

TRANSPORTATION AT AURORA BUSINESS PARK



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Introduction

The urban environment requires continuous expansion in order to meet social and economic needs of the society. On the other hand, the urban environment encounters problems such as air and water pollutants, material waste management and greenhouse gases emission due to lack of proper planning and long-term vision for urban planning and development. In recent years, the developed world has increased its awareness of conspicuous resource consumption and environmental degradation while the urban environments become less livable overtime.

As one of the most prosperous city in Canada, Calgary has experienced exponential population growth, which parallels its employment opportunities in recent decades. New residential communities have developed in order to meet the population needs, when such development has even worsen the traffic congestion and air pollution within the city when many of the urban dwellers are still driving private vehicles to the inner city, where the employment opportunities concentrates.

In order to alleviate the urban and environmental problems and enhance the livability in Calgary, it is necessary to implement measures to control and manage the causes of these factors through sustainable development – which satisfy the economic, social and environmental needs of both current and future generations. Developing more sustainable transportation, such as creating suburban employment centers, increase the effectiveness and accessibility to public transit are able to provide long-term solution to the over populated and congested urban environment in Calgary. The purpose of proposing the Aurora Business Park in North Calgary is to present the best practice of sustainable development with a focus on transportation by shortening the travel distance from home to work.

Background

The Aurora Business Park is 263 acres in size. It is located north of the Harvest Hills community, south of Beddington Heights community, west of Deerfoot Trail, and

east of Harvest Hills Boulevard respectively. This area is designated for commercial usage, proposed with the intention of diverting congestion from high-density downtown. In turn, the density in suburban areas will increase. Due to its close proximity to Calgary International Airport's runway, there are regulations indicating how neighboring land use can be zoned. Besides that, noise and potential pollution hazards also deem the site extremely unfavorable for residential use. First proposed in Calgary North Policy Report of 1981, this project has been identified again for continuation with timeline completion in 20 to 25 years.

Sustainability was first described by Brundtland Commission during the United Nations World Commission on Environment and Development in 1987.¹ Sustainability was first described as development that meets the need of the present generation without compromising the ability for future generations to do the same.² It covers three major areas: social, economic, and environmental. Sustainability has become a common theme in current City of Calgary planning, and inspiration for the imagineCalgary plan.

Transit Oriented Development (TOD) was first introduced in Stockholm in 1998.³ TOD is implemented to create urban villages, and an overall "multicentric" design opposed to the monocentric city (such as Calgary designing a single large employment district). Calgary focuses on providing use of Light Rapid Transit and Bus Rapid Transit with accessibility by foot or other means in a 600m radius. TOD offers advantages covering all aspects of sustainability integrating alternative forms of transit. Encouraging mixed-use land development promotes social interaction, environmental awareness, and economic stability. Therefore, TOD offers many benefits and "a more sustainable approach to urban planning,"⁴ "optimizing the use of land around transit stations."⁵

The imagineCalgary initiative was launched in June of 2006 by the City council. The project's purpose is to plan for Calgary's long-term growth. The time limit for this

¹ Hodge, Gerald, and David L.A. Gordon. *Planning Canadian Communities*. 5th edition. Toronto: Thomson Nelson, 2008.

² UN, Brundtland G. 1987. *Our common future / World Commission on environment and development*. 1987 Aug. 4. Oxford, NY Oxford University Press. As submitted to United Nations.

³ Newman P. 1998. From symbolic gesture to the mainstream: next steps in local urban sustainability. *Local Environment*. 3(3):299-311.

⁴ Calgary, 2005 "Transit Oriented Development Policy Guidelines". The City of Calgary, Retrieved on April 3rd, 2008 from http://www.calgary.ca/DocGallery/BU/planning/pdf/tod/tod_policy_guidelines.pdf

plan is 100 years and it is to provide a vision of improved and enhanced growth of in the quality of living conditions in communities. Its bottom line is to create connection with others, shape Calgary into “a great place to make a living, a great place to make a life.”⁶ Within social systems, its main focus is to increase interaction between people, and to create a sense of belonging within communities. ImagineCalgary is used to create a diverse and sustainable business community in Calgary. The goal environmentally is to reduce the overall ecological footprint of the city without increasing emissions and pollution levels from 2001 rates. ImagineCalgary is the inspiration used throughout the Aurora Business Park plan.

Site Assessment Results

This section details the results of the site assessment. The site assessment examines only the elements of the site that affect transportation, as this is the focus of the project. Other factors, such as the constraints imposed by the nearby runway, are taken as stated by the City of Calgary’s plan for the area, and are not investigated. Still other factors, such as water flows and runoff, are left to another assessment. This is done in order to focus attention on the transportation system more broadly and thoroughly, rather than focusing on only the immediate area of the site.

The transportation system in this site assessment consists of walking and cycling paths, light rail transit, bus rapid transit, and vehicles. This is consistent with the categories in the Plan It Calgary transportation hierarchy. The system components chosen were examined in their current and planned forms.

Walking and Cycling Paths

The structure of the walking and cycling paths around Aurora Business Park is seen in **Figure 1**. The light blue lines show 500 m, 1 km, 5 km, and 10 km distances from the outside edge of the park. These are distances that people would be willing to walk or bike, depending on the weather, time constraints, and personal preference. Generally speaking, more people would be willing to walk from 500 m than 1 km, and more people

⁶ Calgary, 2006. “Long Range Urban Sustainability Plan for Calgary”. The City of Calgary. Retrieved on April 3rd, 2008 from http://www.calgary.ca/docgallery/bu/planning/pdf/long_range_urban_sus_plan.pdf

would be willing to bike from anywhere within 5 km than somewhere within 10 km of the site.

Within the 500 m area there are very few households, and within the 1 km area there are not many more. This means that few people will be willing to walk to the site. In order to increase the number of people willing to walk to the site, the plan would need to include many attractive walkways to draw people in. This would need to occur in the areas peripheral to the site. Residential development within the site is not possible due to the loud noise levels from planes taking off, so this strategy cannot be used to increase pedestrianism in the area.

In order to decrease the dependence on vehicles that can arise from pedestrian inaccessibility the site can take advantage of the numbers of household within the cycling catchment areas. Again, many attractive walkways would encourage biking, and this would have to occur outside the site. Inside the site, covered, secure bike storage would make biking an easier choice to make for each individual.

Finally, in order to further decrease the numbers of people driving to the site, public transportation would be necessary. The transportation network would need to be reliable and fast to be seen as a viable option. In addition, the network would need to reach many areas to be attractive to as many people as possible. The next two sections discuss the transportation network.

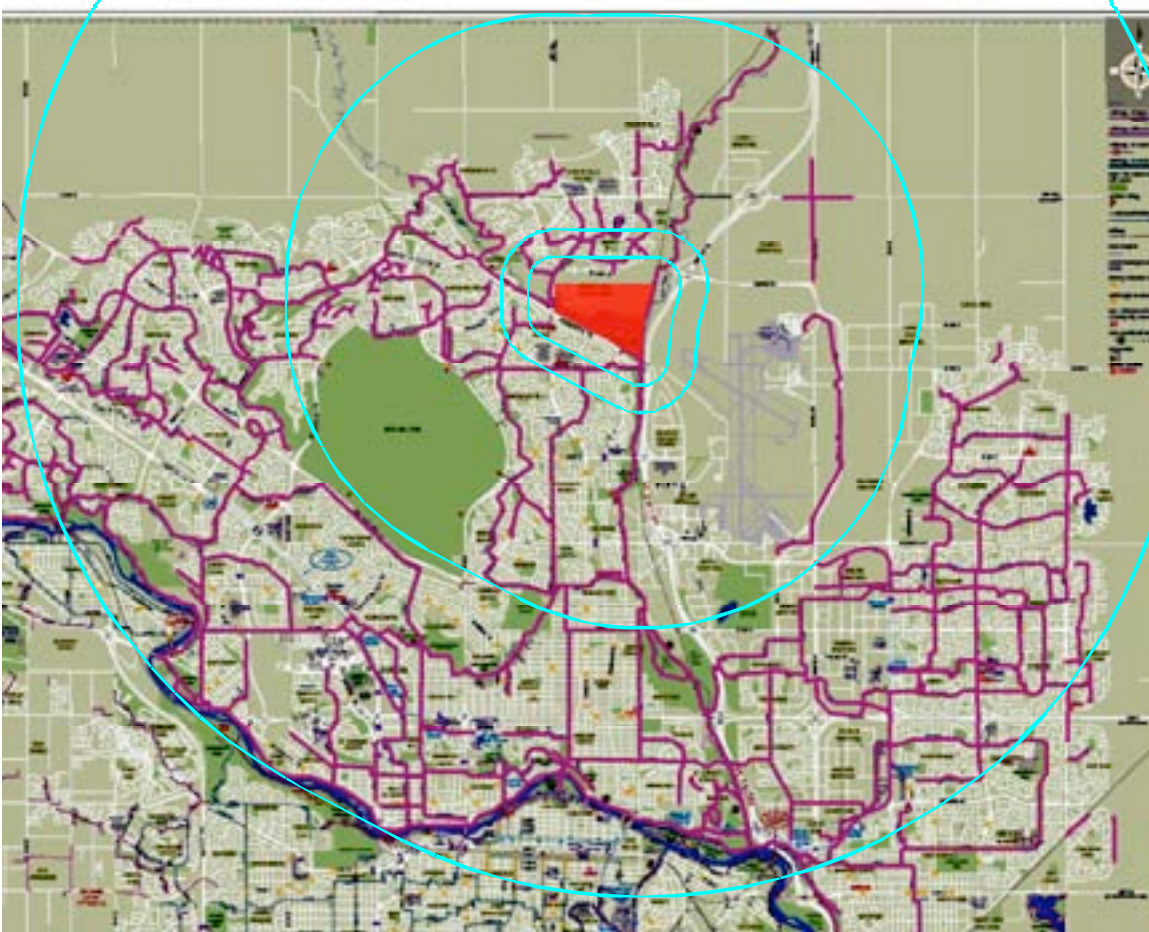


Figure 1 – Walking and biking paths in the north of Calgary. The red area shows the subject site, the purple lines show the paths, and the light blue lines show 500 m, 1 km, 5 km, and 10 km distances from the edge of the site.

Public Transit

Light Rail Transit

The planned north line of the C-train runs up Deerfoot Trail from the Bow River, and then cuts across the top of the Aurora Business Park before heading north again. Stops are planned just east and west of the site, as well as in the center-north of the site. All of this can be seen in [Figure 2](#). These stops are very important areas to be planned, as for many, they will be the first thing seen when entering the site. These stops should make use of transit oriented design (TOD) strategies in order to maximize their utility.

This line will connect to the northeast line (that ends at McKnight), just east of the city center. The exact connection is not yet known, but it is most likely to be as described above.⁷ This is significant as many living in the northwest of the city would be unwilling to take the train to the center, switch to the McKnight train, and then switch again to the north line.

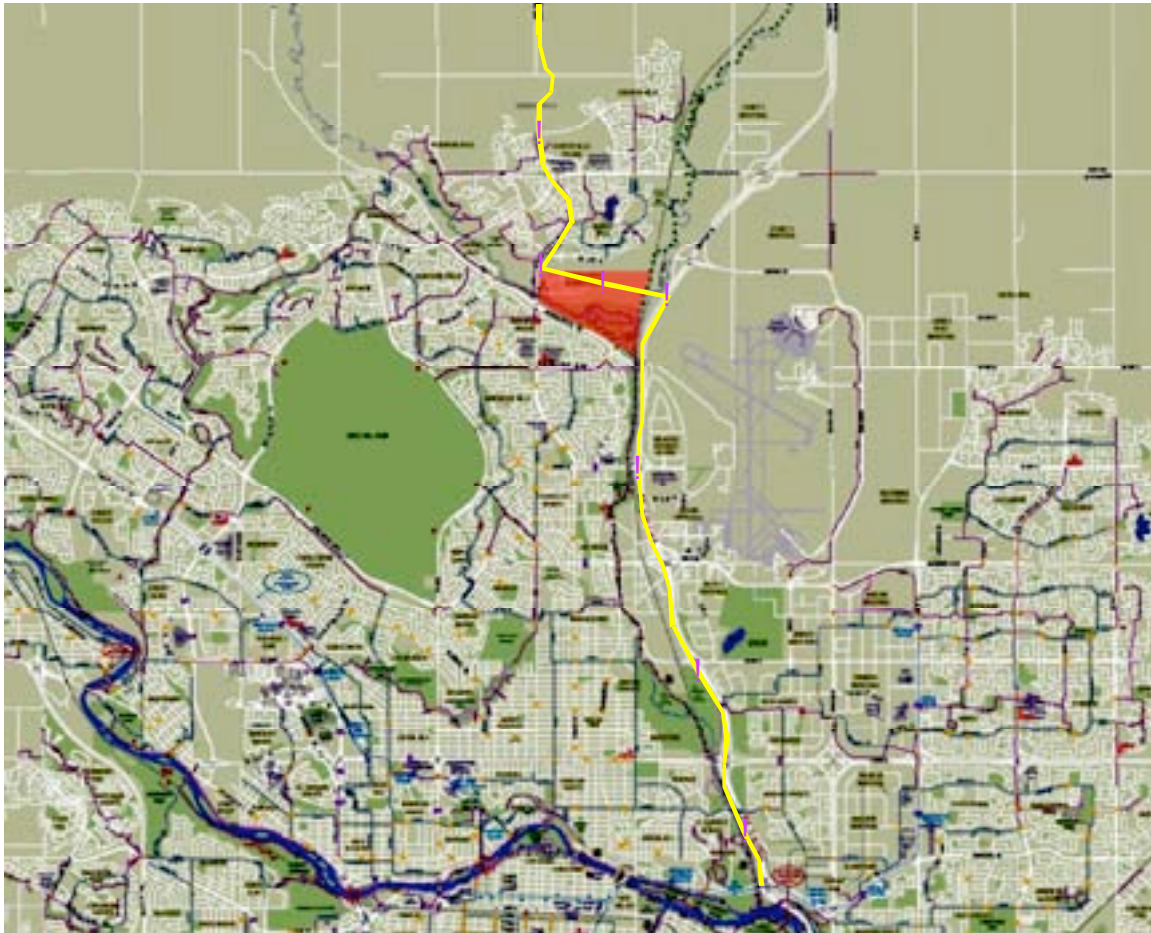


Figure 2 – The proposed north line of the LRT system. The line is shown in yellow, and the red area is the subject site. There are LRT stops immediately east and west of the site, as well as in the center-north of the site.

Even without all the connections, going from the northwest to the center, to the northeast is an inefficient and unappealing trip. This would be the case in many areas of the city. Thus, in terms of its use to the Aurora Business Park, the north light rail transit

⁷ Calgary Transit North-Center Plan Reference

(LRT) line is limited. Only those riders on the line itself, or in the center-south or the city are likely to be willing to use it.

Bus Rapid Transit

The bus rapid transit (BRT) that currently exists follows the proposed north LRT line discussed in the above section. This BRT line is serving the purpose of the LRT line until it is put in. The proposed BRT lines run from the northwest to the current line; the intersection is roughly a kilometre south of the south of the site. Another proposed BRT line runs from north of the airport to the site, and has a stop in the center-north of the site. These lines can be seen in [Figure 3](#).

The catchment area of the BRT lines is greater than that of the LRT lines. Additionally, the BRT lines will become useful to more people as development progresses outward along the lines. The east BRT line will be particularly useful to connect the site to the airport.

In order to make the BRT a central transportation option to the site, the stops within the site can be emphasized and improved using TOD methods. This will be easiest if the BRT stops coincide with the future LRT stops.

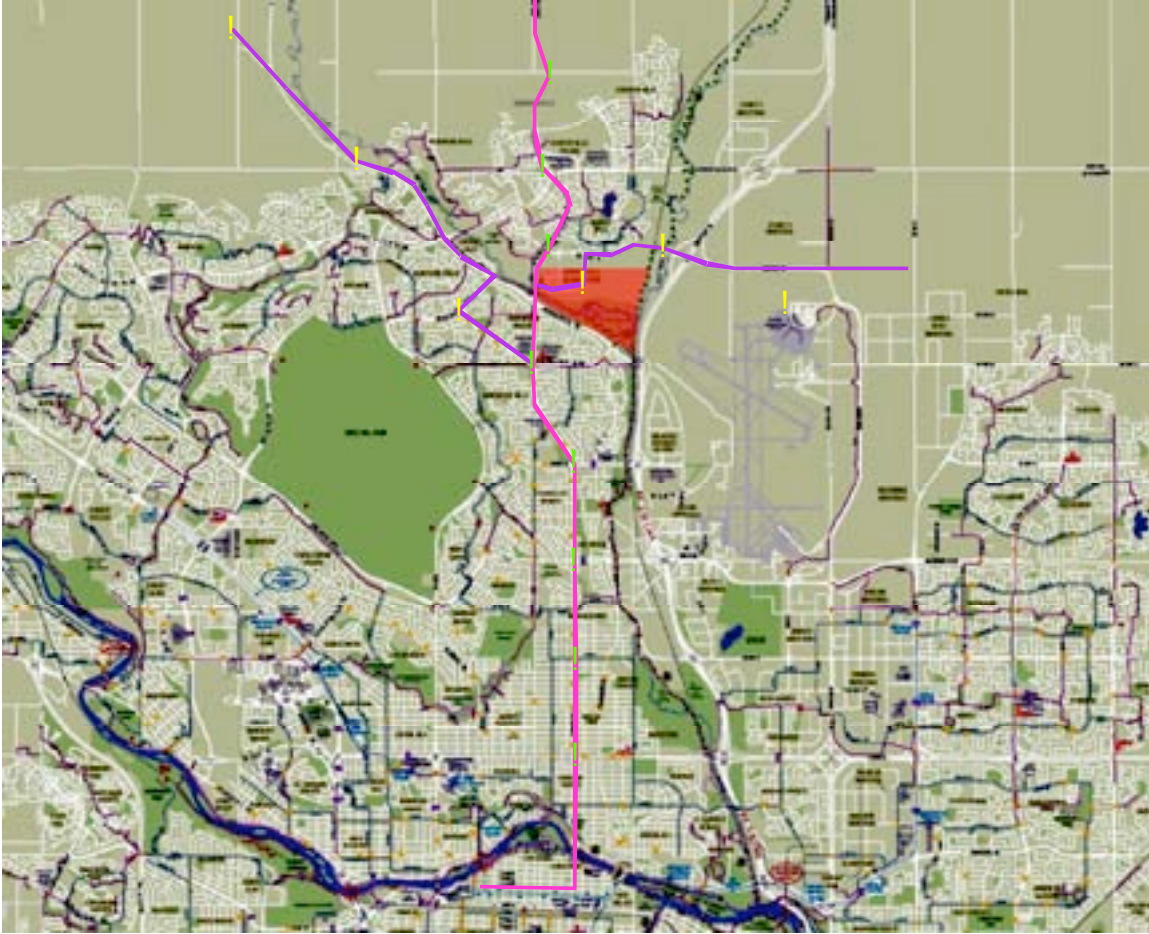


Figure 3 – Bus rapid transit lines in north Calgary. The pink line is current, while the two purple lines are proposed. The subject site is in red. There is a stop on a proposed BRT line in the center-north of the site.

The main transit lines into the site are central to making transit a more attractive option for site visitors. As we have seen, there are only four main lines into the site: three BRT lines, one current and two planned, and one future LRT line. These do not serve the entire city; in fact, they serve very little of it. In order to improve this situation in time to serve development, there should be more BRT lines coming in from more diverse regions of the city. Some example areas include the northwest of Calgary, and the northeast beyond the airport. This is beyond the scope of the plan for the immediate site, but should be a consideration, and communication between the site planners and Calgary Transit would be very beneficial.

Vehicles

Vehicular traffic will be important to the site, as there will be commercial deliveries and pick-ups, as well as private vehicle traffic. The vision for the project is a sustainable transportation network for the site, therefore commercial vehicle traffic is not a priority. However, it will be necessary, at least until the public transit infrastructure is heavily enhanced.

The current roads serving the site are seen in [Figure 4](#). Deerfoot Trail runs along the east side, Beddington Trail along the south-west, and Harvest Hills Boulevard along the west side. Deerfoot in particular makes the site very accessible by vehicle from the south of the city, thus decreasing the attractiveness of taking transit from there.



Figure 4 – The road network around the subject site (shown in dark blue) as well as the site, shown in red. Deerfoot trail runs along the east of the site, Beddington Trail along the southwest, and Harvest Hills Boulevard along the west.

Access to the site may not be possible directly off Deerfoot, as this is a high speed, high volume road. This will need to be investigated and considered in the site design. Access off Beddington and Harvest Hills will be possible, so all vehicular entryways will likely be planned from there.

It is important to note that Beddington runs nearly parallel to an environmentally sensitive and attractive valley. Access off of Beddington would likely disturb this natural feature, which should be preserved due to its ecological sensitivity. Thus, disturbance to the area should be avoided for ecological as well as social reasons. This area is home to many bike and walking paths.

Vehicular access is thus restricted to the west of the site. Because of this the site plan must consider how to arrange access such that it can accommodate the site users comfortably.

In addition to this, once vehicles have accessed the site, they will need to be stored. Parking will be necessary until better public transportation is secured. This parking should be unobtrusive in order to increase the walkability and attractiveness of the area. This can be done by placing parking behind buildings, away from the pedestrian and main entry areas. Other possibilities include multi-storey parkades that can be tucked away from view, or covered using liner buildings.

Site Assessment Conclusion

All of the above opportunities and constraints should be taken into account when considering the design and plan of the site. Walking and cycling opportunities are somewhat limited, so these aspects will have to be heavily emphasized and central to the design in order to encourage them. Public transit is limited, so communication lines should be kept open with Calgary Transit in order to remedy the situation, and bus and train stops should be made as attractive and useful as possible using TOD methods. Finally, vehicles will need to be accommodated because of the limited pedestrian, bicycle, and transit options. Vehicular access will be restricted by the Deerfoot and the valley at the south of the site. Vehicle access and parking should be as unobtrusive as possible to further emphasize more sustainable transportation options. Should all these

considerations be taken into account and planned well, the site will be well on its way to being a success in terms of sustainability.

Transportation Goals

Aurora Business Park must be planned to in accordance with TOD principles to create a sustainable business park. As mentioned throughout the site assessment, the business park does face certain constraints. These constraints must be considered, and must be planned around to become a sustainable development. Aurora Business Park will implement many different forms of transportation access including: walking, cycling, bus, LRT, BRT, carpooling, and automobile use. The focus is to make Aurora Business Park very accessible through the use of public transit.



Reduction of Automobile Use

The first goal is to satisfy mobility needs in Calgary by operating a well-organized public transit system, creating an encouraging climate for the use of public transit and providing an alternative to private vehicle usage in order to lighten the congestion, which has caused continuous problems for the city as a whole.

According to the statistics from imagineCalgary, the vehicle km traveled per person per year grew from 4,000 in 1964 to 13,500 in 2001. The continued vehicle travel growth in Calgary is due to the rapid increase of population, job growth and travel by individuals. However, the general road pattern in Calgary is not well planned to accommodate for such rapid growth in vehicle usage and congestion has worsened dramatically in recent years. The ongoing construction in various locations of Calgary

has not happened fast enough to alleviate congestion in the city, but has even caused more inconvenience to drivers. In recent years, however, some drivers have switched to take the overcrowded and often late public transit to their destination instead of driving.

As the levels of provincial funding do not allow the city to maintain both roads and transit systems at the same time, prioritizing either one system or the other is therefore necessary. As the inner city roads are not expandable, transit-oriented development is a more favorable choice to inhibit the ongoing congestion in the city.

The purpose of developing the Aurora Business Park in the North with a LRT connection is to support TOD in Calgary. Residential communities at the North of Nose Creek have been experiencing rapid growth in size and population for the past decade, so building an adjacent suburban employment center with LRT connection should provide a more comfortable and convenient option to travel to work, and possibly change the mobility pattern along the North communities as well as minimize the dependency on driving private vehicles and lessen the congestion during the peak hours.

The transit-oriented development is not limited to LRT connected suburban employment center; indeed, shortening the distance between the residential communities and LRT stations is also vital to enhance the usage of public transit.

Recently, many of the suburban LRT stations are surrounded with nothing but parking lots and bus terminals. The traditional LRT station setting in Calgary has discouraged suburban residents to use public transit, especially those without vehicles. Besides, most of the current Calgary Transit bus routes connect to LRT stations, but poor bus frequency even reduced the desire of people to use public transit for mobility needs.

If Calgary were continuing the direction of transit-oriented development, some changes would need to take place at the LRT station sites, especially the ones with spacious parking lots. Revising the land use districts, allowing high-density housing development nearby the major transit facilities is necessary to benefit residents' access to LRT stations in walkable distances. A good example is the recently released Heritage Station Transit Oriented Development Plan with its proposal to construct apartment buildings, employment sites and denser parkade buildings to replace the wide park-and-ride lots and the surrounding vacant land parcels in different stages.

For the existing suburban communities, enhancing the reliability of buses to

connect to LRT stations is necessary to stimulate usage of public transit instead of driving; increasing the bus frequencies, enhancing bus stops environment and adjusting the bus route are all considerable choices to make. More importantly, strengthening the security and cleanliness in all transit facilities is necessary to encourage the residents to ride with public transit when they know its environment is safer and more pleasant.



The expanded 4-train platform at Downtown Calgary

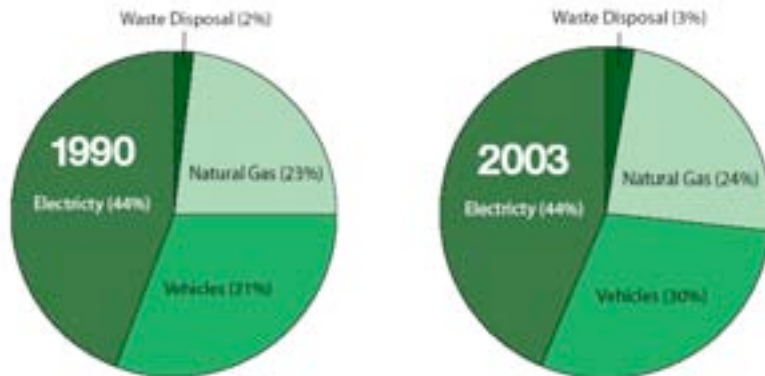
The imagineCalgary states its major strategy is to create and concentrate employment clusters in strategic locations and provide public amenities at those locations. More transit-accessible employment clusters would further direct the people to ride with transit instead of driving to work.

The setting and plans for the future Aurora Business Park fits the demands of being a walkable employment center, when a future LRT route will pass through the business park site with a station proposed in it. Concentrating the buildings on the land parcels that are adjacent to the transit facility, and reducing the parking standards (such as creating paid parking lots at marginal locations) is also considerable in encouraging people to be more transit-oriented in accessing their workplaces.

Traffic congestion in Calgary is not only making the city less accessible, but also exacerbating the pollution problem when the increasing number of private vehicles releases more greenhouse gas to the atmosphere. According to the Greenhouse Gas

Emission Study that was prepared by Environment Canada, Statistics Canada and Health Canada, Alberta and Ontario were recognized as the worst provinces in the creation of greenhouse gas emissions in 2003. In Calgary, vehicles are the second major source (about 30%) of greenhouse gas emission, when the consumption of energy derived from fossil fuel is dominant.

Figure 2: Calgary Community Greenhouse Gas Emissions by Source 1990 and 2003

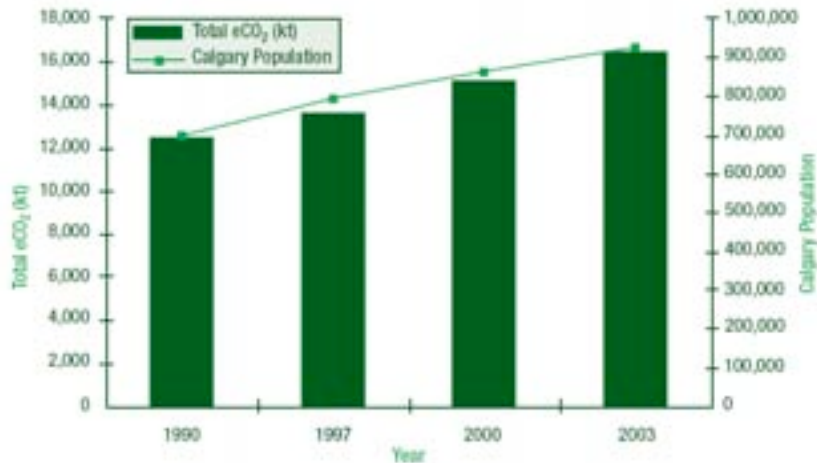


Calgary Community Greenhouse Gas Emission by Source

(Picture Credit to <http://www.calgary.ca/>)

Even though the component of greenhouse gas in Calgary has not changed over years, statistics have revealed that the greenhouse gas emission growth rate is essentially parallel to population growth over the period of 1990 to 2003, when the population of Calgary has rapidly increased with better employment opportunity locally.

Figure 3: Change in Calgary's Population and GHG Emissions in 1990, 1997, 2000 and 2003



Change of Calgary Population and Greenhouse Gas Emission from 1990 to 2003

(Picture Credit to <http://www.calgary.ca/>)

The imagineCalgary project has suggested two solutions for lowering the greenhouse gas emission levels in Calgary: encourage the use of energy-efficient and lower-emission vehicles, or reduce the private vehicle kilometers traveled per person.

As mentioned in the previous three targets, the purpose of proposing the Aurora Business Park concept is to alleviate the traffic congestion, to fit the transit-oriented development direction and to encourage the public to use public transit for mobility needs. Increasing walkability for public transit accessibility from home and business and improving the overall transit facility services would more likely guarantee comfortable and convenient rides for people, as an alternative to private vehicle use.

Calgary Transit is using cleaner-burning fuels for buses and the LRT trains are all wind-powered. When more people switch their mobility habits, greenhouse gas emission rates in Calgary should be improved. When more people choose not to be reliant on private vehicles for the sake of the ecosystem and the community, this has immediate positive effects.

Alternative Methods of Transportation

The keys to achieving an increase in employees who walk, cycle and take public transit to work are to make sure citizens are provided with an extensive transit network and encouraged to use it. Access to foot and/or bike paths to and from work for all employees is the most important element of influence when trying to change employees' travel patterns. Aurora Business Park will implement bike storage facilities at all office towers. Allowing for employees to easily store their bikes and accessories safely. There will also be change facilities on their work sites, allowing access for those who bike, walk or run to work.

During peak hours of transportation (7:00 – 9:00 AM and 4:00 to 6:00PM), buses and LRT cars to and from the downtown are overcrowded in one direction and nearly empty in the other. This implies a greater number of vehicles are needed in the peak hours, poor utilization of transit vehicles and unnecessary emissions of GHGs as vehicles

consume fuel even though they operate with few passengers. This issue is not important from the perspective of climate change only, but also as it affects overall planning for the city. Calgary continues to grow, and the continually increasing population could lead to public transportation problems unless the city has an efficient plan to manage that growth⁸. This transportation issue shows a problem on the over reliance on downtown as the business and transit core of the city. The construction of Aurora Business Park provides more business development outside the downtown core. This will deviate some transit trips away from downtown and towards Aurora Business Park. Public transportation will see increased efficiency and less congestion. Strong transit support for Aurora Business is, thus, a sustainable choice that will benefit the city.

Parking lots will be small and will not provide parking for all employees close to their specific locations. There will be a main parking lot for all employees of Aurora Business Park that is located in the far corner of the development and parking passes will be costly to discourage automobile use. Carpooling parking lots will be located closer to the office towers and will have cheap rates depending on the number of employees in each vehicle. Parking lots machine will be powered by solar panels to avoid unnecessary energy usage.



Source: Portland Transportation

⁸ Timilsina, Govinda R., Paul R. Kralovic, and "Potential Effects of Climate Change on the City of Calgary: Adapting to a New Environment." Canadian Energy Research Institute (2005): 23-25.

Employees will be informed about the different transportation options. The costs will be clearly outlined and shown to encourage other forms of transit than the automobile. Flexible hours of work will be implemented to avoid congestion of roadways and pathways. “Peak period vehicular travel to downtown places the most strain on the transportation system. By increasing non-vehicular travel during the peak period, we can reduce the demands placed on the roadways, etc.”⁹

The City of Portland has been very successful in encouraging carpooling through their program *SmartTrips*. The city has offered multiple carpooling options, along with employee subsidies for those who take alternate forms of transit.

“Motivate employees to use transit options by reserving parking spaces for carpools and vanpools near employee entrances. This has great appeal where parking is limited or lots are large. Put up a few signs, paint the parking spaces and promote yet another great benefit to your employees. *CarpoolCheck* allows companies to pay part of their employees' carpool parking costs at selected parking locations in downtown Portland where there is a monthly parking fee. Financial subsidies encourage employees to use commuting options. Most companies offering subsidies for carpools also offer cash, gift certificates or vouchers (like *CarpoolCheck*) that apply to the cost of regular automobile maintenance, gas or parking.”¹⁰

Imagine Calgary states its major strategies for achieving this goal:

- Increase the residential population and number of jobs within walking distance (up to 600 metres) of LRT stations and major bus zones by 100 per cent and 50 per cent respectively.
- Implement transit-oriented development funded or supported by The City, to be given priority over current LRT park-and-ride lots.
- Limit suburban office development in areas not well served by transit.

⁹ City of Calgary, *Imagine Calgary Plan: Long Range Urban Sustainability* (Calgary: City of Calgary, 2007).

¹⁰ "Portland Transportation." City of Portland. Office of Transportation. 13 Mar 2008
<http://www.portlandonline.com/TRANSPORTATION/index.cfm?c=32360>.

- Improve the pedestrian environment in older districts, including industrial areas.

The major strategies implemented in Aurora Business Park will include transit-oriented development and the reduction of suburban office developments not well linked to transit. Aurora Business Park will become a second business centre for the city, thus creating the need for a strong transit connection to the business park. Aurora Business Park will follow TOD principles to provide a more effective form of transportation. Aurora Business Park will be highly walkable and pedestrian friendly. It will also serve as a secondary transit hub to downtown, as it will have an LRT link and bus service. Aurora Business Park will include mixed-use land development including retail and office. "Transit Oriented Development as an approach to combat traffic congestion and protect the environment has caught on all across the country. The trick for real estate developers has always been identifying the hot transportation system. Today, highways are out; urban transit systems are in." ¹¹. Both pathways and bike paths, along with an LRT extension and bus service, will directly serve Aurora Business Park. Calgarians have already shown a willingness to use public transit to go to work. The average distance traveled per person within the city has increased by nearly 3,000 km per year between 1991 and 2001. ¹² It is interesting to note that Calgary has a relatively higher proportion of its labour force using public transportation as compared to other cities in Western Canada. ¹³ (Please see Table 3.2)

¹¹ "Design for a better future." Transit Oriented Development. March 2008. 15 Mar 2008
<<http://www.transitorienteddevelopment.org/>>.

¹² "City Transportation." The City of Calgary. 13 Mar 2008
<<http://www.calgary.ca/portal/server.pt?open=512&objID=217&PageID=0&cached=true&mode=2&userID=2>>.

¹³ Timilsina, Govinda R., Paul R. Kralovic, and "Potential Effects of Climate Change on the City of Calgary: Adapting to a New Environment." Canadian Energy Research Institute (2005): 23-25.

Table 3.2
Employed Labour Force by Mode of Transportation (2001 Census)

	Saskatoon	Calgary	Edmonton	Vancouver	Victoria
Total Employed Labour	106,825	499,045	445,220	905,995	140,515
Car, truck or van, as driver	80%	72%	78%	72%	68%
Car, truck or van, as passenger	7%	7%	7%	7%	6%
Public transit	4%	13%	9%	11%	10%
Walked to work	6%	6%	5%	6%	10%
Bicycle	3%	1%	1%	2%	3%
Motorcycle	0%	0%	0%	0%	1%
Taxicab	0%	0%	0%	0%	0%
Other method	1%	1%	2%	1%	1%

Source: Statistics Canada, Census of Population

• Transit trips percapita is a measure of how effective transit service is in serving Calgarians’ travel needs. If transit ridership goes up, it is usually the result of two factors: more people in Calgary or more frequent use of transit by existing Calgarians. In the past 10 years, not only did ridership increase, but so did the transit trips per capita. This means that transit’s share of the travel market increased, as well as the total market. This measure will help determine if we are attracting trips to transit that would formally have been made by other modes.¹⁴

Bike Pathways

Calgary already boasts one of largest bike pathways in North America. The imagineCalgary plan envisions a continuation of the development of Calgary’s pathway network. Pathways would be very effective in moving traffic towards Aurora Business Park. Proper facilities are essential when trying to promote biking, running, or walking to work. The implementation of bike lockers, along with changing facilities for employees is essential. Subsidies to promote the usage of pathways as alternative to driving are a good option to increase the use of alternate forms of transit. Pathways will fully serve the Aurora Business Park to/from all surrounding communities, and therefore it will be a real transit option for all employees living there. Bike lanes along roadways around and inside Aurora Business Park will be promoted to allow for safe bike travel. During the winter season all pathways must be kept clear of snow to insure public safety. “Providing safe space for bicycle travel is important. We already have a great system of pathways and

¹⁴ City of Calgary, *imagineCalgary Plan: Long Range Urban Sustainability* (Calgary: City of Calgary, 2007).

these should be maintained and expanded upon over the next 30 years. On-street bikeways are another way to make it easier to enable a broader range of travel choices.”

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Source: ImagineCalgary Plan

Renewable Energy Ideas

One goal for the Aurora Business Park is for it to be completely energy self-sufficient. There should be multiple renewable energy sources used in order to create this self-sufficiency. There are numerous solar energy options which could be implemented as well as options such as bio-methane generation. We believe that the use of renewable energy sources will be fostered and enhanced by promoting businesses within the renewable energy industry to populate the park. This promotion will be crucial as our economy moves towards solutions to our oil and gas dependency. We envision the Aurora Business Park being a leading centre in Canada and North America for renewable energy R&D.

¹⁵ Ibid

isn't sunny the park would need to rely on the grid or other renewable sources for its electricity.

Another application for solar energy in the form of space heating was inspired by the solar community of Drake Landing in Okotoks.¹⁸ In this application, solar energy is collected using solar panels that heat water that is stored in insulated pipes underground. The heated water travels to a central unit that stores the thermal energy through the summer months and releases it through the insulated pipes to the buildings during the winter months for space heating. For the Aurora Business Park this type of system would need to be scaled up to a larger size and would ideally be positioned on the southern periphery of the park in order to capture the most sunshine without obstruction. Also of interest to us, but not feasible for the Aurora Business Park site, is a system similar to that of Seville, Spain.¹⁹ They have built a giant solar power plant that currently powers about 60,000 households; it is a 40-storey tower surrounded by hundreds of mirrors that track the sun and focus its energy on a central location atop the tower. Water flows through pipes at the top of the tower creating steam that powers turbines creating electricity. This is a great application that might be further researched for its suitability and perhaps built outside the city to provide electricity for the Aurora Business Park as well as elsewhere in the city of Calgary.

Bio-methane

To supplement the use of solar power in the Aurora Business Park, bio-methane could be an additional option. Aurora Business Park could employ an intensive composting and wastewater treatment system with the organic waste being used to produce bio-methane. The goal is to use anaerobic digesters to produce the methane, which would be captured and used in a cogeneration system to produce electricity and steam.²⁰ Cogeneration systems come in numerous sizes and we would identify the correct size for our application. The composting/waste management site could be situated in the SE corner of the light industrial zone so as to minimize the effects of the likely odors which will emanate from the process.

¹⁸ www.dlsc.ca April 6, 2008 5:28pm

¹⁹ www.inhabitat.com/2007/05/21/sevilles-solar-power-tower/ April 6, 2008 5:43pm

²⁰ www.biomethane.com April 6, 2008 6:39pm

Summary

The nature of the Park's reliance on renewable sources of energy for operation leads us to our next recommendation that the Park be home to renewable energy R&D. We believe this will be best achieved by a mixture of public and private institutions working in conjunction to further understanding and development of renewable sources of energy. Ideally we would like to see the city of Calgary, the University of Calgary, and private partners set up business within the park. We want to see the Aurora Business Park be a leader in the renewable energy industry and a first hand example of what we can do to limit our use of fossil fuels.

Built Environment

Urban development patterns affect the built environment, blueprint of natural land cover, and human activity patterns – occurring with differential consequences on the local and global ecosystem.²¹ With the stated preference for a closed circuit related-business park development we hope to achieve a building standard of minimum LEED practices where developers are encouraged to create eco-friendly appropriately designed commercial buildings. Encouraging a productive research friendly centre should welcome attempts of creating best practice integrated building design (as outlined by the Canada Green Building Council).²²

Developers will be encouraged through passive incentive based programs (ex increasing LEED scores equate to decreased costs of additional units) as well as coercive minimum standards of “green” technology design. Architects, designers, developers, and planners will be working as a team for the numerous structures to create a comprehensive integrated park layout where natural system connectivity and energy efficiency will be the focus. Techniques such as ‘green-roof’ design allow for a reduction in storm water run off, decrease in local heat island effect (especially encouraging light-colored paving, roofing, and shading), air cleaning and increased biotic support to list only the foremost

²¹ Alberti M, Marzluff JM. 2004. Ecological resilience in urban ecosystem: Linking urban patterns to human and ecological functions. *Urban Ecosystem*. 7:241-265.

²² Canada green building council. http://www.cagbc.org/resources/general_information/articles103.htm

benefits and will be strongly recommended.²³ Admittedly the relationship between biophysical and socioeconomic environments is not well understood, allowing for a conscious learning process to adapt affordability and practicality with minimizing of natural system disturbance.

Ensuring safe construction practices, the development will occur with minimal soil disruption and compaction during the construction process, with implementation of green building materials (i.e. those that use the Earth's resources in an environmentally responsible way, respecting the limitations of nonrenewable resources with regard for the manufacturing and future use efficiency).²⁴ Success of high-performance green development relies heavily on the construction process; building managers will be stressed to accept and participate with the responsibilities of creating resource-efficient buildings, keeping the footprint of the building and operating process to a minimum. As adapted from Kibert's *Green Construction*²⁵ the following outlines examples of healthy footprint reducing practices:

- Site protection planning
- Health and safety planning
- Construction and demolition waste management
- Encouraging re-use, recycling, and reduction of waste materials
- Develop procedures for separation of hazardous waste by-products
- Document existing sensitive natural areas
- Prohibit clearing of vegetation beyond 12.2 meters from building perimeter
- Minimize impervious paved areas (such as parking lots, buildings, and other paved sites)
- Make use of alternative storm water technologies (such as pervious concrete or asphalt), create sealed removable storm water collection structures (piping systems or retention tanks) during construction

²³ Metro Vancouver. <http://www.gvrd.bc.ca/BuildSmart/design-practices.htm>

²⁴ Spiegel R, Meadows D. 2006. *Green building materials: A guide to produce selection and specification*. 2ed pg. 27-31. Wiley & Sons, Hoboken, NJ, USA.

²⁵ Kibert CJ. 2007. *Sustainable Construction: Green building design and delivery*. Wiley & Sons, Hoboken, NJ, USA. pg 241-248, 309-316

- Re-use existing structures (share closed loop construction materials) and building components (using intact building structures from previously deconstructed forms)
- Reduce material use within building code limitations
- Reduce construction dust, minimizing onsite contamination
- Use materials created from renewable resources (ex. polylactic acid polymer plastics)
- Use locally produced materials
- Disregard non-inert and off-gassing or ozone depleting options for construction material

The orientation and layout of the business park will incorporate on ground involvement, with the placement of benches, parks, and sitting areas, inviting walkable corridors for foot and bicycle transportation. These mini-plazas will encourage citizens to appreciate the maintained natural surrounding environment while promoting physical activity on a daily basis. Allowances will be made for flexible commercial opportunities (such as cafes and small grocery / stationary stores) placed on public transit corridors.

Natural Environment

Changes in urbanization are detrimental for ecosystem health.²⁶ As the current boundaries of the Aurora Business Park lie as a natural land corridor buffering three communities from highway and airfield pollution, a special care must be paid to maintain the ecological integrity of the local system. Hopes of implementing a holistic approach to green space design will be encouraged. Ecosystem planning allows an interdisciplinary approach to site design, integrating biophysical and socioeconomic understanding of the system; increasing the knowledge of interactions between urban structures, function and human activities on local animal populations.²⁷ While the site is highly regarded for increasing Calgary's polycentric commercial densities, it maintains preciously scarce wetlands, a creek, and a large block of undeveloped green space. Pollution of these key areas by increased runoff, emissions, and anthropogenic pollutants would be harmful for the health of the local, and consequently regional, ecosystems. Maintaining a healthy development with appropriate land cover may be achieved while encouraging participation with the local communities, business owners, and employees.

The ground landscaping will consist of native central Albertan species of vegetation, encouraging small wildlife to live throughout the designated park areas. Preserving the existing natural features, integrating them within the development process is encouraged at all possible opportunities. Native drought tolerant plants, trees, grasses and shrubs will bring appropriate biodiversity within the bounds of the park, where small segments (particularly along the creek and wetlands boundaries) will be maintained and sequestered as sanctuary. Allowing for connected green spaces, with such innovations as green-roofs will increase collection of excess runoff, while encouraging natural recharge of ground and aquifer water supply. Landscaping techniques such as bioretention of runoff water, rainwater gardens, precipitation collection in contribution with grey water recycling will decrease dependency on city water supply, lowering regional dependency.

²⁶ Pickett STA, Cadenasso ML, Grove M, Nilon CH, Pouyat RV, Costanza R, Zipperer WC. 2001. Urban ecological systems: Linking terrestrial ecological, physical, and socioeconomic components of metropolitan areas. *Annual review of ecology and systematics*. 32: 127-157

²⁷ Slocombe SD. 1993. Environmental planning, ecosystem science, and ecosystem approaches for integrating environment and development. *Environmental management*. 17(3): 289-303.

The association between maintaining a healthy, responsible green space is conducive to increasing community support, enhancing pride within the employees and a sense of ownership and involvement in the overall wellbeing of the local environment. Biological indicators can provide useful information concerning site status, but the success of biological techniques depends largely upon choosing sensitive and ecologically relevant assays.²⁸ With the use of bioindicator programs the local population will be encouraged to understand and participate with adapting the localized ecosystem to become as healthy as possible. Bioindicators are those species of plants and animals that are found in numerous areas of an environment that may be surveyed for toxicity levels, morphological malformations as caused by pollution or anthropogenic sources, or population patterns as related to changes in local habitat. Two simple and increasingly used types of programs are suggested:

Bird Counting

A system of nesting boxes and natural areas will be counted previous to construction, during development, and post development. These nesting areas and habitats are then counted in a series of tri annual surveys for a population estimate of differing species within the park. Each year the population statistics will be tabulated to note shifts, in hope of a correlation to immediate on site factors such as an increase in traffic, decreases in habitat connectivity and increases in human activity. This type of exercise will encourage local schools and community association participation, as these numbers are migratory (between season, and area) the results will allow for interpretation of successful and unsuccessful green and urban space design alike. Maintaining large tree segments and multi-layered vegetation structure is essential in protecting and maintaining species diversity²⁹, conclusions will allow interpretation for planned area adequacy to support vital biodiversity.

²⁸Hankard P, Svendsen C, Wright C, Wienberg C, Fishwick S, Spurgeon DJ, Weeks JM. 2004. Biological assessment of contaminated land using earthworm biomarkers in support of chemical analysis. *Science of the total environment*. 330(1):9-20.

²⁹Sandström UG, Angelstam P, Mikusiński G. 2006. Ecological diversity of birds in relation to the structure of urban green space. *Landscape and Urban Planning* 77 pp. 39-53.

Soil and Aquatic stability

Soils in urban landscapes retain and supply nutrients, serve as a growth medium and substrate for soil flora, and absorb and store water.³⁰ Understanding the affects of anthropogenic disturbance (pollution, and human activity) on soil functionality is crucial in understanding park ecology. To focus on soil contamination and subsequent consequences, native spruces will be planted and maintained in both park and natural sequestered areas (such as *Picea glauca* – white spruce). Pine and spruce species are preferred for this type of study as the diplontic nature of their pollen grain show genomic alterations due to amassing of pollutants³¹, and conclusions of genotoxicity (collection of chemically induced gene mutation) may be applied to a wide range of native flora. Pollen grains show emission consequences in morphological malformations³² that may be surveyed after collection of grains from designated sites under low powered microscopes. By comparing phenotype frequencies (differing morphology of pollen grains) with rates of exposure to emissions and pollutants (as each site will be differentially exposed), resulting once again in an understanding of local site effects on ecological health.

As stated previously, the park encloses wetlands and a creek; health of this area is crucial in maintaining rich biodiversity. As such aquatic invertebrates may be used as indicators of the watershed. A collection of selected invertebrates (ex earthworm) will take place biannually, where population numbers will be estimated (rate of individuals per area) as well as physical analysis of toxic chemicals absorbed. In situ exposure to chemicals accumulate in higher species down the food chain (this is called bioaccumulation), understanding low level populations (such as invertebrates) allows for an understanding of their environment as well as the possible toxic accumulation in predators.³³ Admittedly a new science, the study of eco-toxicity is increasing in assurance of methodology for monitoring the status of soil ecosystems (where earthworms are the most relevant species).³⁴ Collection may be done to bring awareness to students of

³⁰ Micieta K, Murin G. 1998. Three species of genus *Pinus* suitable as bioindicators of polluted environment. *Water, air, soil pollution*. 104:413-422

³¹ Ibid.

³² Ibid.

³³ Hankard P, Svendsen C, Wright C, Wienberg C, Fishwick S, Spurgeon DJ, Weeks JM. 2004. Biological assessment of contaminated land using earthworm biomarkers in support of chemical analysis. *Science of the total environment*. 330(1):9-20.

³⁴ Ibid.

surrounding schools of ecological practices, pollution dynamics, and their effects of our built environment.

Conclusion

As every urban environment requires continuous development overtime, it is necessary to plan and develop the new communities in more sustainable ways to meet the current and future urban needs. The Aurora Business Park project has suggested a sustainable development by providing more accessible and usable transportation alternatives in order to mitigate inner-city congestion and renewable energy alternatives to power the site.

In the project, the development of sustainable transportation is according to the principles of transit-oriented design (TOD) and the inspirations from the ImagineCalgary Plan. Sustainable transportation is provided through building attractive walkways and cycling paths, developing well-organized public transit systems (such as Light Rail Transit and Bus Rapid Transit lines), enhancing public transit services, discouraging parking, using renewable fuel for transit and creating an encouraging climate to use public transit in order to maximize the utility of public transportation and reducing the usage of private automobiles.

Achieving sustainability in the Aurora Business Park is not limited to enhancing accessibility through alternative transportation. Using renewable resources to run energy efficient spaces, maximizing LEED practices by creating eco-friendly commercial buildings is also a priority. Ecological integrity will be maintained through interactive green spaces and environmental programs. Our aspirations for the Aurora Business Park are that it becomes a framework and guideline for future sustainable developments while helping to alleviate the current ailments of the city of Calgary.

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