic conflicts	Potential bus-motor vehicle conflicts						✓	1	
	Conflicts with vulnerable road users	Potential conflicts with peds and cyclists						✓	3	**2**
	Personal security	Personal safety, visibility at night, access to assistance						✓	1	
Community	Land use	Sites affected by transit facilities/roadway changes						✓	3	**2**
	Traffic circulation and parking	Effects on traffic circulation and parking on campus						✓	1	
Environmental	Noise	Relative noise levels on campus						✓	1	
	Air quality	Relative bus emissions on campus						✓	1	**1**
	Appearance and aesthetics	Visual benefits/impacts						✓	2	
Transit operations	Operations	Operational flexibility and issues						✓	4	**4**
		Average round trip time	✓	18.4 min			3			
Ridership	"External" trips to/from UBC	AM peak hour ridership to UBC	✓	4,400 trips			3			**4**
	Mode share	AM peak hour transit mode share of trips to/from UBC	✓	40%						
	"Internal" trips within UBC	Ability to accommodate internal trips						✓	4	
Cost	Service costs	2.5-hour simulation period operating costs	✓			$3,600				**4**
		• *Regional buses*	✓	*41.1 hr*		*$2,800*				
		• *Community shuttle*	✓	*15 hr*		*$800*				
		Weekday operating costs	✓			$27,400				
		• *Regional buses*	✓			*$22,000*				
		• *Community shuttle*	✓			*$5,400*				
		Annual operating costs	✓			$8,700,000				
		• *Regional buses*	✓	*105,200 hr*		*$7,000,000*				
		• *Community shuttle*	✓	*34,600 hr*		*$1,700,000*				
	Vehicle costs	Annual debt service costs	✓			$1,990,000				
		• *Regional buses*	✓	*31 buses*		*$1,800,000*				
		• *Community shuttle*	✓	*6 buses*		*$190,000*				
	Infrastructure costs	Transit terminals/layover facilities	✓		$3,000,000	$213,000				
		Trolley overhead	✓	1.9 km	$570,000	$40,000				
		Transit priority measures	✓		$0	$0				
		Annual operating/maintenance cost	✓			$50,000				
	Total annual costs		✓			$11,000,000	3			
Implementation	Timing and ease of implementation	Transit terminals/layover locations						✓	5	**5**
		Transit priority measures and roadway changes						✓	5	

Overall and qualitative scores are rated from 1 (worst) to 5 (best)

Factors

Service costs	Regional buses	$67	per hour
	Community shuttle	$50	per hour
Service hours	Weekday/simulation period ratio		
	• Regional buses	8.0	
	• Community shuttle	7.2	
	Annual/weekday ratio	320	
Vehicle costs	Regional bus debt service costs	$58,000	per bus
	Community shuttle bus debt service costs	$31,000	per bus
Infrastructure costs	Trolley overhead	$250,000	
Amortization		25	year amortization period
		5%	interest rate
		$0.0710	annual cost of $1 capital cost

UBC Campus Transit Plan

APPENDIX D

Open House Comment Sheet

1332.0048.01
June 2003

URBANSYSTEMS.

Campus Transit Plan

Comment Sheet

April 23, 2003

The Campus Transit Plan was initiated in Fall 2002 by UBC, TransLink and the GVRD. The objectives of the plan are to determine how transit service can best be provided to UBC in the future, and to determine how transit service can be improved to encourage more people to use transit at UBC.

The Campus Transit Plan is needed because the existing bus loop is over capacity, and cannot accommodate the increased transit ridership and service expected this fall with introduction of U-Pass. In determining how to expand or replace the bus loop, a wide variety of means of providing transit service at UBC have been considered. A preferred transit service concept has been identified based on a comprehensive evaluation of customer service and comfort, safety and security, environmental considerations and service efficiency.

This open house is your opportunity to learn more about the preferred transit service concept, and to provide input to the planning team. Your input will be considered in finalizing the Campus Transit Plan.

The recommendations of the Campus Transit Plan will be incorporated into other plans which UBC is developing — including the University Boulevard Neighbourhood Plan — as well as updates of the Official Community Plan and the Strategic Transportation Plan.

Please provide your comments on the reverse. You can return your comment sheet in the box marked “Completed Comment Sheets” or fax it to 604-822-6119. You can also e-mail your comments to transitplan@ubc.ca.

Copies of the open house display boards and this comment sheet can be downloaded from the Trek program Centre web site at www.trek.ubc.ca.

Thank you!

TRANSLINK

UBC

Greater Vancouver Regional District

1. **What features of Concept 1 do you like?**

2. **What features of Concept 1 do you not like or feel need to be improved?**

3. **Do you have any other comments or questions regarding the Campus Transit Plan?**

4. **Where do you live?**

- ☐ UBC
- ☐ University Endowment Lands
- ☐ Point Grey
- ☐ Dunbar
- ☐ Southlands
- ☐ Other Vancouver
- ☐ Elsewhere

5. **What do you do at UBC?**
(please check all that apply)

- ☐ Student
- ☐ Staff
- ☐ Faculty
- ☐ Visitor
- ☐ Other

Thank you!