D9A & D9B – THESIS

THESIS RESEARCH DOCUMENT

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ACKNOWLEDGEMENTS

I would like to kindly thank the following individuals for their support, leadership, and encouragement throughout the process known as the RAIC Syllabus program and now during Thesis: Michelle Deskin, Simon Glew, Ron Keays, Thomas Blood, Jerry Coviensky, Richard Kaplin, and Mr. & Mrs. Lozano.

I would like to invite all the readers to refer to Appendix A – Presentation Boards, which are the graphic representation of the same titles herein.

INTEGRATING SUSTAINABLE MOBILITY IN MONTREAL

Montreal is a city that has unequalled assets due to its cultural diversity, its' links to Europe, to the United States, and to the rest of Canada. All large cities conscious of their futures, and concerned about protecting their place on the global chess board innovate, build, renovate, re-invent…they move! To do so, their people must move, thus, the transportation systems offered must come in a variety of forms to have a well-balanced and accessible city. A key to having a great city is to have a great public transportation system which includes interconnected networks such as airport-to-city rail link, intercity and regional rail, metro, tram, bus, bike, and walk.

The current problem with public transportation in Montreal stems from the public's perception that multiple transportation systems are independent from one another. The current systems include intercity and regional rail service, metro and bus networks. The public's understanding of the problem is how to prioritize one of the new three main components proposed to join the public transportation system: a new airport shuttle with expanded intercity and regional train service; a new tram network; and an expanded bus service to the off-island suburbs.

This thesis shall demonstrate that an architectural solution, based on transportation and land-use decisions made simultaneously, can help solve the problem while none of the three main components need to be prioritized in a mutually exclusive manner; but rather that the role they play, and their integration into the ultimate solution, need to be clearly defined and explained to the public. The solution shall intend to be not only the main component in the transformation of a particular area in which it will be located, but also one of Canada's most comprehensive transport interchanges to encompass high-speed intercity trains, rapid regional rail services, and tram, metro and bus networks. In this sense, the 'architecture' will be a catalyst that allows the city a better understanding of itself, a prerequisite for the attraction and nurturing of people from the city and abroad, and demonstrate that Montreal knows how to evolve, develop itself, and above all, move.

A VISION

In 2002, Montreal adopted a Transportation Vision and strategic objectives consisting of:

> *"Meeting the transportation needs of all Montreal residents by providing our community with a high quality of life and ensuring its role as a prosperous and environmentally friendly economic powerhouse. To achieve this goal, Montreal intends to significantly reduce its dependence on cars through massive investment in various forms of public transit and active transportation, including the tramway system, the subway system, bus rapid service, trains, bikes and walking, and by encouraging such more appropriate uses for cars as carpooling, car-sharing and taxi service."*[1]

Since the current problem with public transportation in Montreal stems from the public's perception that multiple transportation systems are independent from one another, there must be a root to this stem. Alas, Montreal "*suffers from a metropolitan cacophony because of the multitude of organizations involved in public transit planning, a conference heard*"[2] during the week of June 15th, 2010. According to Gerald Beaudet, "*up to 19 organizations – transit authorities and regional and municipal bodies – can now be involved in planning, so it's no wonder conflicts arise involving transit coordination and fares…The symposium heard about a possible model for transit planning and funding in Montreal: Translink, the regional transportation authority in Vancouver that covers 22 municipalities, 1,800 square kilometers, and 2.3 million residents. To better coordinate and plan transport, it was created in 1999 with a unique structure. In addition to regional transit (buses, trains and ferries) and cycling infrastructures, it is responsible for major regional roads and bridges, and is involved in land-use planning…Ridership has grown 52% since TransLink's birth*"[2].

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[1] Montreal Transportation Plan; City of Montreal ; 2008; http://ville.montreal.qc.ca
[2] Transit planners get stuck in traffic; Andy Riga – Gazette Transportation Reporter, The Gazette, June 20th, 2010.

TransLink benefits from are a stable, dedicated and long-term funding, a 15-cent-per-litre regional gas tax (in the Montreal area, it is 5 cents per litre), and a strategy that involves land-use planning by creating frequent transit networks in areas where municipalities promise to foster transit oriented communities. How has Montreal suffered by not having its own regional transportation authority?

In Henry Aubin's editorial of June 5th, 2010, he enumerates various ambitious transportation plans for the Montreal metropolitan area such as "*the remake of the Turcot interchange, the light-rail line linking Brossard to downtown, the train to the airport, a fleet of new metro cars, the rehabilitation of the Champlain Bridge, the tram network, the redesign of the Bonaventure Expressway, and three new metro extensions. Phew. What do they all have in common? Each has been in the wind for years. None has gotten off the ground…It all testifies to a lack of strategic planning by all levels of government. No overarching vision exists.*"[1]

A Regional Transportation Authority in Montreal, like TransLink in Vancouver, could potentially hold the key to solving the problem of the public's perception by clearly defining and explaining to the public that no one component in the public transportation system needs to be prioritized in a mutually exclusive manner, but rather that the role they play, and their integration into the ultimate solution can be the result of transportation and land-use decisions made simultaneously. Furthermore, such an authority would have to plan for Montreal's growth in terms of population, jobs, and modes of transportation, as well as the intangible notion of people's change in transportation habits.

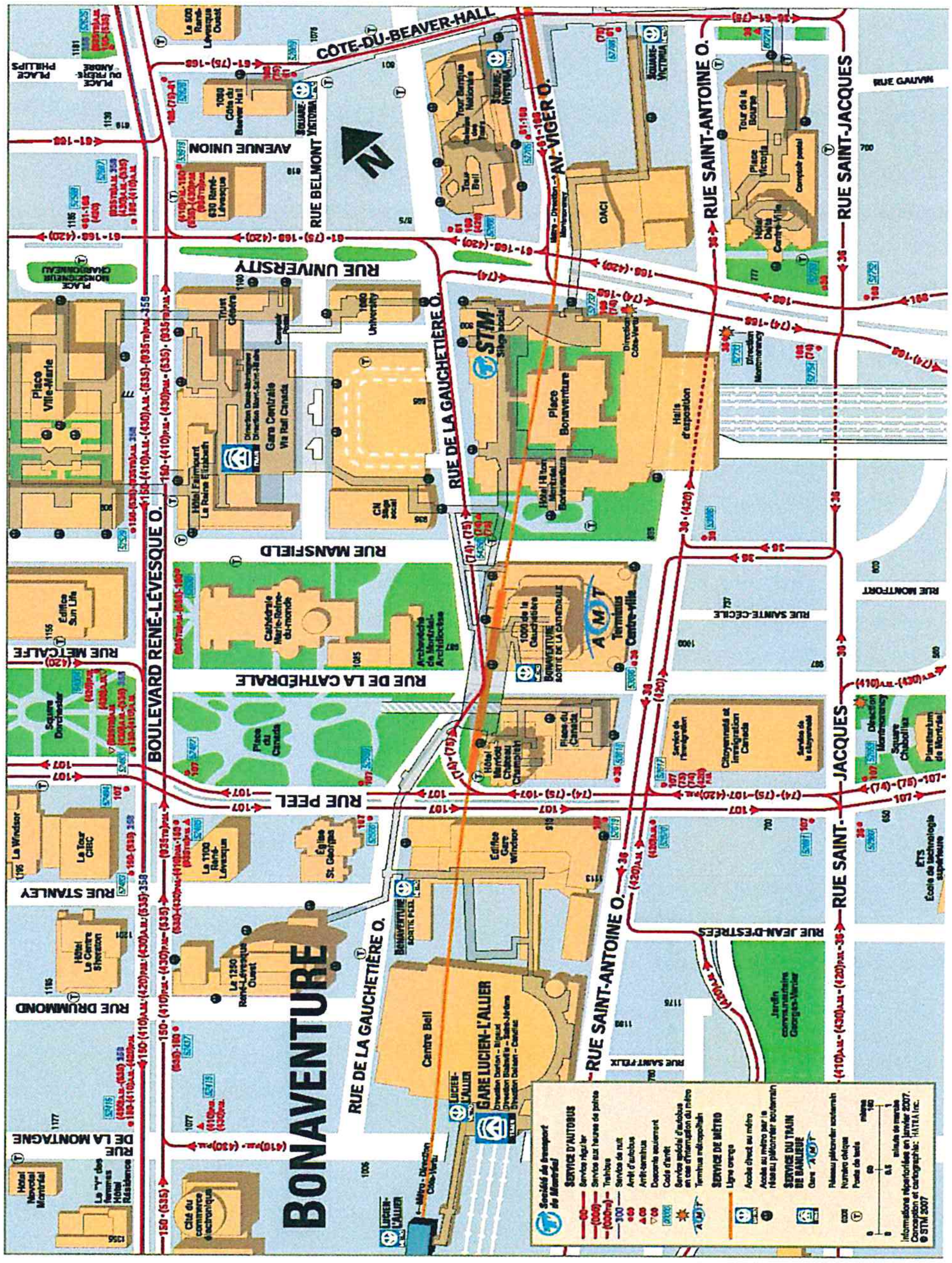
[1] Transport plans sit idling because agencies don't talk; Henry Aubin, The Gazette, June 5th, 2010.

PEOPLE ON THE MOVE

Based on Montreal Master Plan's growth forecasts, the Island of Montreal's population may climb by a little more than 9% by 2021. It also predicts some 110,000 new jobs on the island or 9.9% increase over the next 10 years[1]. Based on the expected growth of jobs and the population, the number of morning rush hour trips within and to the island could rise moderately by 2021, by approximately 10%. However, the modal share of public transit may decline in coming years simply because most new households will be established in more peripheral areas of the Island of Montreal. What this means is that "*the use of current ridership rates in projecting those for 2021 might reveal a decline in public transit's modal share for travel to the Island of Montreal.*"[2] Besides the distribution of population, the region's main employment hubs, population aging, and the rate of car ownership by households are all factors that can influence the modal share of public transit travel.

Currently, there are almost 500,000 morning rush-hour trips into the downtown core of Montreal. The core is bound by Jean-Talon on the North, Wellington on the South, Saint-Laurent on the East and Atwater on the West. Of that amount, about half enter the area equivalent to three (3) city blocks, known as the Gare Centrale or Bonaventure station via intercontinental rail, regional rail, metro, and bus. The key buildings known as terminals for these methods of transportation are illustrated on he following page as: Gare Lucien-L'Allier for regional rail from the West, Terminus Centre-Ville for the off-island regional bus service, and Gare Centrale for intercontinental rail and regional rail from the North, South and East.

[1] Master Plan of Montreal; p.48-49, City of Montreal, 2004; http://ville.montreal.qc.ca
[2] Montreal Transportation Plan; City of Montreal ; 2008; http://ville.montreal.qc.ca


CÔTE-DU-BEAVER-HALL
AV. VIGER O.
RUE SAINT-ANTOINE O.
RUE SAINT-JACQUES
AVENUE UNION
RUE BELMONT
RUE UNIVERSITY
RUE DE LA GAUCHETIÈRE O.
STM
RUE MANSFIELD
RUE METCALFE
RUE DE LA CATHÉDRALE
BOULEVARD RENÉ-LÉVESQUE O.
RUE PEEL
RUE STANLEY
RUE DRUMMOND
RUE DE LA MONTAGNE
BONAVENTURE
GARE LUCIEN-L'ALLIER
RUE SAINT-JACQUES
RUE SAINT-ANTOINE O.
RUE DE LA GAUCHETIÈRE O.

PUBLIC TRANSPORTATION SYSTEMS – EXISTING, PROPOSED & TERMINALS

Montreal's public transit systems were mostly all introduced in the 1960's and '70's in expectation of Expo '67 and the '76 Olympic Games. The Montreal Metro was inaugurated in time for Expo '67 as well as the Bonaventure Expressway that would link Montreal's downtown core to the Expo site. The metro continued its expansion throughout the 1970s and into the 1980's adding many stations. In the meantime, tramways were replaced by the metro and an expanded bus service throughout the island. These same systems continue to represent key means of transportation for the region of Greater Montreal.

However, in the early 90's, the Quebec government pulled out funding for public transit services, and told the municipalities to offset the shortfall. Needless to say, this caused a decline in bus and metro service as well as an abandonment of the existing infrastructures. But in recent years, fare increases, tax hikes, gas-tax increases, car ownership tax, etc., have been introduced to restore and now increase service levels on the Island of Montreal. Contrary to logic, commuter train service was restored in the 1990's. There are currently five (5) commuter lines now in operation, and two more are scheduled to begin service by 2015 including, the East-end and the West-end lines. The Montreal Transportation Plan of 2008 is looking at expanding the many existing transportation systems, and even studying bringing in a few new ones.

The existing public transportation systems consisting of regional rail, metro, bus service, bicycle-sharing program and paths, and the indoor pedestrian network, all interconnect at the Bonaventure Station. Furthermore, the proposed additions to the existing infrastructure: the airport rail-link with expanded regional rail service, a new tram network, and an expanded bus service to the off-island suburbs will all interconnect in the same location. However, there does not seem to be a vision or a strategy in the Montreal Transportation Plan that indicates how the current systems and new systems will interchange its people. After all, this is what it is all about, people!

The Terminus Centre-Ville (TCV) for off-island bus service is already functioning at 100% capacity which includes *"385 bus arrivals and departures during peak periods"*[1]. The service is scheduled to triple in the next 2 years, and maintain such volume until an LRT can be built. However, the LRT is dependent on a 'new' Champlain Bridge being built, which according to a newly released study indicates that a new bridge will be required, but not under construction for at least 7-9 years, and operational in 10 years at the earliest. Thus, a new bus terminal is required until an LRT can replace the buses, or will the LRT ever replace the buses, or will it complement an expanded bus service thanks to a new bus terminal?

The new tramway network will originate at the Bonaventure station and head north through the city. It will use the existing facilities of the Gare Centrale which are capable of handling additional 'rail' service.

The airport rail-link will have the same terminus as well. It will use existing railway tracks, except for the little portion currently under construction at the airport. The terminal of Gare Centrale is capable of handling this increase in passenger traffic. After all, Gare Centrale was built to accommodate up to two times the current traffic flow of 100,000 daily commuters.

[1] Montreal Transportation Plan; City of Montreal ; 2008; http://ville.montreal.qc.ca

REGION & NEIGHBORHOOD

The neighborhood in which the terminals are located is known as Griffintown. This parcel of land that sits at the foot of Montreal's famed Mount Royal and the Port of Montreal was once the gateway to Canada and North America. In the earliest days of Montreal, this land was owned by Jeanne Mance, who called it "the poor's farm" as its proceeds was used for the benefit of the poor of Hotel Dieu hospital. In the late 18th century, Montreal was under British rule, and this land was leased to Thomas McCord by the Nuns of Hotel Dieu. But while McCord tended to business in Britain, the land here continued to gain value with talk of construction of a navigable canal to access the great lakes. And so while McCord remained in Britain, the land was illegally sold by an unscrupulous business associate to a Mrs Mary Griffin who immediately drew up plans to subdivide the land into streets and building lots. Even though McCord managed to retrieve the land, it had already taken on the name of its developer.

This part of the city was the heart of the industrial revolution in Canada, while building the Grand Trunk Railway, the Victoria Bridge, and the Lachine Canal. Even as late as the 1960's, this area was still rampant with industry in close proximity to the city core. However, when the Bonaventure Expressway came along, it created a tear in the urban fabric. The railway that had preceded the expressway, had been elevated to allow passage of chariots and automobiles underneath it along the same roads that existed before. However, the expressway that was also elevated created a rip in the urban fabric because its pillars were close in proximity not allowing the short city blocks to continue underneath it. Furthermore, the spaces under the expressway were left as derelict urban spaces. The expressway separates a residential area (Old Montreal) from an industrial area (Griffintown).

The Montreal Master Plan in conjunction with the Societe du Havre de Montreal proposed to tear down the elevated portion of the expressway and turn it into an urban boulevard with plots of land in the middle of the north and south directions of traffic. In my Design Studio D8 Urban Design, I proposed an alternative solution all the while maintaining the intent of the Master Plan to keep the urban boulevard, however, fill the space between the north and south directions of traffic with green areas (see Street & Building boards in Appendix A). Make the entrance to the city one to remember, every day.

ORIENTE STATION

Oriente Station was the result of an invited competition, which Calatrava won in 1993. The station was intended to be the primary transportation connection for the 1998 World's Fair that Portugal was to host in the Olivais district, some five kilometers from the heart of Lisbon.

The station is located between the railway and the river embankment, the area was an industrial wasteland at the time of the competition to be completely renewed after the fair ended. The planners and city officials intended the station to become not only the main component in the transformation of the whole area but also one of Europe's most comprehensive transport interchanges to encompass high-speed intercity trains, rapid regional transport, standard rail services, and tram and metro networks. Responding to the challenge, Calatrava, once more appealed to the ambitions of the planning committee, going beyond the strict requirements of the competition to propose a comprehensive urban plan. Thus, in addition to the scheme for a new station on the existing railway lines - which crossed the district on the embankment, defining the western edge of the fair's site; historically a dividing line between residential and industrial areas.

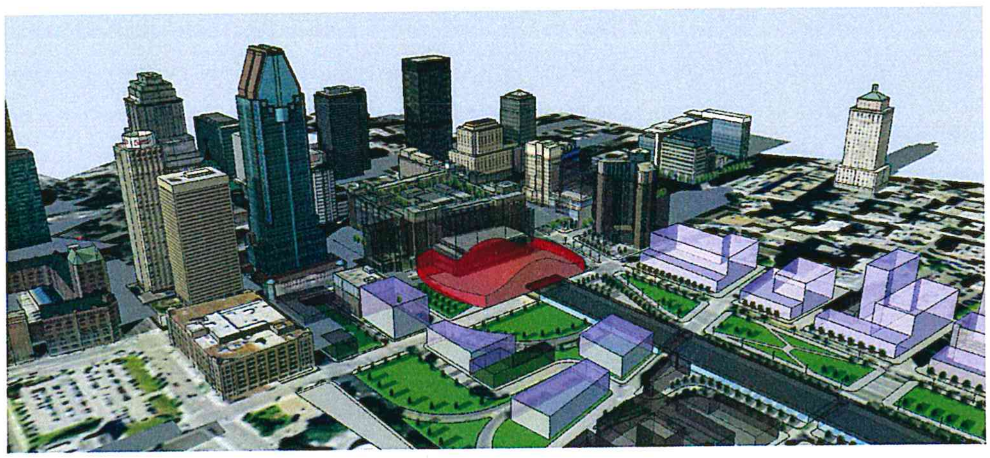
The Oriente station is an inter-modal terminal: Its facilities serve and interconnect several forms of transport. Passengers can change between metropolitan, long- and medium-haul regional and international trains. There are connections into the underground system, national and metropolitan buses or taxis. There is also an airport link and check-in

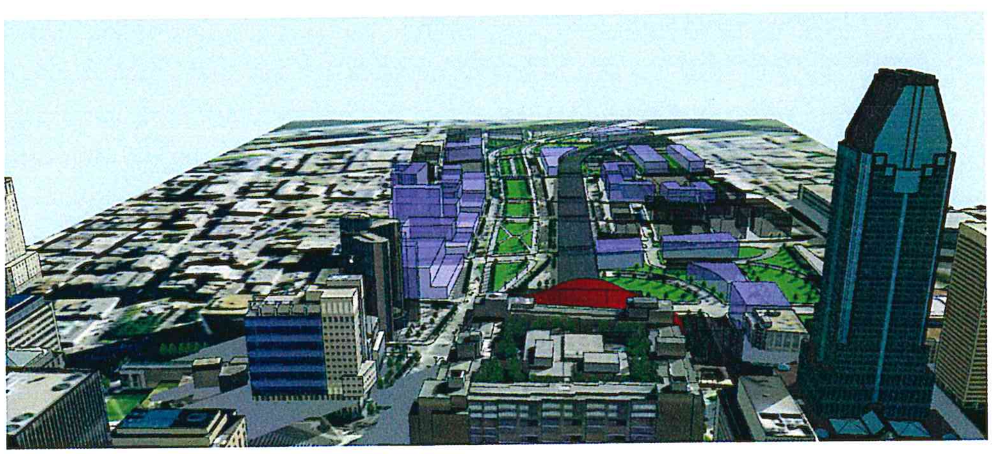
facilities. The station is made out of three self-contained parts and is divided into two levels. The raised level holds the platforms for the national train network; the lower level connects to the underground and emerges at the surface to serve as an entrance to the Expo grounds and also to connect with the third element of the project, a major bus terminal for the city. The four platforms of the train station are reached through ramps or cylindrical glass lifts. These platforms serve eight lines of tracks. The platforms are roofed by a metal structure 25 meters high. This elegant solution consists of a series of slender pillars that split on the top and connect with each other to create a continuous folding structure.

Consistent with the rest of Calatrava's work the analogies from the natural world jump into people's minds: The group of pillars resemble palm trees or lilies, and in a geometric sense it is not far from the also floral fan vaults of the British perpendicular gothic. The structural elements are painted white and the nerves of these so-called palms spread out to hold a folding glass roof where geometry and organic shapes find a synthesis in abstraction. The sky of Lisbon is bright and the heat of the sun implacable; however the metal and glass palms forms a sort of floating oasis with a view to the river, where perhaps the only technical failing is its lack of protection from cross winds. If the raised level stands like an oasis, the ground level is a cave; a huge manmade cavern that shelters the movements of the people from one form of transport to the other. And if the train platforms lie some where within the vegetal kingdom, the ticket hall below is more animal. The concrete arches that define the spatial structure of this space resemble the rib structure of some extinct creature, yet their proportion and arc give an impression of stability and lightness. Transiting through the space there is almost no awareness of the load of trains that the columns support. The movement of the columns as they describe their arches makes an arresting setting together with the hanging bridges, connecting tunnels, lifts and elevators. The main material is concrete, the bridge parapets are made of glass, and the pavement is the typical stonework used in the streets of Lisbon. Metal appears again as the connection to the bus station and as the colossal cantilevered roof that signals the gate to the Expo grounds. The span of this roof is simply mind-blowing, even after experiencing the rest of the structural feats that make up the project. The Bus station is rather straightforward in the structural sense, but no less expressive. Perhaps the distinction of the project elements through the use of material and structure gives to the station a strange sense of fragmentation but each of the pieces is masterfully synthetic in themselves.

PROPOSED SOLUTION

The architectural solution is where the architecture is the catalyst that allows the city a better understanding of itself by providing a space where people can interconnect with their various public transportation systems. Furthermore, it will provide an architectural solution to urban problem as well as a social, political, and economical problem. This is the type of project this city needs to attract people to the city and nurture those people from the city. The proposed new intermodal terminal at Bonaventure (in RED) could be jump-started by a new Regional Transportation Authority, or vice-versa.





The proposed solution is functionally based on the human scale, the Nova Bus and the Bombardier Tram platforms. These modules were integrated into the existing railway and Bonaventure railway station. The architectural form is based on two elements: the free-flowing roof representing the joie-de-vivre of Montrealers; and the mostly glass perimeter walls representing the transparency between building and means of transit. The high part of the roof will be covered in PV panels capable of producing over 10,000 kW, while the low part of the roof will be a green roof capable of mitigating the rain water runoff from the PV panels above it.

The interior circulation is connected to Montreal's famous underground pedestrian network which will link the building to two (2) existing metro stations of Bonaventure and Square Victoria, the Bonaventure Railway station, and many landmark buildings of the downtown core such as Place Ville-Marie, Square Victoria and the Quartier International, and the Bell Center. The facility will accommodate a park-and-ride underground parking including for car-sharing service already in full swing in Montreal, known as Communauto. It will also be connected to the proposed viaduct shops located under the exiting railway (currently a self-storage).

The building ground floor area will have a drop-off and pick-up on the west side, taxi stand on the north side, and Tram stop on the south side. The east side is maintained liberated so as to not infringe onto University Street and its proposed reserved bus and taxi lanes. The bus platforms are mostly encased in glass and served by two (2) sets of stairs each as well as an elevator. Each platform can accommodate up to eight (8) buses simultaneously, for a total of forty (40) bus gates in the building. This allows to double the amount of gates compared to the current bus terminal which only has twenty (20) gates, thus allowing a tripling of service. All floors would be open spaces as much as possible except for service rooms such as washrooms, janitor rooms, and a few lease area possibilities in the middle of the main hall. The intent is to maintain an airy-like feel for each person experiencing the building either entering from the street or coming off a bus, train, Tram, LRT, or metro. The third floor houses the platform to the Airport Rail train as well as the stairway leading to the Bonaventure Conference Halls located in the middle floors of the Bonaventure Railway Station and Hilton Hotel. The ceiling of the station is red cedar wood so as to bring warmth to the building given that the balance is white-painted steel, aluminum and glass, and ceramic floors.

This building culminates the proposed Bonaventure urban boulevard and this is how the architecture can be a catalyst that allows the city a better understanding of itself and demonstrates that Montreal knows how to evolve, develop itself, and above all, move.

METHODOLOGY

The methodology used for this Thesis was to complete the reading of the Literature Material which allowed for a more in-depth understanding of the challenges ahead in order to provide an architectural solution where none of the new three main components proposed to join the public transportation system need to be prioritized in a mutually exclusive manner. These challenges were documented and illustrated so as to allow a third party the ability to understand the problem that Montrealers face and allow the exploration of how architecture can be a catalyst that allows the city a better understanding of itself.

The project development shall undergo the following steps:

1. Program & Design Development
    a. Program Development:
        i. Document and illustrate the problem
        ii. Explore architectural solutions that could solve the problem, attain the goal of a catalyst, and choose the best.
        iii. Provide a critical analysis of the best architectural solution through an analysis of the architectural, economic, social, political, and urban issues.
        iv. Propose the architectural solution and potential sites
        v. Choose the site
        vi. Program Analysis
    b. Schematic Design
    c. Interim Presentation
    d. Final Development
    e. Final Presentation

BIBLIOGRAPHY

The Primary Literature Material listed here below shall bring an understanding of the vision and strategic objectives to be set out in order to meet the transportation needs of all Montreal residents and visitors.

The Secondary Literature Material list demonstrates the problems and solutions in other cities in the world that were similar to those encountered currently in Montreal.

PRIMARY LITERATURE MATERIAL CONSIDERED SHALL BE:

Clear-Eyed Vision of Quebec; Lucien Bouchard et al.; 2005; www.pourunquebeclucide.com

Master Plan of Montreal; City of Montreal, 2004; http://ville.montreal.qc.ca

Montreal Transportation Plan; City of Montreal ; 2008; http://ville.montreal.qc.ca

The Smart Growth Manual; Andres Duany and Jeff Speck with Mike Lydon; McGraw-Hill, 2010

SECONDARY LITERATURE MATERIAL CONSIDERED SHALL BE:

Architecture Theory since 1968; K. Michael Hays; MIT Press, 2000

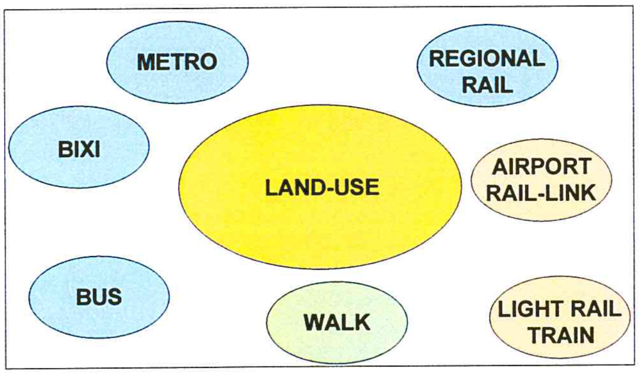
Architectural Record - Transit Takes Off; March 2010; McGraw-Hill, 2010

Precedents in Architecture; Roger H. Clarke and Michael Pause; John Wiley & Sons, 2005

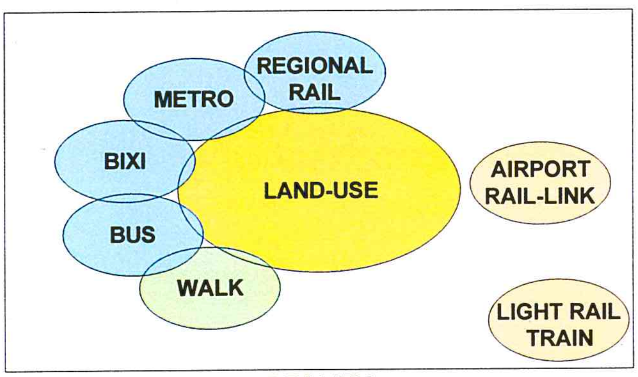
Santiago Calatrava, The Complete Works; Alexander Tzonis; Rizzoli International Publications Inc., 2004

SITE Identity in Density; Michael Crosby, Michael McDonough, James Wines; The Images Publishing Group Pty Ltd., 2005

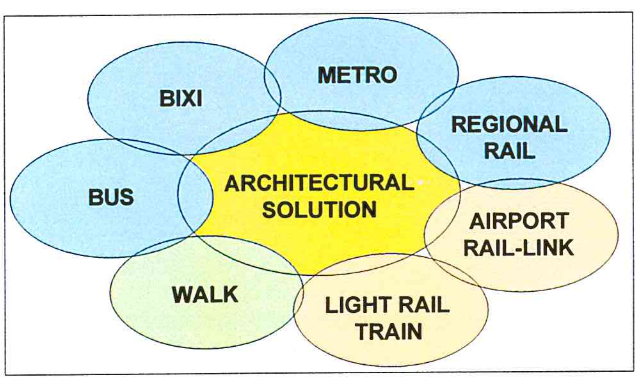
Theorizing a New Agenda for Architecture; Kate Nesbitt; Princeton Architectural Press, 1996



PUBLIC PERCEPTION



REALITY



ULTIMATE GOAL

Montreal is a city that has unequalled assets due to its cultural diversity, its' links to Europe, to the United States, and to the rest of Canada. All large cities conscious of their futures, and concerned about protecting their place on the global chess board innovate, build, renovate, re-invent...they move! To do so, their people must move, thus, the transportation systems offered must come in a variety of forms to have a well-balanced and accessible city. A key to having a great city is to have a great public transportation system which includes interconnected networks such as airport-to-city rail link, intercity and regional rail, metro, tram, bus, bike, and walk.

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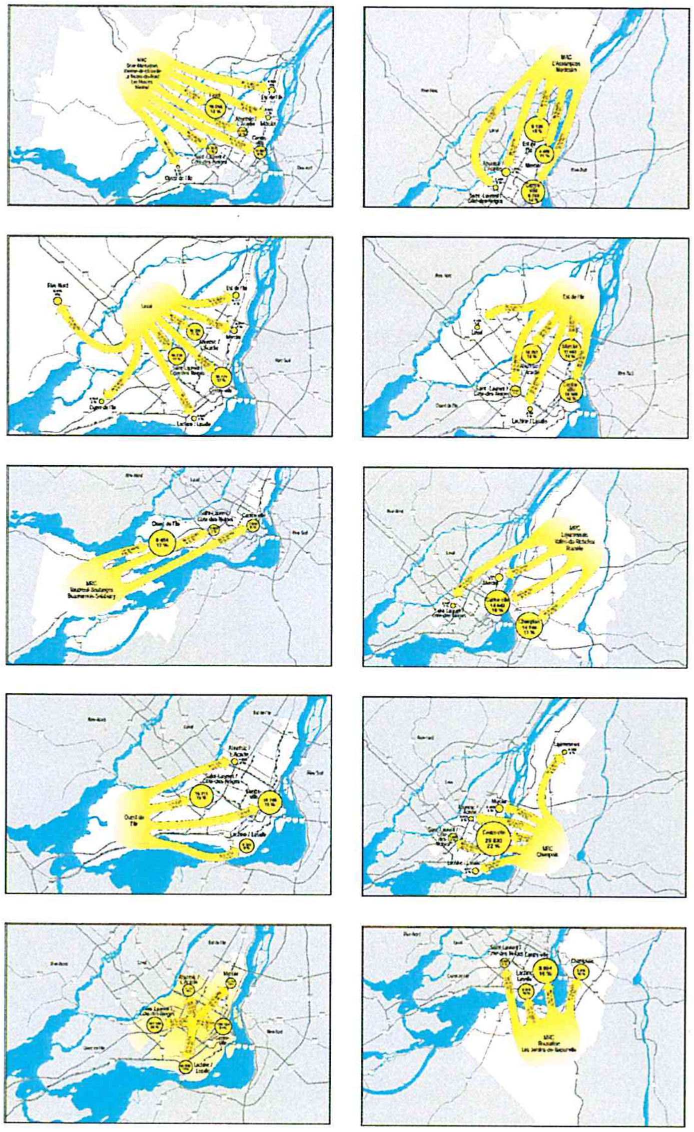
This thesis shall demonstrate that an architectural solution, based on transportation and land-use decisions made simultaneously, can help solve the problem while none of the three main components need to be prioritized in a mutually exclusive manner; but rather that the role they play, and their integration into the ultimate solution, need to be clearly defined and explained to the public. The solution shall intend to be not only the main component in the transformation of a particular area in which it will be located, but also one of Canada's most comprehensive transport interchanges to encompass high-speed intercity trains, rapid regional rail services, and tram, metro and bus networks. In this sense, the 'architecture' will be a catalyst that allows the city a better understanding of itself, a prerequisite for the attraction and nurturing of people from the city and abroad, and demonstrate that Montreal knows how to evolve, develop itself, and above all, move.



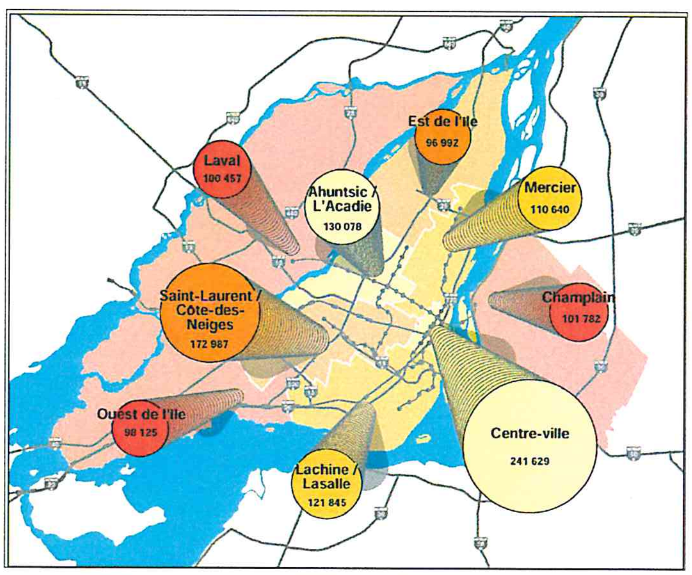


TABLE 1 | Predicted Population Growth in Greater Montréal, 2001-2021 *(in thousands)*

	HOUSEHOLDS		CHANGE (%)	POPULATION		CHANGE (%)
	2001	2021		2001	2012	
Island of Montréal	805.8	943.4	17.1%	1,812.7	1,981.2	9.3%
Rest of Greater Montréal	611.6	774.0	26.6%	1,613.7	1,869.1	15.8%
Total	1,417.4	1,717.4	21.2%	3,426.4	3,850.3	12.4%

TABLE 2 | Predicted Job Growth in Greater Montréal, 2001-2021 *(in thousands)*

	JOBS		CHANGE (%)
	2001	2021	
Island of Montréal	1 112.8	1,223.0	9.9%
Rest of Greater Montréal	509.9	682.2	33.8%
Total	1,622.7	1,905.2	17.4%

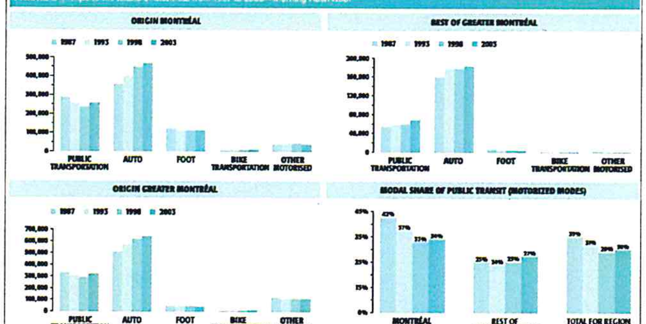
TABLE 3 | Predicted Growth in Number of Trips in Greater Montréal, 2003-2021—Morning Rush Hour *(in thousands)*

NUMBER OF TRIPS IN 2003	DESTINATION		
ORIGIN	ISLAND OF MONTRÉAL	REST OF GREATER MONTRÉAL	TOTAL
Island of Montréal	885	53	**938**
Rest of Greater Montréal	271	687	**958**
TOTAL	1,156	740	1,896

NUMBER OF TRIPS IN 2021	DESTINATION		
ORIGIN	ISLAND OF MONTRÉAL	REST OF GREATER MONTRÉAL	TOTAL
Island of Montréal	976	68	**1,044**
Rest of Greater Montréal	292	841	**1,133**
TOTAL	1,268	909	2 177

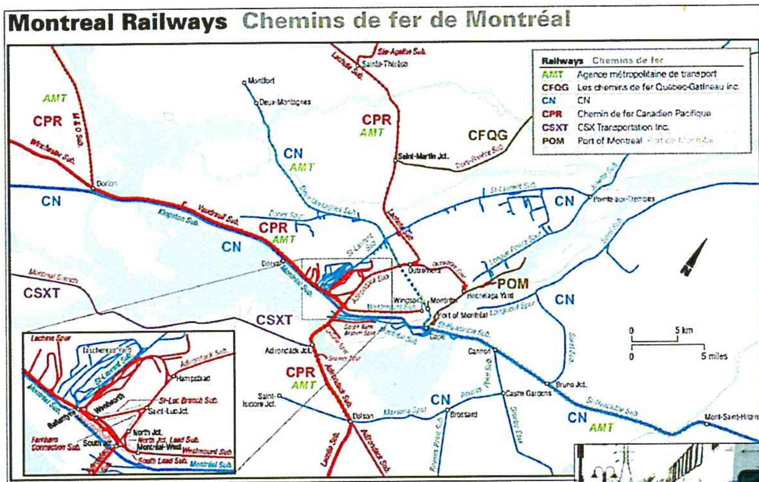
CHANGE FROM 2003-2021	DESTINATION		
ORIGIN	ISLAND OF MONTRÉAL	REST OF GREATER MONTRÉAL	TOTAL
Island of Montréal	10.3%	28.3%	**11.3%**
Rest of Greater Montréal	7.7%	22.4%	**18.3%**
TOTAL	9.7%	22.8%	14.8%

FIGURE 2 | Trips to the Island of Montréal from 1987 to 2003—Morning Rush Hour



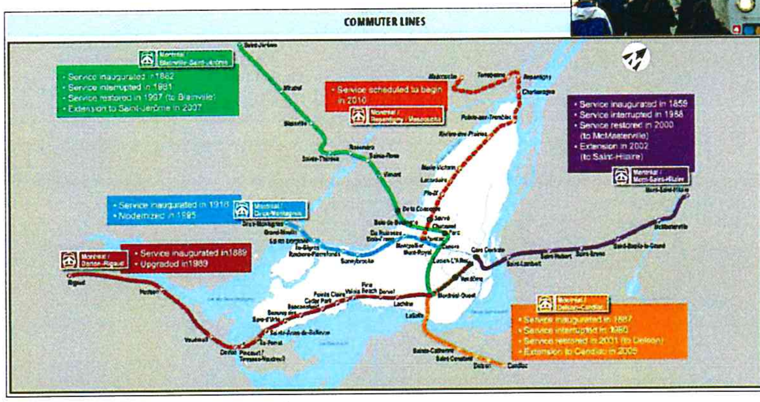
Source: AMT, O-D surveys 1987-2003. Processed by the STM and Tecsult in 2006.

PEOPLE ON THE MOVE



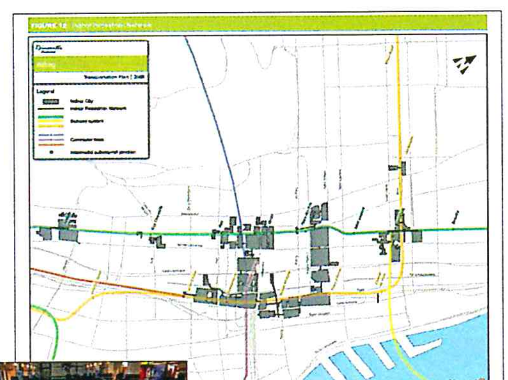
INTERCONTINENTAL RAIL & REGIONAL RAIL

ROAD SYSTEM FOR BUS SYSTEM



REGIONAL RAIL

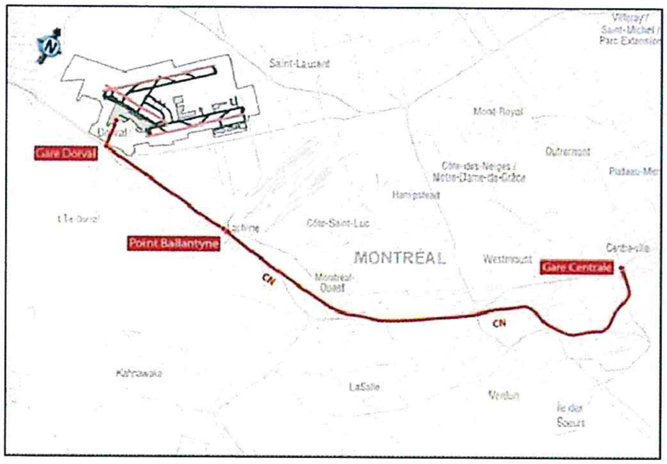
BIKE PATH NETWORK



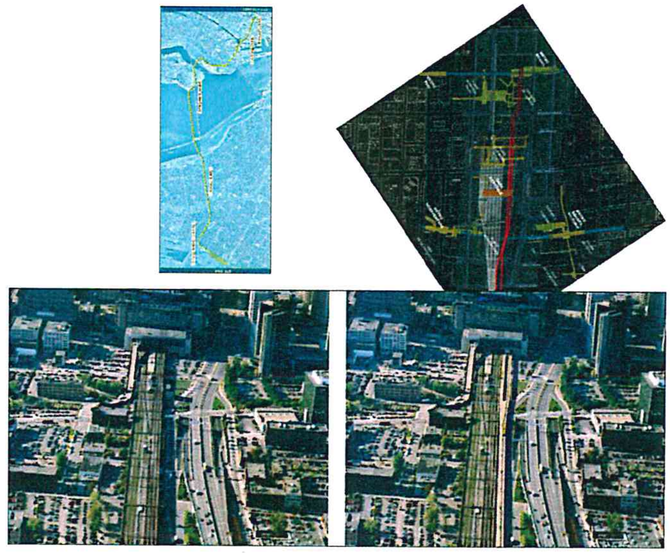
METRO

INDOOR PEDESTRIAN NETWORK

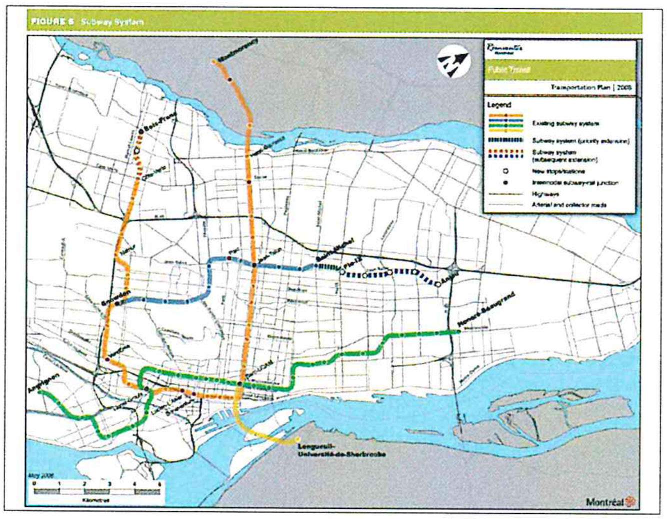
EXISTING PUBLIC TRANSPORTATION SYSTEMS



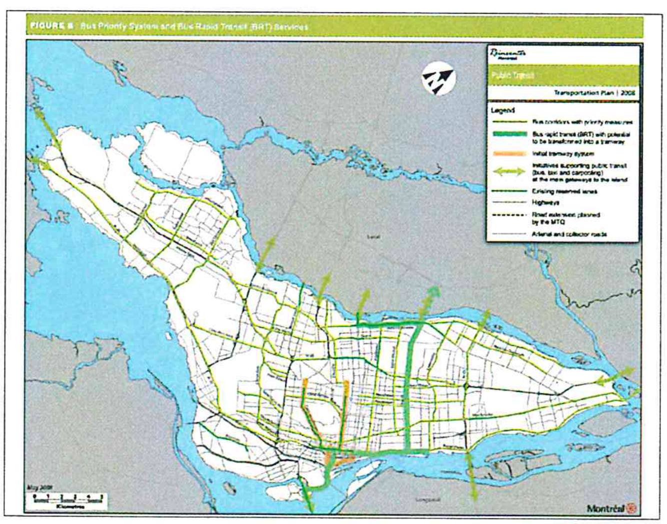
AIRPORT RAIL LINK



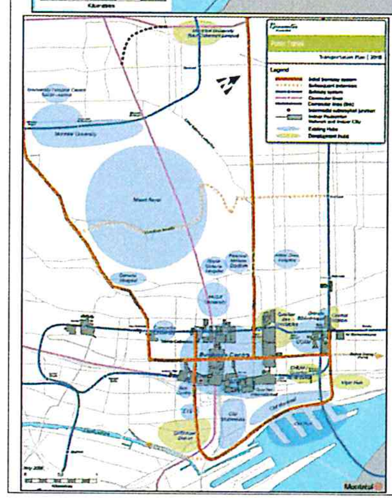
NEW LRT NETWORK



METRO EXTENSION



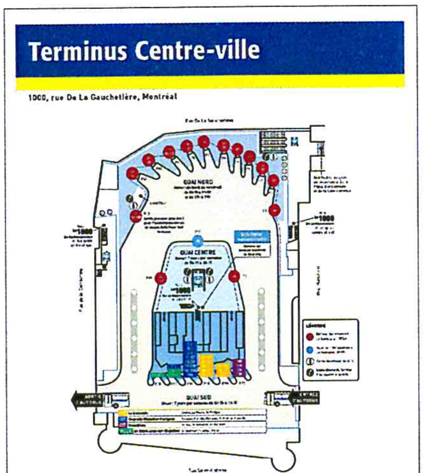
BUS NETWORK EXPANSION



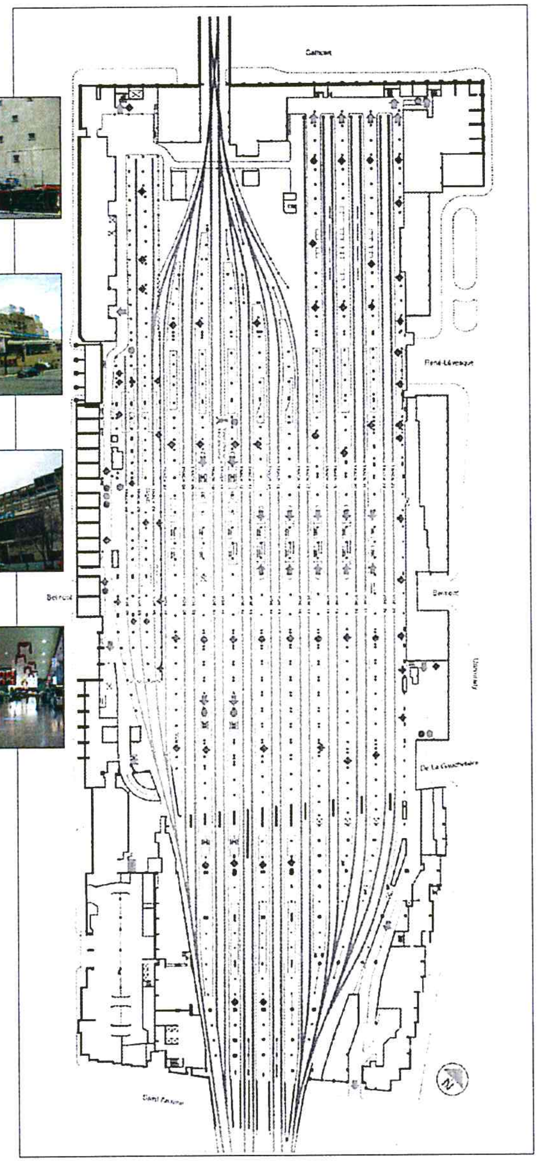
NEW TRAMWAY NETWORK

PROPOSED PUBLIC TRANSPORTATION SYSTEMS

NEIGHBORHOOD MAP



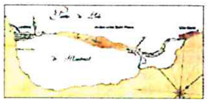
BUS NETWORK TERMINAL



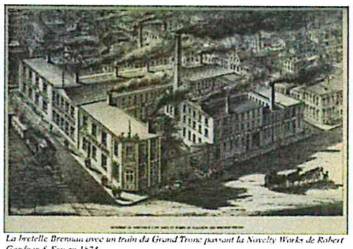
GARE CENTRALE - BONAVENTURE STATION

LUCIEN L'ALLIER TRAIN STATION (FORMERLY WINDSOR STATION)

Gravure de 1817 : le fort de la Montagne sur le domaine des sulpiciens (site actuel du Grand Séminaire, rue Sherbrooke). M971.171 McCord



Plan de 1733, montrant la rivière Saint-Pierre, le lac Saint-Pierre et des segments de canal proposés entre Ville-Marie et Lachine (G.-J. Chaussegros de Léry.



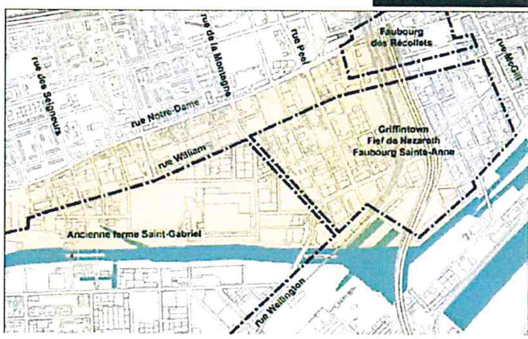
La bretelle Brennan avec un train du Grand Tronc passant la Novelty Works de Robert Gardner & Son en 1874
Source : De Volpi et Winkworth, Montréal, Recueil iconographique, volume 2

PROBLEM STATEMENT

THE TEAR IN THE URBAN FABRIC MADE BY THE BONAVENTURE EXPRESSWAY CAUSED THE DIVISION OF A ONCE VIBRANT & SUCCESSFUL NEIGHBORHOOD KNOWN AS GRIFFINTOWN.

THE PROBLEM IS THAT TRANSPORATION AND LAND-USE DECISIONS WERE NOT MADE IN TANDEM.

IN THIS CASE, IN THE MID-1800'S, THE RAILWAY BEGAN TO RUN DIRECTLY INTO TOWN TO BONAVENTURE RAILWAY STATION. IN THE 1930'S, THE RAILWAY WAS ENLARGED AND ELEVATED CREATING TUNNELS UNDERNEATH FOR THE ROADWAYS TO RUN EAST-WEST. IN THE 1960'S TO ACCOMODATE THE INCREASE IN TRAFFIC FROM THE DOWNTOWN CORE TO EXPO '67, THE BONAVENTURE WAS ERECTED AS AN ELEVATED HIGHWAY CREATING THE RIP IN THE URBAN FABRIC WHICH WAS THE NEIGHBORHOOD OF GRIFFINTOWN.

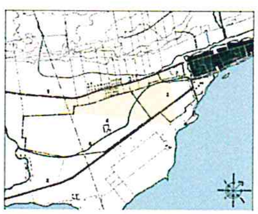


SOUTHWEST MONTREAL

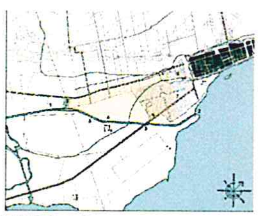
Départ du premier train Montréal & Lachine de la gare Bonaventure au Square Chaboillez en 1847
Source : Tableau par Jeffreys, Musée Château Ramezay

L'église Ste-Anne de 1854 au milieu des maisons ouvrières et des hangars de charbon en 1896
Source : Photo Notman, Musée McCord, View-2942

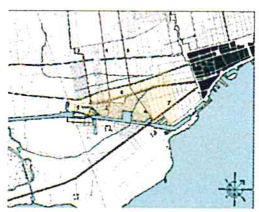
HISTORY OF MONTREAL'S SOUTHWEST



1645 - 1800 1. UPPER LACHINE ROAD (TODAY: NOTRE-DAME STREET); 2. LOWER LACHINE ROAD (WELLINGTON STREET); 3. GREY NUNS PROPERTY - NAZARETH COUNTY; 4. SAINT-GABRIEL FARM (OWNED BY SULPICIENS); 5. SAINT-PIERRE RIVER (DRAINAGE FOR AGRICULTURAL LAND & ENERGY FOR MILLS)

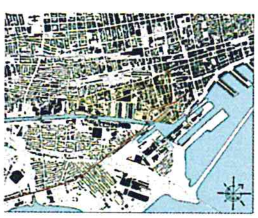


1800 - 1845 1. FIRST NAVIGABLE CANAL BUILT BETWEEN 1819 & 1826; 2. FIRST LOCKS; 3 SAINT-GABRIEL FARM; 4. SAINT-GABRIEL FARM BRIDGE; 5. LOWER LACHINE ROAD (TODAY: WELLINGTON STREET)

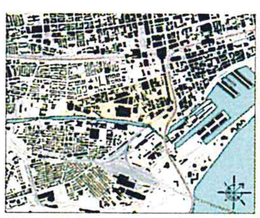


1845 - 1880 1. SAINT-GABRIEL LOCKS; 2. SULPICIENS CREATE LOT DIVISIONS OF THEIR FORMER LAND; 3. RUE DES SEIGNEURS LINKS THE FARM TO THE MOUNTAIN FORT; 4. GUY STREET LINKS THE LACHINE CANAL TO COTE-DES-NEIGES AND MOUNT-ROYAL; 5. DE LA MONTAGNE BOUNDS THE SULPICIENS' LAND AND LINKS TO WELLINGTON STREET; 6. WILLIAM STREET LINKS THE HYDRAULIC BASSIN TO PLACE D'YOUVILLE; 7. SAINT-ANN'S WARD IS CREATED WITH THE AMALGAMATION OF GRIFFINTOWN, PART OF FAUBOURG RECOLLETS AND PART OF POINTE ST-CHARLES

1880 - 1915 1. CONSTRUCTION OF VICTORIA BRIDGE AND POINTE ST-CHARLES RAIL SHOPS; 2. THE RAILWAY DIVIDES THE LAND AND BUILDINGS ARE CONSTRUCTED IN CONSEQUENCE TO THEIR LOCATION RELATIVE TO THE RAILWAY; 3. GRIFFINTOWN HOUSING AND INDUSTRY IS ESTABLISHED ON EITHER SIDE OF WELLINGTON STREET; 4. LOADING DOCKS AND DEVELOPED ON EITHER SIDE OF THE SAINT-GABRIEL LOCK; 5. PEEL BASSIN

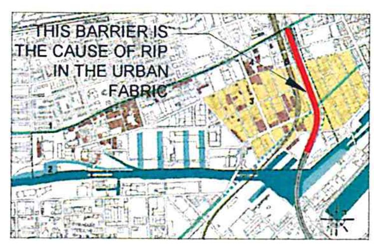


1915 - 1960 1. AN ELEVATED RAILWAY IS CONSTRUCTED TO LINK THE VICTORIA BRIDGE TO THE NEWLY BUILT BONAVENTURE STATION; 2. BONAVENTURE STATION; 3. WELLINGTON STREET IS DEVIATED TO ACCOMODATE NEW RAILWAY; 4. RAILWAY YARD AND STORAGE (TODAY: MY HOME)



1960 - 1990 1. VILLE-MARIE EXPRESSWAY; 2. RESIDENCES BUILT ON TOP OF FORMER RAILWAY YARDS; 3. THE ELEVATED BONAVENTURE HIGHWAY IS CONSTRUCTED AND DIVIDES ST-ANN'S WARD; 4. ALL LOADING DOCK BASINS ARE INFILLED AND ACCOMODATE A NEW CANADA POST BUILDING; 5. PEEL BASSIN PARTIALLY INFILLED; 6. LOCKS PARK IS REVITALIZED IN 1990

1990 - 2000 1. OLD MONTREAL AND LACHINE CANAL NATIONAL HISTORIC PARK IS REVITALIZED BETWEEN 1997-2002; 2. PEEL BASIN IS DUG-OUT AND RETURNED TO ORIGINAL CONFIGURATION; 3. REDPATH AND BELDING-CORTICELLI BUILDINGS TURNED INTO RESIDENTIAL LOFTS; 4. NEW RESIDENTIAL BUILDINGS CONSTRUCTED ALONG THE CANAL; 5. CANADA POST BUILDING AND OTHER CANADA LANDS PROPERTIES BECOME AVAILABLE FOR REDEVELOPMENT; 6. ECOLE DE TECHNOLOGIE SUPERIEUR TAKES OVER THE FORMER OKEEFE BUILDINGS (FORMERLY DOW); 7. QUARTIER INTERNATIONAL; 8 FAUBOURG DES RECOLLETS; 9 CITE MULTIMEDIA

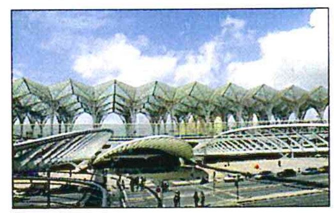


TODAY 1 NOTRE-DAME AND WELLINGTON STREETS ARE TEH HERITAGE STREETS THAT BOUND THE NEIGHBORHOOD NORTH AND SOUTH RESPECTIVELY; 2. THE LACHINE CANAL ALLOWED FOR SHIPS TO AVOID THE LACHINE RAPIDS DURING THE INDUSTRIAL REVOLUTION UNTIL THE ST-LAWRENCE SEAWAY WAS OPENED FOR SHIPPING; 3. THE FORMER NAZARETH COUNTY, GRIFFINTOWN, AND ST-ANN'S WARD WERE THE FIRST NEIGHBORHOODS TO BE DEVELOPED WITH AN ORTHOGONAL GRID; 4 MANY HERITAGE BUILDINGS WERE LOST OVER THE YEARS, THOSE REMAINING ARE SEEN IN RED; 5 RAILWAY VIADUC; 6 BONAVENTURE HIGHWAY

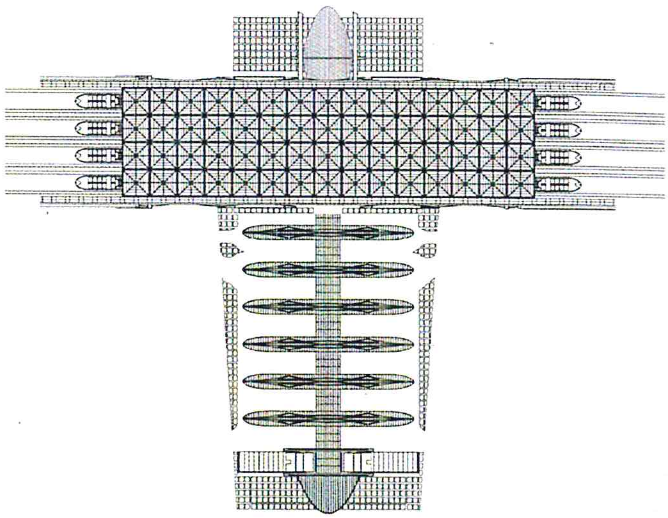
Oriente Station was the result of an invited competition, which Calatrava won in 1993. The station was intended to be the primary transportation connection for the 1998 World's Fair that Portugal was to host in the Olivais district, some five kilometers from the heart of Lisbon.

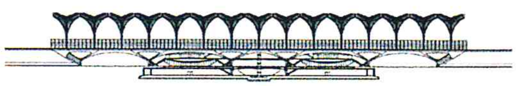
The station is located between the railway and the river embankment, the area was an industrial wasteland at the time of the competition to be completely renewed after the fair ended. The planners and city officials intended the station to become not only the main component in the transformation of the whole area but also one of Europe's most comprehensive transport interchanges to encompass high-speed intercity trains, rapid regional transport, standard rail services, and tram and metro networks.

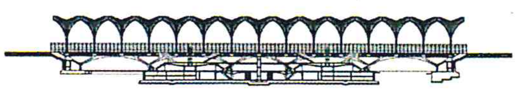
Responding to the challenge, Calatrava, once more appealed to the ambitions of the planning committee, going beyond the strict requirements of the competition to propose a comprehensive urban plan. Thus, in addition to the scheme for a new station on the existing railway lines - which crossed the district on the embankment defining the western edge of the fair's site, historically a dividin line between residential and industrial areas.

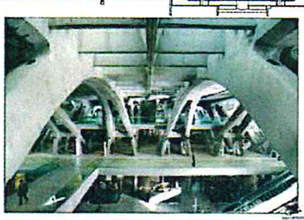


ORIENTE STATION - LISBON, PORTUGAL









The Oriente station by Santiago Calatrava was commissioned by the city of Lisbon in 1993, after an invited competition. Its immediate goal was to serve the great number of visitors expected for the World Expo in 1998.

In the future the station is set to become the main train terminal of the city, since the main growth of Lisbon is planned towards that side of the Tagus River. Moreover, the building that used to host the Portuguese Pavilion (by Alvaro Siza) is expected to house the city government, which together with other permanent buildings remaining from the Expo form part of what is nowadays known as Parque das Naçoes, a new city park. All of these initiatives are aimed at contributing to the creation of a new city center.

The Oriente station is an inter-modal terminal: Its facilities serve and interconnect several forms of transport. Passengers can change between metropolitan, long- and medium-haul regional and international trains. There are connections into the underground system, national and metropolitan buses or taxis. There is also an airport link and check-in facilities.

The station is made out of three self-contained parts and is divided into two levels. The raised level holds the platforms for the national train network; the lower level connects to the underground and emerges at the surface to serve as an entrance to the Expo grounds and also to connect with the third element of the project, a major bus terminal for the city.

The four platforms of the train station are reached through ramps or cylindrical glass lifts. These platforms serve eight lines of tracks. The platforms are roofed by a metal structure 25 meters high. This elegant solution consists of a series of slender pillars that split on the top and connect with each other to create a continuous folding structure.

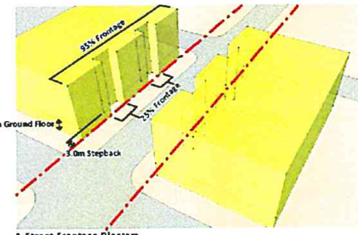
Consistent with the rest of Calatrava's work the analogies from the natural world jump into people's minds: The group of pillars resemble palm trees or lilies, and in a geometric sense it is not far from the also floral fan vaults of the British perpendicular gothic. The structural elements are painted white and the nerves of these so-called palms spread out to hold a folding glass roof where geometry and organic shapes find a synthesis in abstraction. The sky of Lisbon is bright and the heat of the sun implacable; however the metal and glass palms forms a sort of floating oasis with a view to the river, where perhaps the only technical failing is its lack of protection from cross winds.

If the raised level stands like an oasis, the ground level is a cave; a huge manmade cavern that shelters the movements of the people from one form of transport to the other. And if the train platforms lie some where within the vegetal kingdom, the ticket hall below is more animal. The concrete arches that define the spatial structure of this space resemble the rib structure of some extinct creature, yet their proportion and arc give an impression of stability and lightness.

Transiting through the space there is almost no awareness of the load of trains that the columns support. The movement of the columns as they describe their arches makes an arresting setting together with the hanging bridges, connecting tunnels, lifts and elevators. The main material is concrete, the bridge parapets are made of glass, and the pavement is the typical stonework used in the streets of Lisbon. Metal appears again as the connection to the bus station and as the colossal cantilevered roof that signals the gate to the Expo grounds. The span of this roof is simply mind-blowing, even after experiencing the rest of the structural feats that make up the project.

The Bus station is rather straightforward in the structural sense, but no less expressive. Perhaps the distinction of the project elements through the use of material and structure gives to the station a strange sense of fragmentation but each of the pieces is masterfully synthetic in themselves.

ORIENTE STATION - LISBON, PORTUGAL

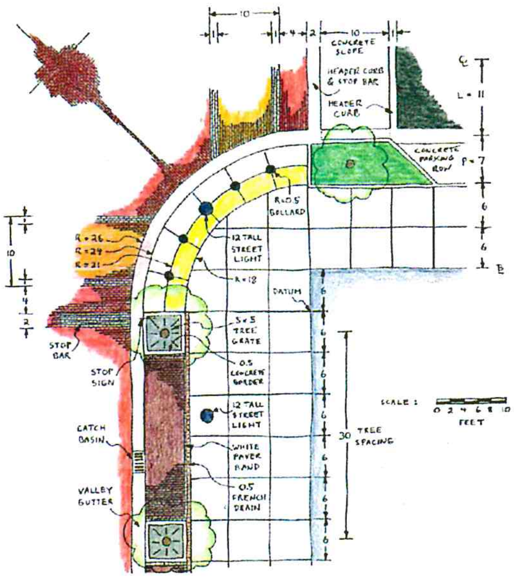


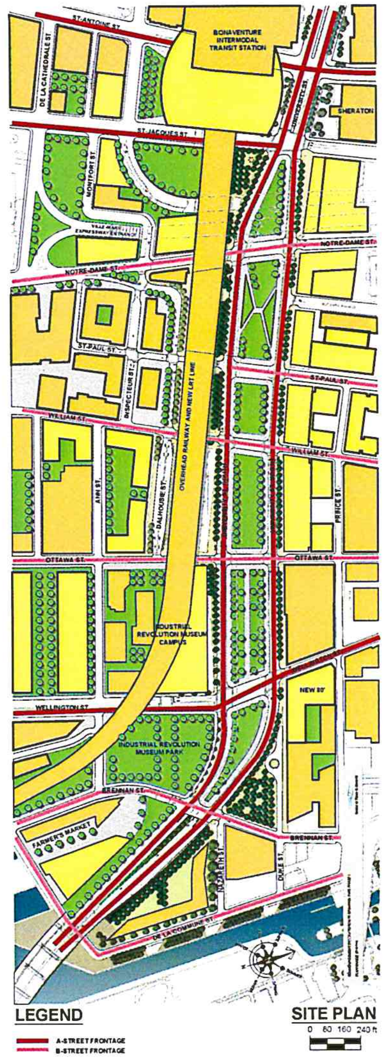
A-Street Frontage Diagram

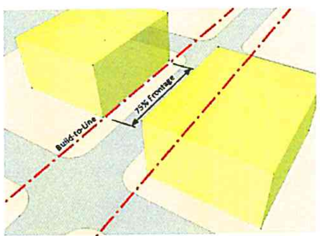
A-Street Frontages

A-Streets are the primary streets in the Downtown and are the most important streets for pedestrian comfort, activity and downtown character.

- Build-to-line: A minimum of 95% of a property's build-to-line frontage is required to be occupied by the principal building façade. Of the property's build-to-line frontage, 25% shall be allowed to stepback a maximum of 3.0m in order to accommodate unique program conditions (e.g. lobby entrance, outdoor cafe/patio, etc).
- Building facades should be parallel to the edge of curb or right-of-way, following curved or angled street configurations.
- A minimum 4.5m floor-to-floor height shall be required for ground floor retail and residential frontages.
- Functioning and principal building entries (pedestrian entrances) and doors shall be located on A-Street frontages.
- Main pedestrian entries must be at sidewalk elevation. Entries must be flush with the sidewalk elevation.
- For buildings that are open to the public (including retail and office uses), the doors shall be open during normal business or operating hours.
- Doors must be designed and constructed such that maximum door swing meets but does not cross the build-to line (i.e., the doors must be inset so that they do not cross the build-to line).
- A-Street frontages shall have ground floor elevations with a minimum of 80% transparent vision glazing with views into the building or display windows which are completely accessible only from the inside of the building.
- Curb cuts, driveways and alleys are prohibited on A-Street frontages.
- Driveways on adjacent B-Street frontages cannot be within 20m of a designated A-Street.
- Exceptions for driveways on A-Street frontages are; 1) if the site or block does not have access to a B-Street or Access Street or, 2) if the building were to have a functional health and safety requirement such as a driveway to an emergency room at a hospital.
- Parking structures shall be screened by "liner" buildings.







B-Street Frontage Diagram

B-Street Frontages

B-Streets are secondary streets, connecting A-Streets to each other and providing motor vehicle access to private property in the Downtown. They provide development blocks with vehicular access for off-street parking, deliveries, and servicing. Standards of B-Street frontages are less restrictive than A-Street frontages.

- Build-to-line: A minimum of 75% of a property's build-to-line frontage is required to be occupied by building façade. Of a property's build-to line frontage, 15% shall be allowed to stepback a maximum of 3.0m in order to accommodate unique program conditions (e.g. lobby entrance, outdoor cafe/patio, etc).
- Building facades should be parallel to the edge of curb or right-of-way, following curved or angled street configurations.
- Functioning and prominent building entries and doors shall be located on B-Street frontages. If a building has both A and B-Street frontages, then the most prominent building entrances shall be located on the A-Street frontage.
- Main pedestrian entries must be flush with the sidewalk elevation.
- For buildings that are open to the public (including retail and office uses), the doors shall be open during normal business or operating hours.
- Doors must be designed and constructed such that maximum door swing meets but does not cross the build to line (i.e., the doors must be inset so that they do not cross the build-to line).
- B-Street frontages shall have ground floor elevations a minimum of 75% transparent vision glazing (unless otherwise specified) with views into the building or views to display windows which are completely accessible only from the inside of the building.
- Two adjacent driveways must have no less than 30m of space between them, measured at the right-of-way line. Driveway widths may not exceed 6.0m in width.

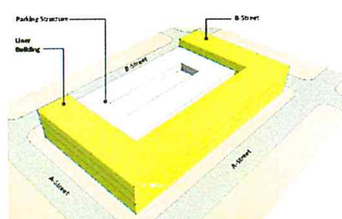
Other Frontage Conditions

- Exceptions to the frontage requirements and build to line requirements may be allowed for: 1) civic & public buildings such as City Hall, court houses, fire stations, public schools, and community centers, 2) park buildings and pavilions.
- If the build-to line is not indicated for a particular street frontage, then the default is that the build-to-line is the right-of-way line (i.e., the maximum setback is zero feet).
- Buildings that share a block with a publically owned park or publically owned square, shall face the edges of the park or square following A-Street frontage standards, where the build-to line is the edge of the park.

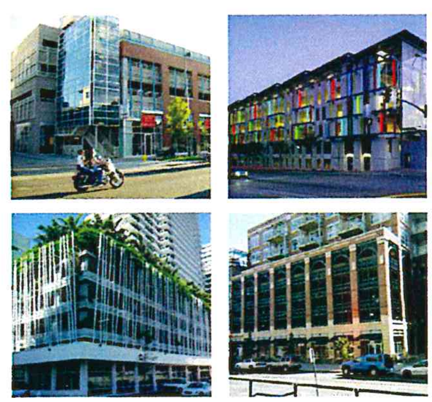
Access Streets

Access streets provide the tertiary connections, and service and parking access to development sites. They are the least public of all the street frontage types and are the most utilitarian.

- Access Streets do not have frontage requirements or build-to lines.
- Access Streets must be freely available for public use 24 hours per day.
- Access Streets require a minimum of a 9m right-of-way, a travel surface that is between 6 and 7m wide, and employ two-way operation.



Parking Structure Frontage Diagram



Parking Structure Frontage

The design and placement of above-grade parking structures will have a significant impact on the character and vitality of the pedestrian street environment. Parking structures shall be designed to minimize the negative visual impact of blank walls and loss of activity on the street.

A-Street Frontages:

- Parking structures cannot front directly on the street but shall be screened by "liner" buildings. The liner buildings place active uses between the parking structure and the street, and screen the parking structure from view.

B-Street Frontages:

- Parking structures may only front directly on one B-street frontage per block.
- All parking structures shall have active uses (retail/services) on the ground floor with a minimum ground floor ground floor height of 4.5 metres in order to accommodate active, street level uses.
- Parking structure facades above the ground floor shall be designed with high level architectural treatment and facade animation (screening, "green walls", facade treatment similar to building) to mask the parking and screen views to the interior.

STREET & BUILDING

Architectural Massing

The built form standards divide the basic massing and form of buildings in the Downtown into two components: 1) base building (street level to midrise) and 2) point towers (midrise and above). The standards for base buildings are tied to the specific street design and dimensions for each street in the Downtown

Key Terms:

Build-to-line – A designated line along the length of a street measured from the right of way that designates the placement and orientation of buildings. Depending on the Street Frontage type a percentage of the build-to-line must be occupied by building façade.

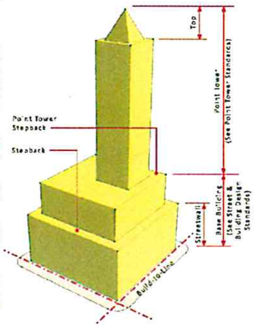
Streetwall – The façade of the building that defines the enclosure of the public space or street. The streetwall will typically vary between 3 to 5 storeys depending on the street. It is defined through the use of a required stepback that articulates the building massing and establishes a consistent architectural line along a street frontage.

Base Building – The street level to midrise building frontage which includes the streetwall and midrise storeys of a building consistent with the Street and Building Design Standards.

Point Tower – Building towers above the base building height governed by design standards that direct slenderness, orientation and separation.

Top – The architectural treatment of the top of point towers. These should be designed to provide variety and architectural interest in terms of views of the Downtown from near and far.

Stepback – A required articulation of the building massing that helps establish the streetwall, reduce the appearance and bulk of midrise buildings, reduce shadow and wind impacts, and mitigate the perception of height from the street.

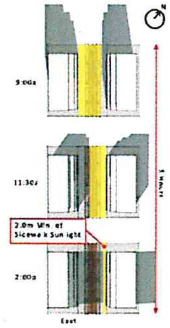


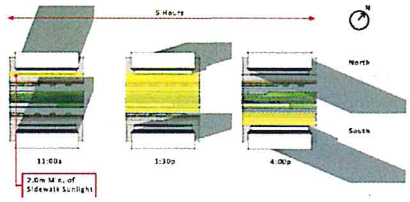
Sunlight Standards & Base Building Height

Protecting sunlight exposure at the street and sidewalk level is an important part of ensuring vibrant and active streets and street level activity. Tall buildings can affect the environmental quality of surrounding areas by overshadowing adjacent streets and public spaces and the loss of sky view. Access to direct sunlight is a measurable quality of a space.

- Buildings on A street frontages shall establish a maximum base building height and massing that maintains a minimum of 5 hours of sunlight (mid-morning to mid-afternoon, between March 21st and September 21st) on at least one side of the street.

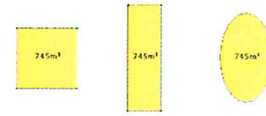
- Buildings on B street frontages shall establish a maximum base building height and massing that maintains a minimum of 3 hours of sunlight (mid morning to mid afternoon, between March 21st and September 21st) on at least one side of the street.





Slenderness / Floor Plate

Point towers are visible from many directions and collectively can have a significant impact on shade and shadow at the street level. To assure slenderness and minimize the shade impact, residential tower floor plates above the base building height, shall be a maximum area of 745 m² (gross floor).



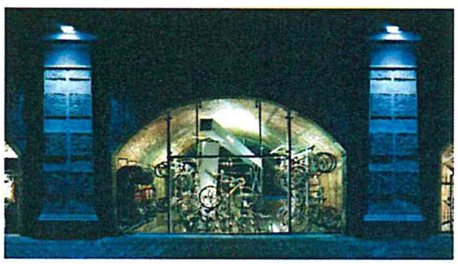
Pedestrian Level Wind Effects

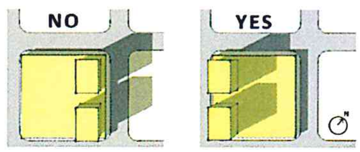
The ultimate built form of the Downtown will affect wind patterns. The pedestrian level wind affects of tall buildings include down drafts off buildings and/or accelerated winds through tunnelling of wind between buildings. The building massing and orientation can be used to mitigate these affects. Basic guidelines include:

- **Stepbacks** – When wind meets a building, wind flowing down a face causes accelerated wind speeds. The required stepbacks for both the point towers and base buildings are intended to both guide architectural massing and mitigate the impact of down flowing wind at the street.

- **Point Tower Slenderness & Orientation** – Orienting the widest point tower building face away from the prevailing winds, and minimizing the size of the point tower floor plate will minimize the affects of down flowing wind.

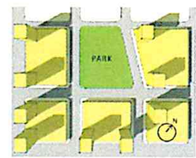
- **Point Tower Separation** – Wind is funnelled between buildings causing acceleration or "wind tunnel" affects. Creating a minimum separation of point towers will mitigate the affects and intensity of wind tunnelling.





Site Orientation

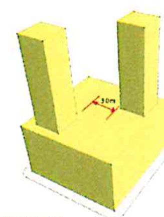
Point towers should be located on the southeast and southwest sides of a block or development site so the shadows will fall primarily within the block rather than on the street. Point towers with elongated floor plates should be oriented north-south in order to minimize shadow impacts.



Park Orientation

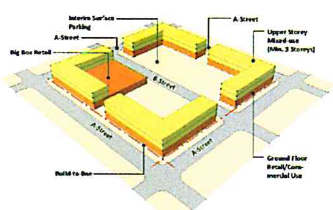
Point towers should be located to minimize shadow impacts on adjacent parks and open spaces. For blocks on the southeast and southwest sides of a park, point towers should be located on the farthest side of the block from the park. For blocks on the northeast and northwest sides of a park, point towers should be located on the southeast and southwest sides of the block.

- **Buildings fronting along parks and open spaces shall establish a maximum base building height and point** tower location/massing that maintains a minimum 5 hours of sunlight (mid morning to mid afternoon, between March 21st and September 21st) over 75% of the adjacent park area.



Tower Separation

Spacing towers with minimum separation will minimize collective shade and sunlight impacts of closely spaced towers on streets, parks and adjacent residential buildings. This will also achieve increased access to sky views and natural lighting as well as increased privacy. The minimum spacing between point towers should be 30m.



Interim Retail Block Frontage Diagram

Interim Retail Block Frontage

Some areas in the Downtown may develop initially as low intensity retail blocks with surface parking and intensify over time as the market changes. To allow for this interim development pattern, A-street frontage requirements apply but, B street frontage requirements may be relaxed to eliminate the minimum build to-line frontage requirement. The result of this, with A-street frontage requirements remaining, is an interim built form block pattern that fronts A-streets and leaves the interior of the block for surface parking. The B street is still required to connect through the block and be designed according to the Street Design Standards, but in the interim is a street that provides access to interior parking lots. Over time this block pattern can be intensified within the established structure of A and B streets.

Interim Side Property & Party Wall Conditions

As the Downtown incrementally urbanizes with mid-rise and taller buildings, new buildings may be adjacent to smaller existing structures or undeveloped property resulting in blank sidewalls. While exposed blank sidewalls are to be expected during this transition period, design guidelines are required to mitigate the appearance and height of blank walls.

- Blank sidewalls should be designed as an architecturally finished surface and large expanses of blank sidewalls should be avoided.
- To mitigate the impact of blank sidewalls they should be designed with a material finish that complements the architectural character of the main building façade.
- Side stepback walls should be a minimum of 5.5 metres from the property line to allow for sufficient glazing and building separation.

STREET & BUILDING

Street-Level Use – Ensure an active and vibrant street.

- **Frontage Activation** - Retail only on the ground floor, 100% of street frontage (excluding lobbies and entrances).
- **Land Use** – Retail uses should include cafes, restaurants, coffee shops, bars/pubs, neighborhood services.

Street-Level Transparency – The uses on the street should be open to view and transparent, creating an inviting and vibrant atmosphere.

- **Ground floor glazing** – 80% - 90% of ground floor façade area between 0.6m and 2.4m from the finished floor must be glazing.
- **Glazing** - No tinting is permitted. Must be able to see at least 0.9 m past the glazing. Three dimensional displays may be within 0.9 m of glazing. Posters, boards, signs, decals, and other flat or near-flat objects or visual obstacles cannot cover more than 20% of the glazed area.

Storefront Design – Create a street-level experience with frequent doors on the street and a variety of small shops and enterprises.

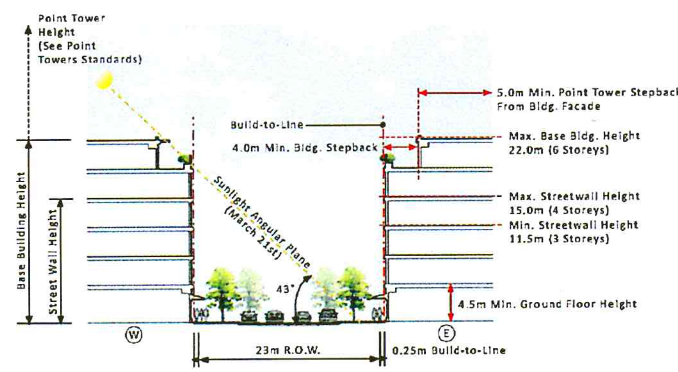
- **Width** – Storefronts and buildings should be designed to articulate a rhythm of different buildings at intervals of every 6 to 10m wide (with the exceptions for a larger grocery store), created through the subdivision of retail space, the use of changing building materials and/or façade articulation. The purpose of this is to create actual separate buildings (or the appearance of separate buildings) at regular intervals to create visual interest along the street.
- **Height** – Ground floor height of 4.5m minimum to ensure flexible retail and/or commercial space.
- **Depth** – Retail space depth of 12 to 15m minimum to ensure reasonable operations.

Building Details

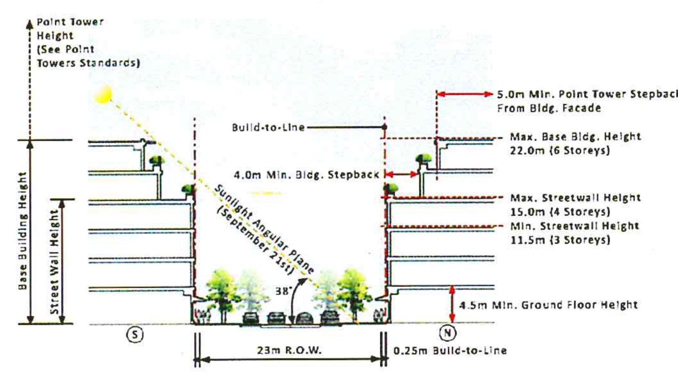
- **Awnings** - Shed type only, across 100% of building façade. 2.25m minimum to 2.75m maximum, protrusion into the right-of-way.
- **Front door** - For buildings that are open to the public, the front doors must be unlocked and usable for normal access to and from the building by the public during normal business hours. Door function should not employ space beyond the face of the building in order to maximize the use of the sidewalk and pedestrian space.
- **Finished floor elevation** - Within 5cm of the sidewalk elevation on the right-of-way line in front of the front door.
- **Streetwall** - Parapet wall required at the streetwall stepback in order to articulate a clear top/cornice to the street, minimum 0.6m, maximum 1.5m high.
- **Window shape** - Individual windows should perceptibly taller than they are wide.

Proposed Typical B-Street Mid-block


Proposed Typical B-Street Intersection

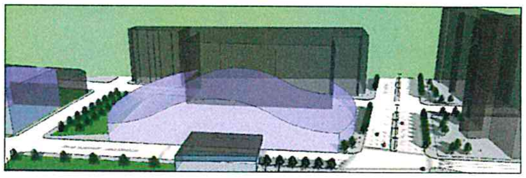


Typical B-Street Building Massing Guidelines
(East-West Street Orientation)

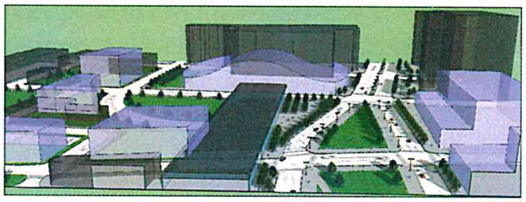


Typical B-Street Building Massing Guidelines
(North-South Street Orientation)

STREET & BUILDING



SECTION A-A



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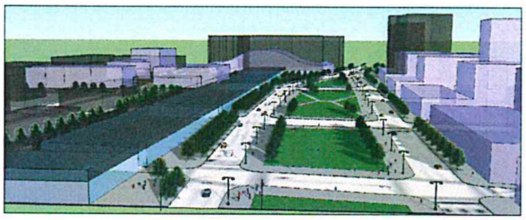
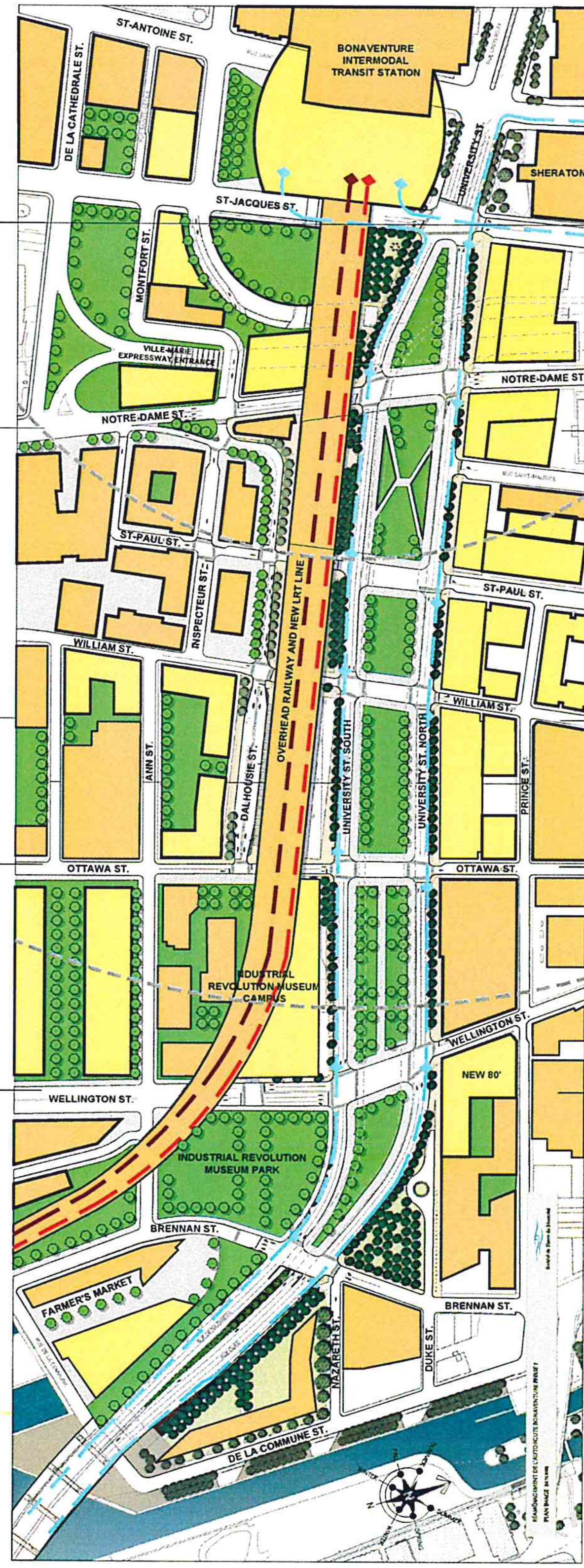


SECTION C-C

SECTION D-D

SECTION E-E



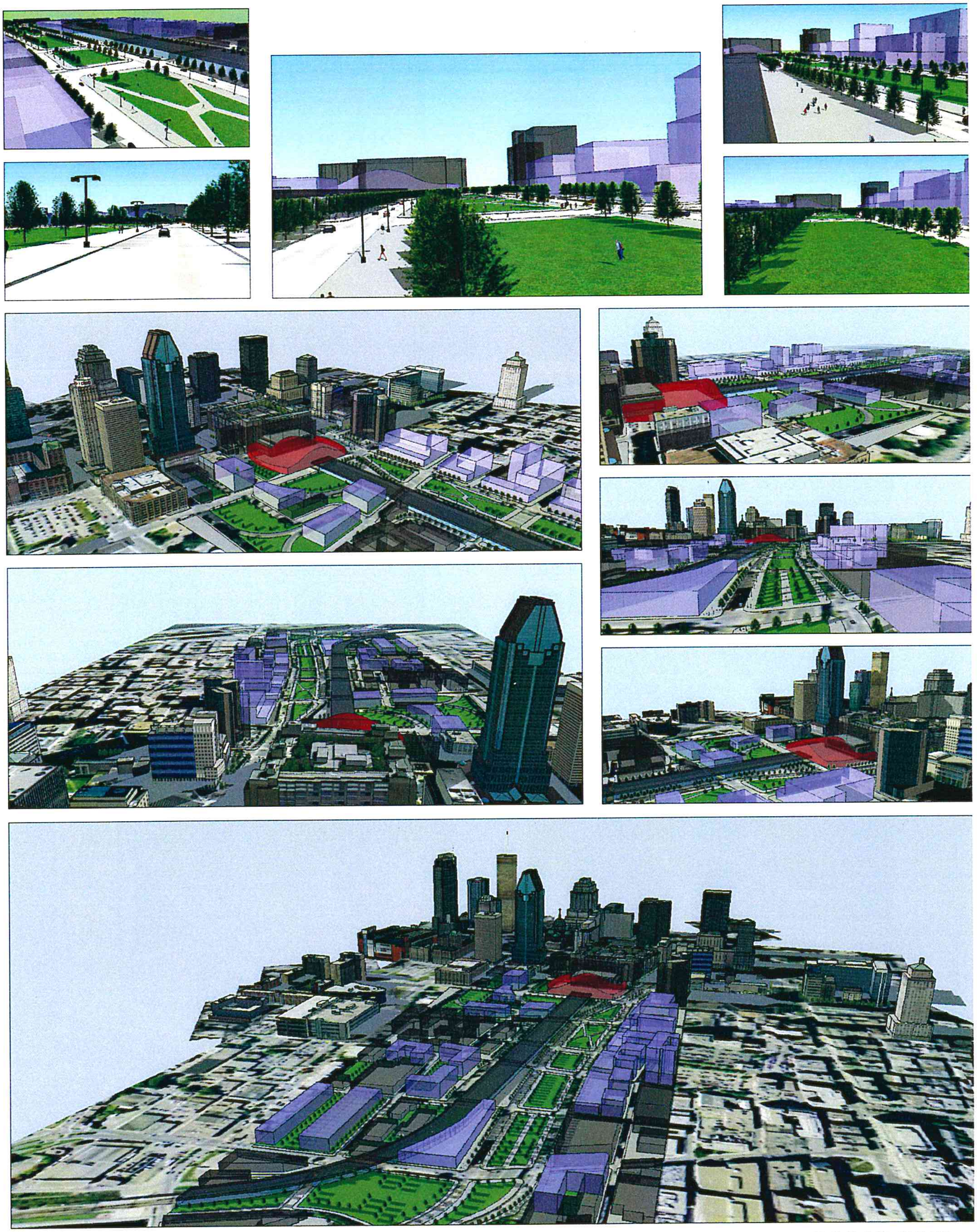
SITE PLAN

0 80 160 240 ft

LEGEND

- NEW BUILDING
- EXISTING BUILDING
- OPEN & GREEN SPACE
- BUS ROUTE AND STOP
- LRT ROUTE AND STOP
- INTERCONTINENTAL RAILWAY
- 5 MINUTE WALK RADIUS (400M = 1300 FEET)

PROPOSED SOLUTION



PROPOSED SOLUTION

NOVABUS

TECHNICAL SPECIFICATIONS
LFS Product Line

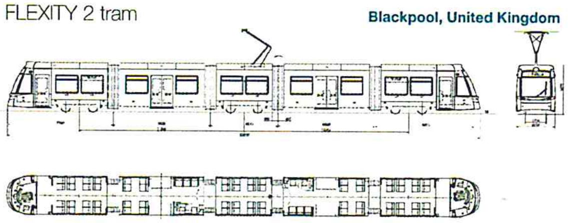
	Standard	Hybrid	Articulated
Length	40.0 ft.	40.0 ft.	62.0 ft
Seating Capacity	Up to 41	Up to 38	Up to 62
Loading Capacity (Seated and Standing)	80	71	112
Wheelchair ramp, flip type at front door	Standard	Standard	Standard
Electric / Electronic system	Volvo Multiplex system (VBEA)	Volvo Multiplex system (VBEA)	Volvo Multiplex system (VBEA)
Outside shell (excl. panels between windows)	Fiberglass and Thermoplastic Skirt Panels	Fiberglass and Thermoplastic Skirt Panels	Fiberglass and Thermoplastic Skirt Panels
Roof-mounted HVAC Multiplex control Carrier heater Carrier AC353 with 05G compressor Thermo-King Athenia with X430 compressor	Standard Optional Optional	Standard Optional Optional	Standard Optional Optional
Kneeling front suspension	Standard	Standard	Standard
Step height	Not kneeled: 14.6 in. Kneeled: 11.6 in.	Not kneeled: 14.6.in. Kneeled: 11.6 in.	Not kneeled: 14.6 in. Kneeled: 11.6 in.
Width	102 in.	102 in.	102 in.
Height (with rear shell)	124 in.	128 in. (with hybrid canopy)	124 in.
Stainless Steel Structure (with min. 10% Cr)	Standard	Standard	Standard
Wheelbase	Front to rear axle: 244 in.	Front to rear axle: 244 in.	Front to mid axle: 244 in. Mid to rear axle: 253 in.
Floor to ceiling height Excluding rear axle Rear platform above rear axle	92.9 in. 76.9 in.	92.9 in. 76.9 in.	92.9 in. 76.9 in.
Turning radius outside body	40 ft. 10 in.	40 ft. 10 in.	44 ft.
Tires	Michelin XZU2 305-70R22.5	Michelin XZU2 305-70R22.5	Front & rear tires: Michelin XZU2 305-70R22.5 - Mid tires: Continental HDU1 385-55R22.5
Engine	Cummins ISL 8.9 280 HP: Standard Cummins ISL 8.9 250 HP: Optional	Cummins ISB 6.7 260 HP: Standard	Cummins ISL 8.9 330 HP: Standard
Transmission	ZF Ecolife transmission (6 speeds): Standard - Allison B400 transmission (6 speeds): Optional Voith DIWA 0.5 (4 speeds): Optional	Allison E^P40 System	ZF Ecolife transmission (6 speeds): Standard - Allison B500 transmission (6 speeds): Optional Voith DIWA 0.5 (4 speeds): Optional
Tilt and telescopic steering column	Standard	Standard	Standard
Axles	Front ZF RL-85 Rear ZF AV-132	Front ZF RL-85 Rear ZF AV-132	Front ZF RL-85 - Mid ZF AVN-132 Rear ZF AV-132
Disc brakes (all-wheels) with Automatic traction control	Standard	Standard	Standard
24V/270 amp oil cooled 50DN alternator	Standard	Standard	Standard
Stainless steel fuel tank capacity	134 gal.	88 gal.	142 gal.
Destination Sign	Axion: Standard Luminator: Optional Twin vision: Optional	Axion: Standard Luminator: Optional Twin vision: Optional	Axion: Standard Luminator: Optional Twin vision: Optional

Also Available	- Suburban or shuttle applications - Under seat lighting - Overhead luggage racks - Personal reading lamps - Wide doors - Flush mounted windows	- Profiled roof treatment - BRT-style mirrors - Integrated front fascia with recessed fog lights - Smooth exterior side walls - Color-coordinated wheel covers and sleek rear fascia

These specifications are based on the latest product information available at press time and are subject to change. Contact your Nova Bus Sales Manager for complete details on standard features and options available.

FLEXITY 2 tram

Blackpool, United Kingdom



General Data

Contract award	July 2009
Type of vehicle	*BOMBARDIER FLEXITY 2*
Model	Bi-directional
Owner	Blackpool Council
Quantity	16
Train consist	5 modules

Dimensions and Weight

Length of vehicle	32.2 m
Height	3.42 m
Width	2.65 m
Entrance height above TOR	
- vehicle empty, new wheels	320 mm
Percentage of low-floor area	100 %
Doors	8
• Electric double-sliding doors	2 per side
- door clearance height	2,030 mm
- door clearance width	1,300 mm
• Electric single-sliding doors	2 per side
- door clearance height	2,030 mm
- door clearance width	800 mm
Wheel diameter (new / worn)	600 mm/540 mm
Gauge	1435 mm
Minimum horizontal curve radius (track/depot)	25 m/20 m
Minimum vertical curve radius, (hog/sag)	275 m/400 m
Car weight (empty)	40.9 t
Car weight (loaded) (4 pass./m²)	56.7 t
Maximum axle load (4 pass./m²)	9.6 t
Buffer load	400 kN

Technical Characteristics

- Nominal current supply: 600 VDC
- Energy recuperation
- Low voltage: 24 VDC
- Four 3-phase asynchronous motors
- Motor power 120 kW
- Liquid-cooled motor
- 2 powered bogies - 1 trailer bogie
- Rubber-metal springs primary suspension
- Elastomer secondary suspension
- Slip and skid protection
- Rescue coupling for emergency
- Generatoric service brake
- Electrohydraulic disk brake system
- Magnetic brake: 6 x 81 kN
- Air conditioned interior cab
- Passenger information system

Performance and Capacity

Maximum speed	70 km/h
Medium acceleration (2/3 load) from 0 ... 70 km/h	0.5 m/s²
Deceleration (2/3 load)	
• service brake	1.2 m/s²
• emergency brake	2.73 m/s²
Maximum gradient	60 ‰
Seated passengers (incl. tip up seats)	74
Standing passengers (4 pass./m²)	148
Multipurpose areas	2

Bombardier Transportation
Hermann Gebauer Straße 5
A-1220 Vienna, Austria

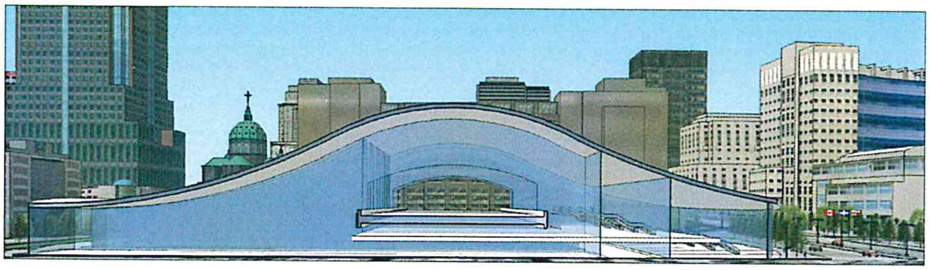
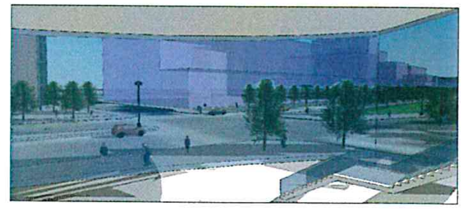
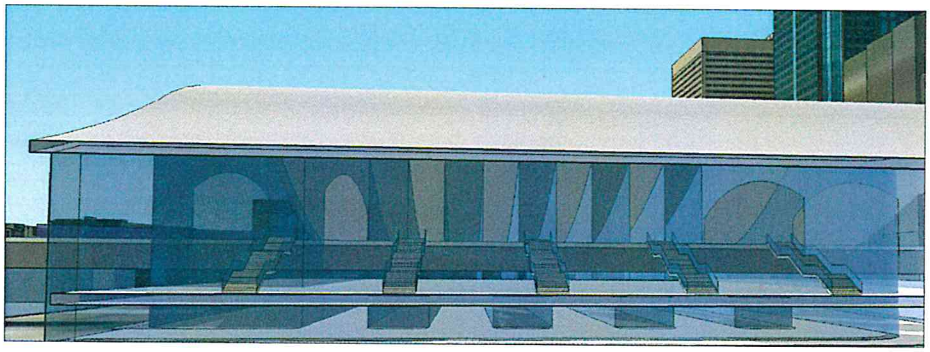
Tel +43 1 25 110 760

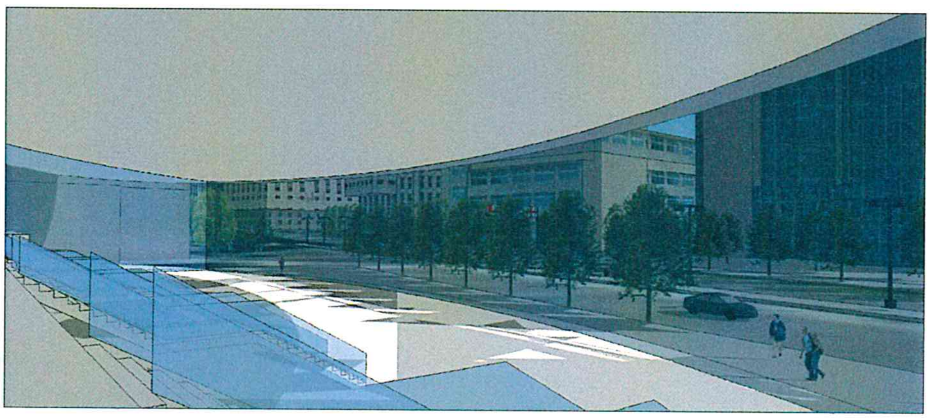
www.bombardier.com

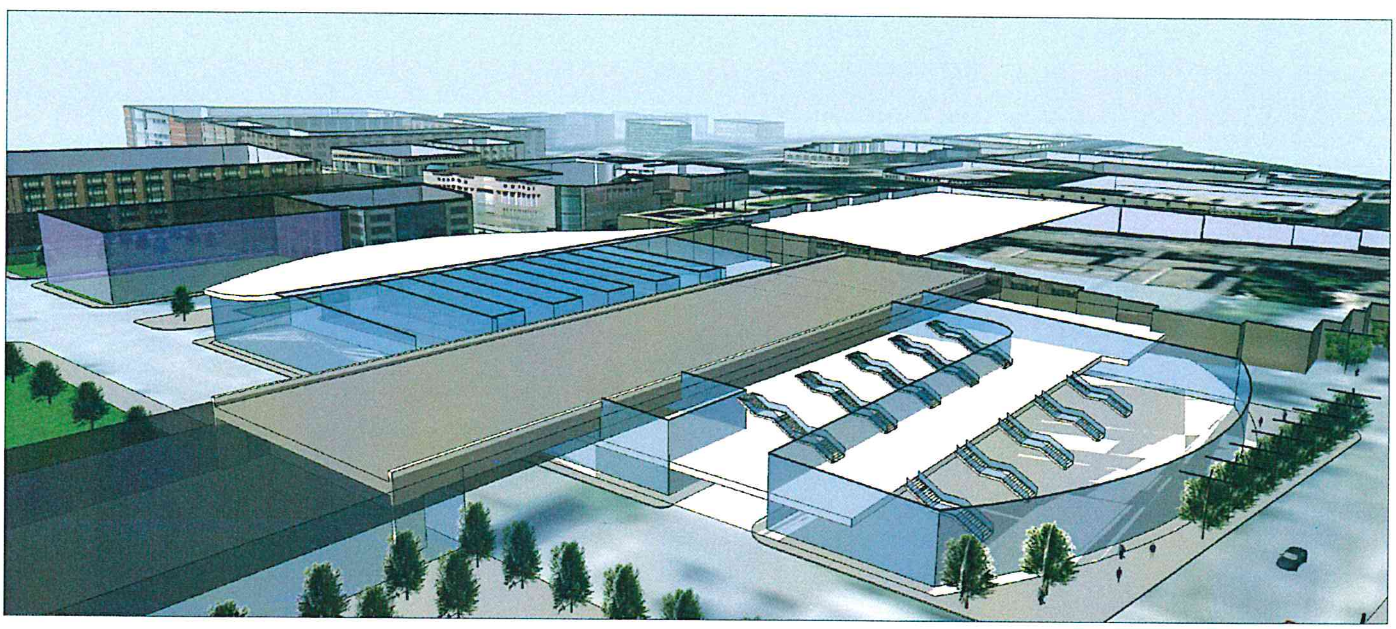
BOMBARDIER

DESIGN MODULES

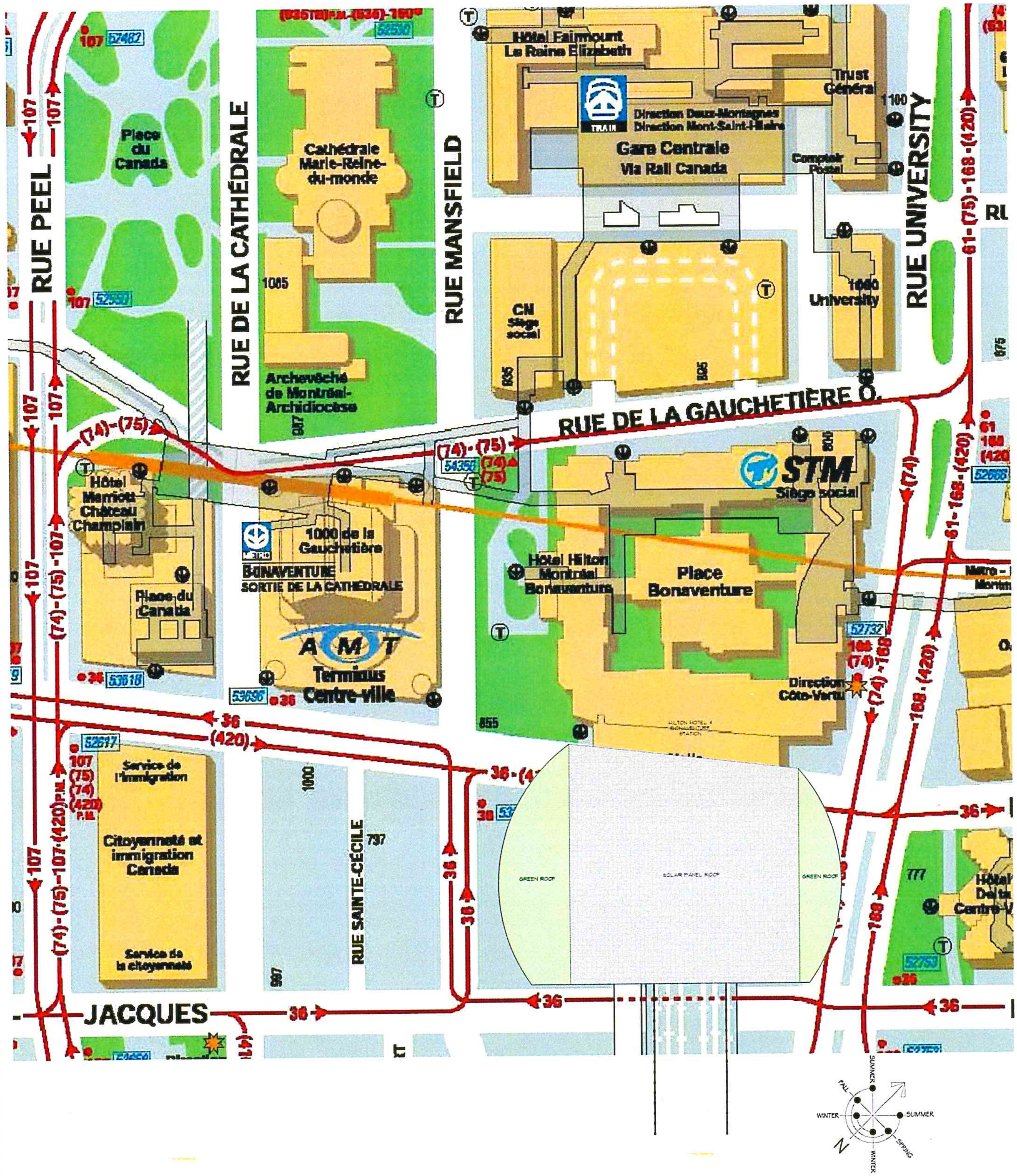
DESIGN VIGNETTES





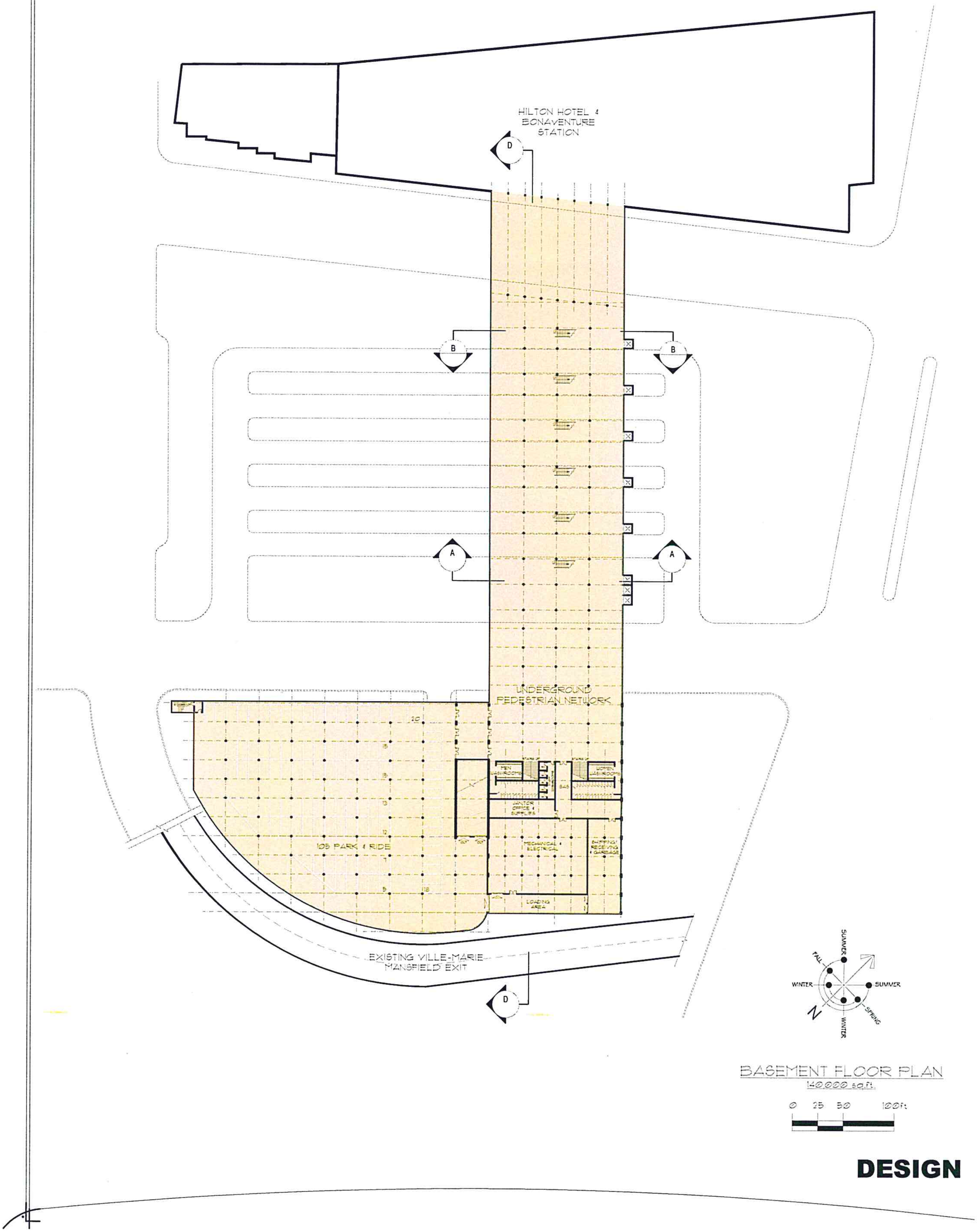
DESIGN VIGNETTES



SITE PLAN
230000 sq.ft.

0 50 100 200ft

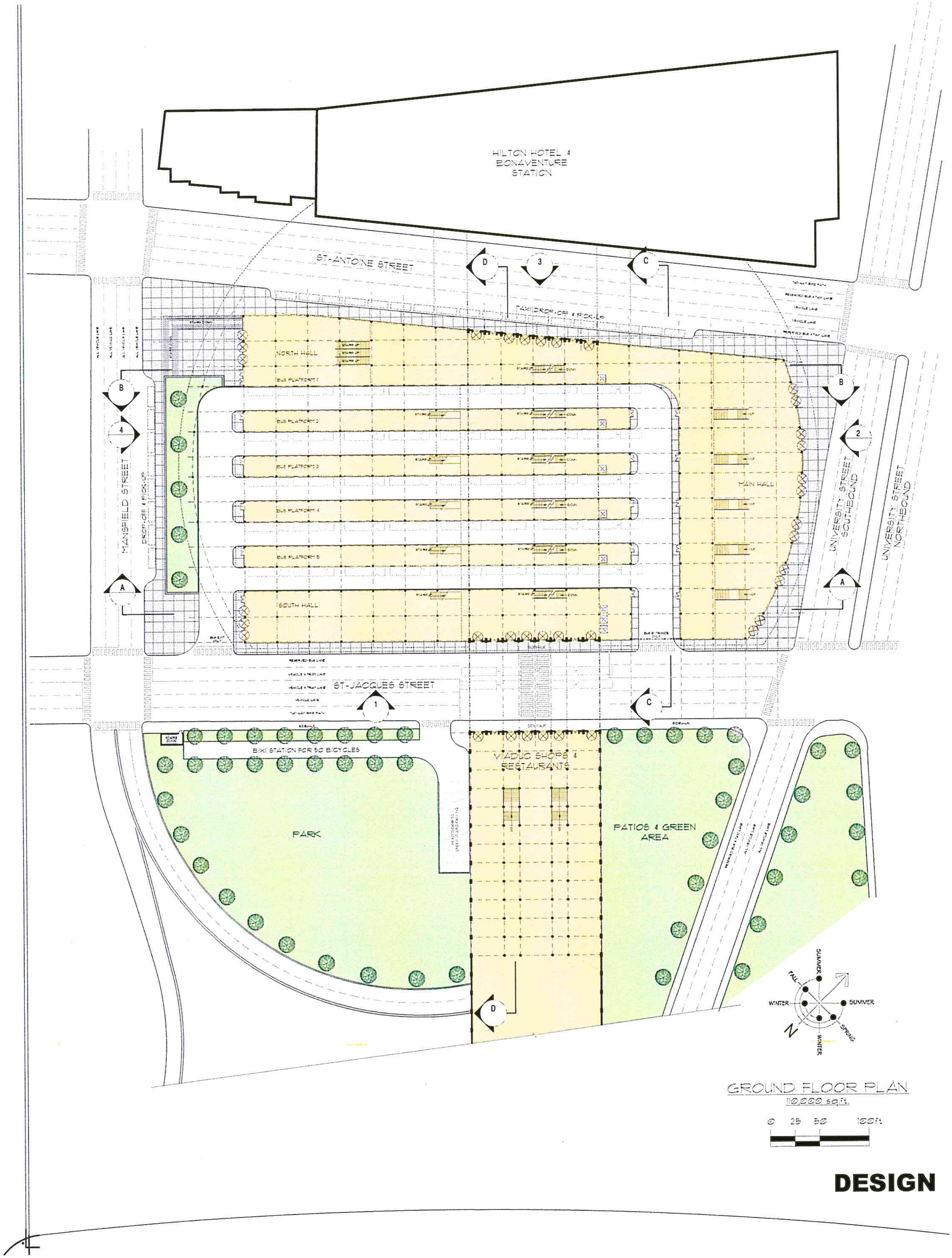
DESIGN



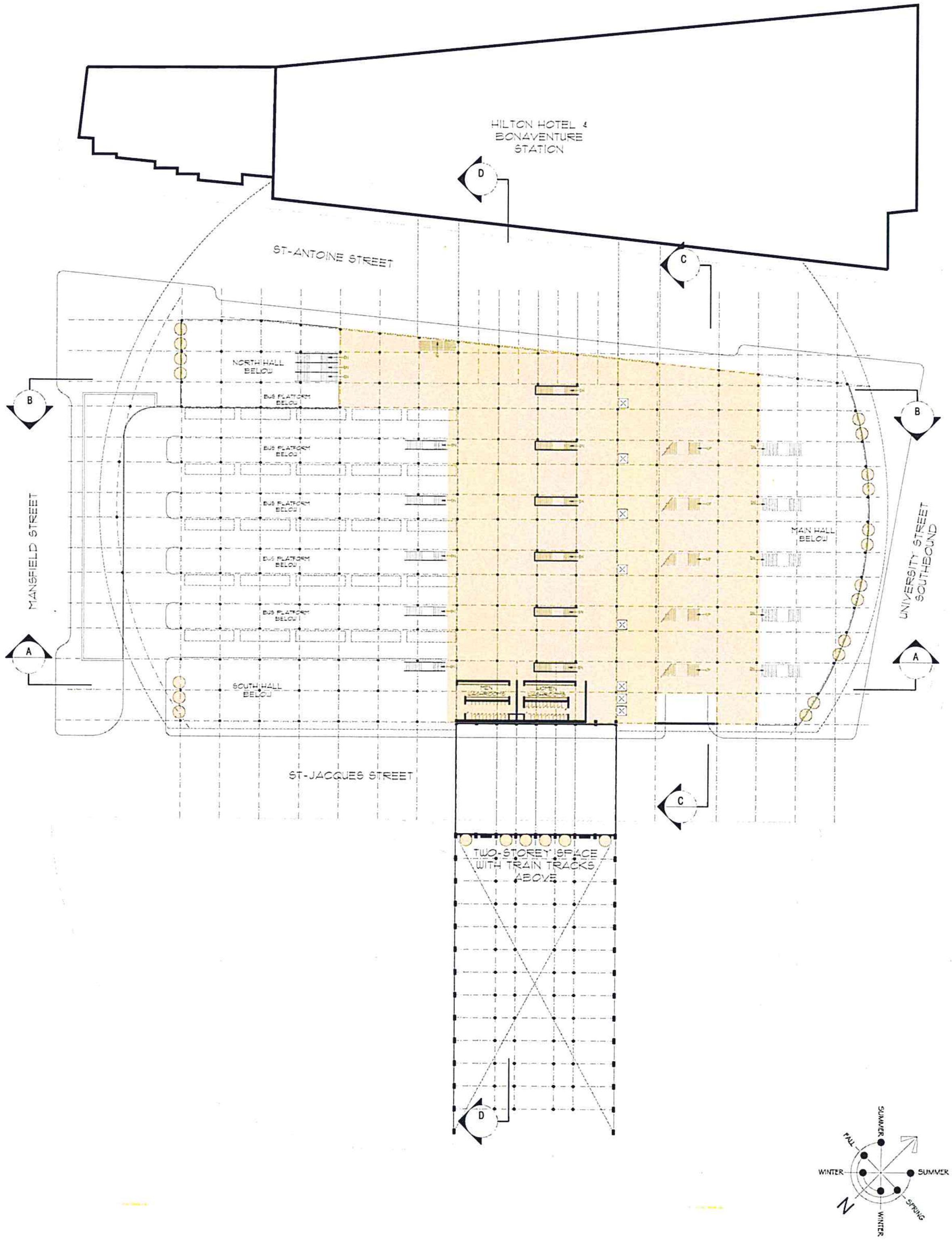
BASEMENT FLOOR PLAN
140,000 sq.ft.

0 25 50 100ft

DESIGN


HILTON HOTEL & BONAVENTURE STATION
ST-ANTOINE STREET
TAXI DROP-OFF & PICK-UP
NORTH HALL
BUS PLATFORM 1
BUS PLATFORM 2
BUS PLATFORM 3
BUS PLATFORM 4
BUS PLATFORM 5
SOUTH HALL
MAIN HALL
MANSFIELD STREET
DROP-OFF & PICK-UP
UNIVERSITY STREET SOUTHBOUND
UNIVERSITY STREET NORTHBOUND
ST-JACQUES STREET
BIXI STATION FOR 50 BICYCLES
PARK
VIADUC SHOPS & RESTAURANTS
PATIOS & GREEN AREA
SUMMER
FALL
WINTER
SUMMER
SPRING
WINTER
N
GROUND FLOOR PLAN
110,000 sq.ft.
0 25 50 100ft.

DESIGN

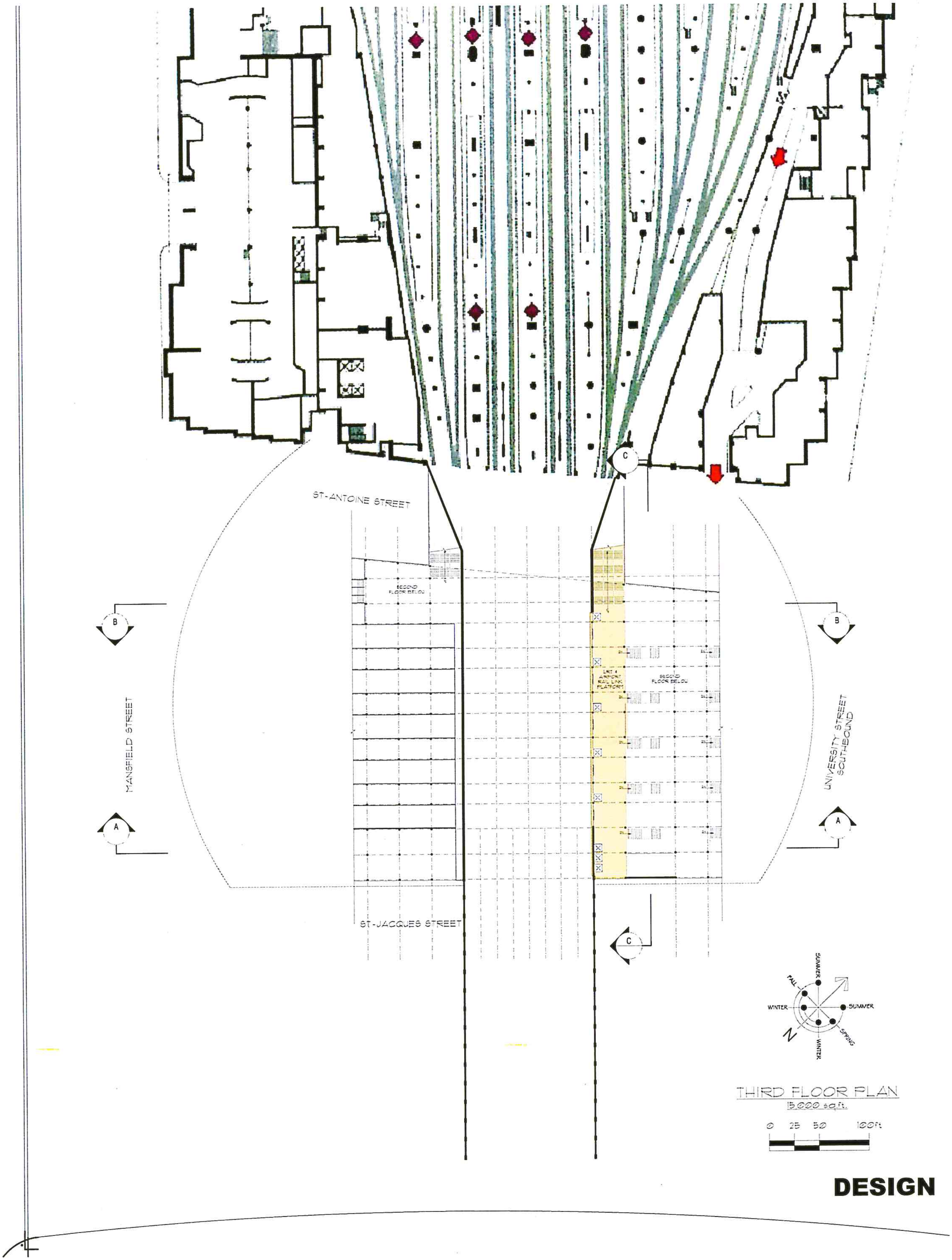


SECOND FLOOR PLAN

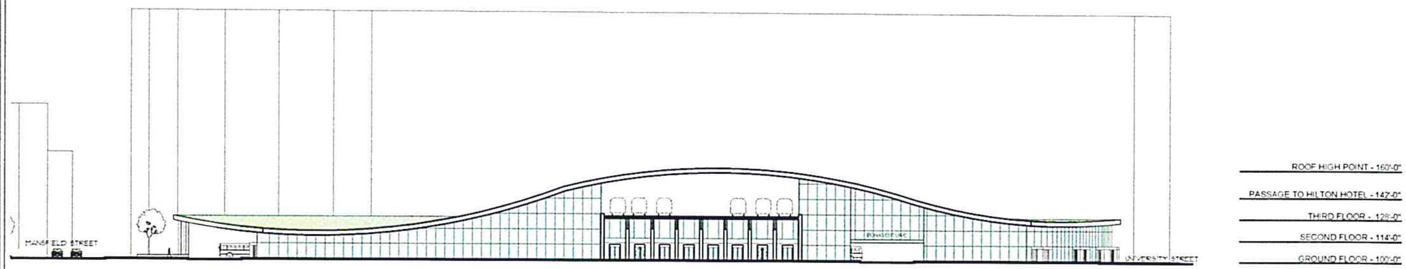
60,000 sq.ft.

0 25 50 100ft

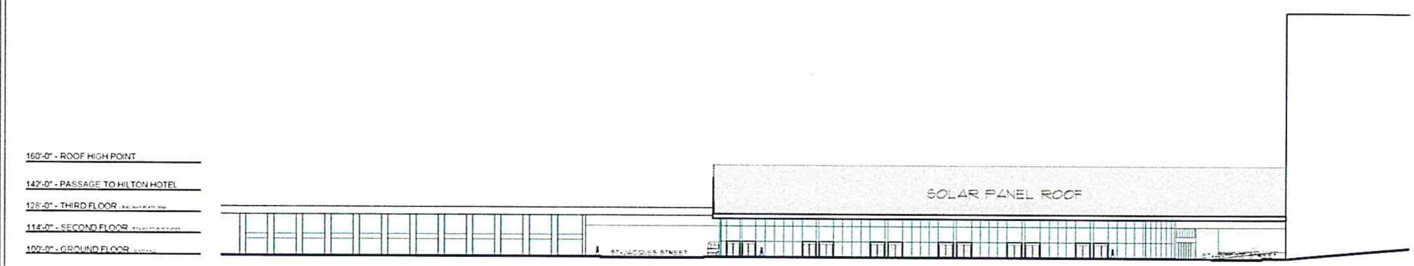
DESIGN


ST-ANTOINE STREET
MANSFIELD STREET
UNIVERSITY STREET SOUTHBOUND
ST-JACQUES STREET
SUMMER
FALL
WINTER
SUMMER
SPRING
WINTER
N
THIRD FLOOR PLAN
15,000 sq.ft.
0 25 50 100ft

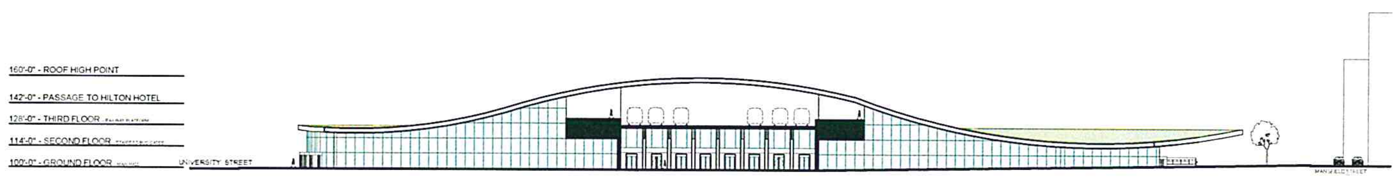
DESIGN



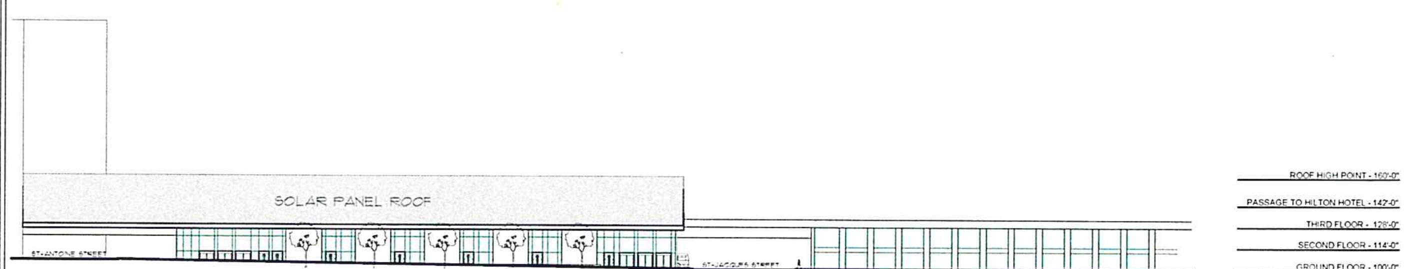
ELEVATION 1-SOUTH ELEVATION



ELEVATION 2-EAST ELEVATION

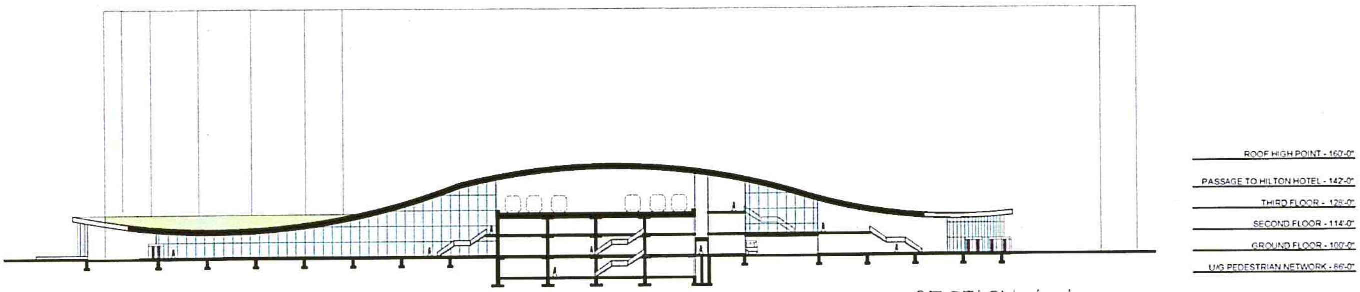


ELEVATION 3-NORTH ELEVATION

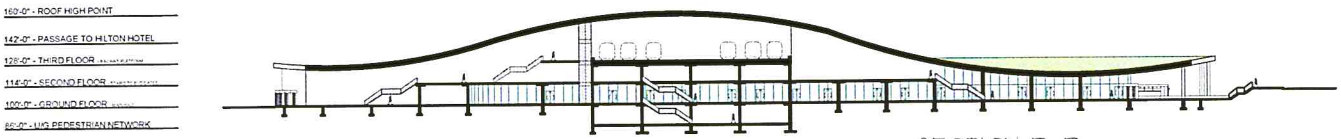


ELEVATION 4-WEST ELEVATION

DESIGN



SECTION A-A



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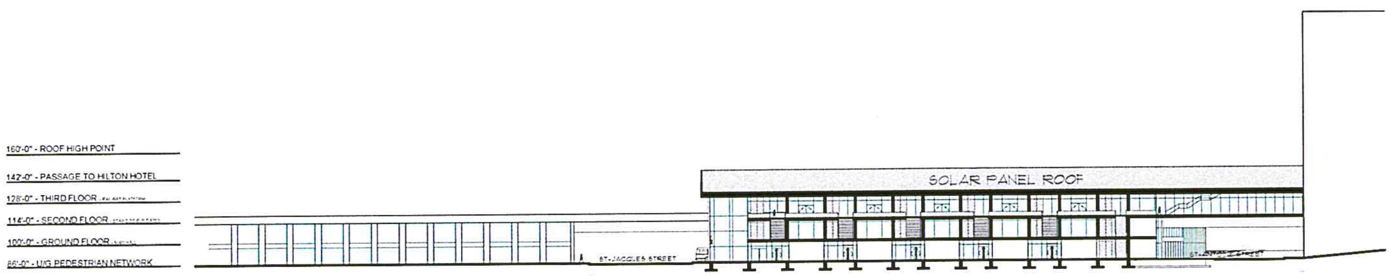

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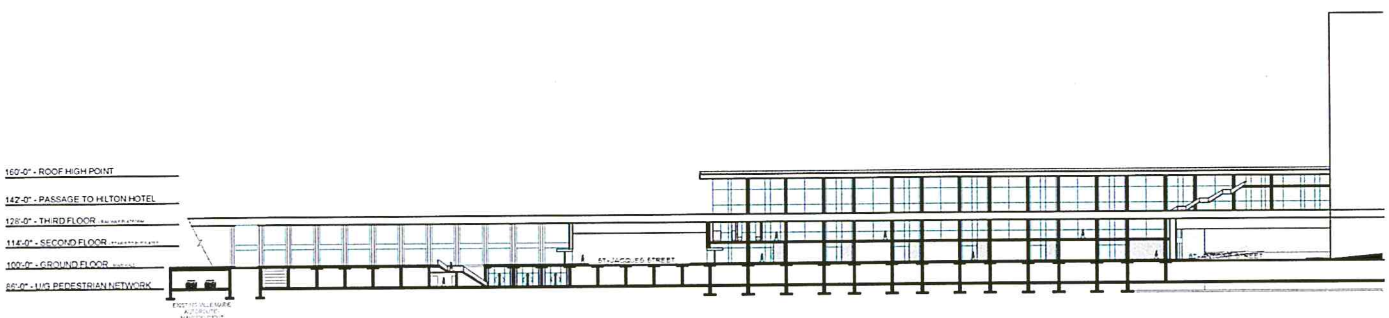

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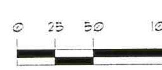

DESIGN

DESIGN

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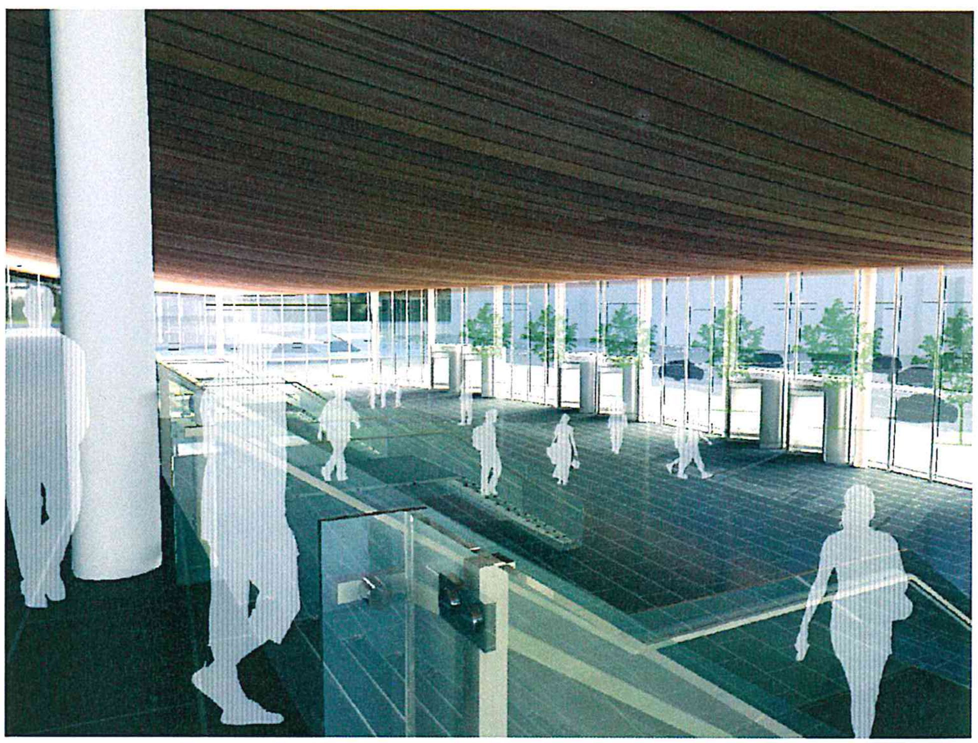

DESIGN