SCHULICH
School of Engineering

ENCI 570 - Civil Engineering Design Project

ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

Stepping Towards a Greener Tomorrow

Final Report

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1.0 Executive Summary

Enclosed within this report is a study of transportation networks near schools in modern cities, specifically the City of Calgary. The main goal of the project is to improve existing, and design new infrastructure, to promote active modes of travel by students during their commutes to and from school. The report contains a detailed analysis on the existing transportation infrastructure conditions and effectiveness surrounding three schools in Calgary. The schools are the Connaught School in the Beltline, École La Mosaïque in Martindale, and Calgary Islamic School Omar Bin Al-Khattab (OBK) in Meridian.

This capstone design project was completed in two phases. The fall term phase consisted of thorough research, as well as identifying and analyzing the existing problem areas of each school to better prepare interventions and improvements. The winter term phase consisted of further studies and detailed proposed designs at all three schools and their surrounding areas. This report emphasizes the work performed in the winter term, with the foundation of research and analysis completed in the fall term. Additionally, this report includes the design methodology followed to develop potential solutions for investors when upgrading the roadway alignments and transportation networks around school areas. Numerous conceptual and a final proposed design for each neighbourhood are presented, along with the following outputs:

- Neighbourhood Active Transportation Network (NATN) plan for community under study
- Construction costs determined through preliminary detailed cost estimation
- General construction implementation and timeline
- Emissions modeling using preliminary calculations and MOVES software model
- Overall recommendations relating to scope of work

The designs and rationale outlined in this report are founded on the research conducted on each school community, as well as data such as children's surveys provided by our partners Sustainable Calgary and Ever Active Schools. The existing traffic conditions explored in this report are built on site visits performed, to achieve traffic counts during peak hours and through general observations.

The preliminary design work explored involved determining design concepts that are suitable for each community to show the connection between transportation infrastructure and active travel. Three preliminary designs per community are defined and ranked depending on the design criteria and their importance. Development and description of final designs are discussed following the use of a weighted selection matrix. Following this the five outputs outlined above were investigated. Assumptions and constraints made throughout this capstone project have been documented. This report concludes with important recommendations to the improvement of transportation networks, to reduce carbon emissions and adopt a low carbon transport hierarchy.

Overall, the work within this report includes tangible design options to create safer and more inviting spaces around schools, by prioritizing pedestrians, specifically children. Accompanied with this is the hope of transitioning modal share to active transportation. This is a required change in human behaviour to lead towards a healthier and more sustainable future.

2.0 Introduction

2.1 Background

Our capstone project, *Active Transportation Safety for School Access*, involved a collaboration with *Sustainable Calgary* and *Ever Active Schools*. The primary focus was finding innovative ways to design new or retrofit existing infrastructure to promote the use of active transportation by children during their school commutes. The Government of Canada defines *active transportation* as "using your own power to get from one place to another" [1]. Physical, societal, economic, and environmental health, all benefit from modes of transport such as walking, biking, skateboarding, wheel chairing, etc.

Table 1 below summarizes some examples of the types of benefits active transportation can have within these four (4) categories [2][3]. These aspects are seen to have an impact on all ages and can lead to a more well-rounded, healthy lifestyle for children specifically. Children who walk or bike to school typically have better academic performance, lower levels of stress, longer attention spans, and an enhanced sense of independence [4].

Table 1: Benefits of Active Transportation in Four Different Aspects

PHYSICAL HEALTH	SOCIETY	ECONOMY	ENVIRONMENT
Increased physical activity Improved cardiovascular fitness Reduced obesity Reduced chronic diseases Improved mental health	Increased mobility Increased sense of community Reduced national health care costs Safety in numbers affect	Reduced fuel, repair, and maintenance costs Reduced external costs to traffic congestion Increased productivity Increased property value	Reduced greenhouse gas emissions Reduced energy consumption Reduced noise Improved land use

Quite often a major barrier to the use of active transportation is the perception that these modes are more dangerous. This perception is fueled by the fact that *"pedestrians and cyclists are more likely to be killed or injured than car and public transport users"* [3, p. 8]. This is greatly due to the lack of safe transport infrastructure that supports active modes of travel [2].

A major issue in transportation infrastructure is that modern cities are built for cars. Car-centric planning privileges the automobile, at the expense of those who walk, bike, or use public transportation [5]. This has altered the way humans primarily travel and has entirely shifted transportation planning to further induce urban sprawl. Pedestrians, specifically children, women, and elderly people, are often an afterthought in urban planning. This leads to a greater dependence on the personal vehicle. As per 2016, in Calgary only 6.2% of people use walking or biking as their main source of commute, and another 14.4% mainly utilize public transportation [6].

The amount of physical area provided to automobiles demonstrates the prioritization design puts on the personal vehicle. For example, a study from Gössling et al. used satellite imagery to establish space distribution in four European cities [7]. In these cities 14.5% to 24.3% of the cities total area was allocated to transport infrastructure, with an average of 48.6% of that area designated as roads. Inadequate space allocated to active modes of travel greatly aids to the perception that using modes such as walking, and biking is not a safe option. Therefore, prioritizing active transport through redistributing space is paramount to support more sustainable travel modes. Consequentially, this will create spaces that are inviting and safe for all ages to use.

Further driving the need to transition human behaviour to favor active modes of transportation is the ongoing climate crisis. As Sustainable Calgary stated in their State of our City 2020 publication "*the window of opportunity for a gradual transition to a sustainable future has closed*" [8. p. 6]. Focusing on the school commute of students in Calgary, this project contributes to the necessary adjustment in our relationship with transportation.

Furthermore, adopting a low carbon transport hierarchy works towards a more sustainable future for all Calgarians. To achieve this hierarchy, there is a need to invest in transit and other active transport infrastructure. Through investments and efforts to challenge current transportation planning, carbon reduction goals can be met to address the Climate Emergency that was declared in Calgary in November 2021. To challenge procedures that have been set for years will not only require technological changes, but also a paradigm shift that prioritizes high accessibility solutions [9]. That is, to narrow the amount of mobility needed for people to meet their needs and favor active travel modes including public transit [9].

2.2 Scope

The project consisted of conducting a rigorous investigation of three (3) schools in the City of Calgary to achieve a finalized proposed design for all neighbourhoods. The three (3) schools under study are the Connaught School in the Beltline, École La Mosaïque in Martindale, and Calgary Islamic School Omar Bin Al-Khattab (OBK) in Meridian. Each of the schools have unique backgrounds and challenges that required the exploration of diverse improvements. Most importantly, the investigations and designs revolved entirely around promoting active modes specifically to students for their commutes to school. This was the primary focus in all deliverables set in the project.

A major component of the work was incorporating the perspectives of children in our designs. Sustainable Calgary and Ever Active Schools, through the initiative, *Stepping Towards a Greener Tomorrow* collected data through surveys from the schools under study. The students were also asked to illustrate how they wish their community was built. This data served as a foundation for our designs, as incorporating the main users' perspective is a collaborative approach that can increase the likelihood of use.

There were three (3) main goals set to achieve with the work in this project, and they are defined as follows:

1. To perform an iterative design process that ultimately led to the selection and further development of a final proposed design for each neighbourhood.
2. To produce a proposed Neighbourhood Active Transportation Network (NATN) to improve the connectivity in the entire neighbourhood the school exists.
3. To model the current carbon dioxide emissions attributed to each of the schools under study so potential future emissions could be determined.

To ensure the work performed followed all applicable guidelines and standards, research was conducted. This involved a thorough literature review of all relevant texts prior to and throughout the design process. Relevant texts included the *Complete Streets Guide*, *NACTO's Designing Streets for Kids*, *Traffic Calming and Pedestrian Policies of the City*, and publications from Sustainable Calgary. Additionally, a detailed review of the existing conditions of the neighbourhoods, including the recreation of a traffic model through the software *PTV VISSIM* was performed.

A weighted decision matrix with categories deemed important to the project was used to select a final design. The final designs for each school were developed in detailed AutoCAD drawings and SketchUp models. Preliminary estimations were made for carbon emissions in the existing conditions of each school environment. Once a final design was selected, a detailed model of carbon emissions was developed using the MOVES software.

To gauge the feasibility of final designs, a preliminary construction cost estimate was completed. Additionally, an implementation timeline was developed to further support the feasibility of construction.

Overall, the deliverables set in the scope of work for this project led to a complete and comprehensive study in how transportation networks around schools can be improved. Throughout all design processes the perspective of students was accounted for, to enhance engagement if implemented.

2.3 Stakeholders

An important aspect of this project is understanding each stakeholder and the role they have. The primary stakeholder, Sustainable Calgary was the main source of communication and provided valuable review of all work. The collaboration with this stakeholder was possible through communication with Ms. Celia Lee and Mr. Ryan Martinson. The collaboration between Sustainable Calgary and Ever Active Schools, led to the latter also being another important stakeholder. The initiatives of both these organizations directly align with the goals set in this project, to encourage the active travel of students to their educational institution, increasing physical activity and improving air quality in their school zones [4]. In addition, the three schools under study and the neighbourhoods they are situated within, Connaught School in Beltline, École La Mosaïque in Martindale, and OBK in Meridian, are also key stakeholders. The work performed in this project will directly impact the school organizations and the communities they reside in as they are of focus.

Separate from organizations there are two other main stakeholders, as they are the targeted users. Children, and specifically the students attending the three schools under investigation are directly affected by the outcomes of this project. Furthermore, the parents of these children are the secondary stakeholder. The choice of transport modes children partake in is greatly affected by the allowance and perception of their parents. We understand that having our design focus on the needs of booth of these groups is detrimental to the success of our proposals.

Finally, the City of Calgary is a stakeholder as a successful project will promote the creation of safer and healthier school zones, whilst reducing traffic and greenhouse gas emissions. As a crucial advisor and member of this project, Dr. Alexandre de Barros is recognized as a stakeholder as well. We also acknowledge the traditional territories of the people of the Treaty 7 region in Southern Alberta, which includes the Blackfoot Confederacy (comprising the Siksika, Piikani, and Kainai First Nations), as well as the Tsuut'ina First Nation, and the Stoney Nakoda (including the Chiniki, Bearspaw, and Wesley First Nations), as well as, Métis Nation of Alberta, Region 3.

To view a complete overview summary of the work completed in this project use the QR code shown.

3.0 Existing Traffic Conditions and Site-Specific Challenges

A major aspect to properly approach the design process involved gaining a deep understanding of the current conditions of each school and neighbourhood. This required research and site visits to obtain pertinent information of the challenges existing in the areas. Surveys and data provided by Sustainable Calgary and Ever Active Schools were reviewed and served as a basis of information for the behaviour of student commutes.

3.1 Beltline

Due to its central location, the Beltline experiences significant heavy traffic, both motor vehicles, and pedestrians. It is one of the densest communities in the City of Calgary, housing over 24,887 people as of 2018 [10].

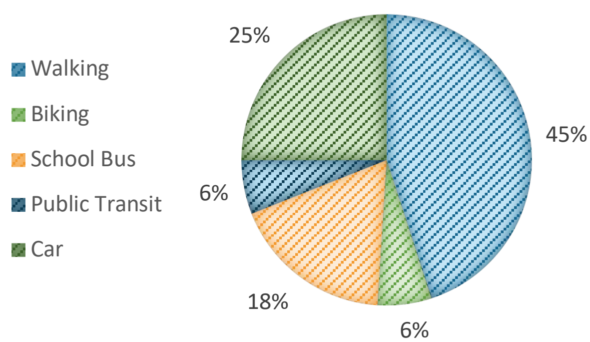

Figure 1: Modal Split for Connaught School

Figure 1 depicts the modal split of students commuting to the Connaught school. A significant number of students walk to school, with the second most significant group of students getting driven via automobile. Due to the already heavy walking presence to the Connaught school, a priority for the Beltline group is improving the safety of walking students. This will be accompanied by the goal to shift most students to active modes.

During site visits to the Connaught School, several concerns were identified. The first concern was the inadequacy of the sidewalk around the school, especially the side adjacent to 12^{th} Avenue SW. This is especially important, as it is the primary access point to public transit, as well as a common path to the convenience store often visited by students. The sidewalk along 13^{th} Avenue SW were also inadequate widths for the school commuters' needs. Often people would move onto the grassy area or slow to fall in line to make room for others moving in the opposite direction.

Visibility on 13^{th} Avenue SW was also observed to be lacking. As this street is most utilized for drop-offs and pick-ups for Connaught School, vehicles were constantly being parked, blocking the vision of parents and children jaywalking across the avenue. Another concern identified was a tendency of vehicles to drive fast on 12^{th} Avenue. This in conjunction with poorly placed school zone signage leads 12^{th} Avenue to be a generally unsafe zone for students and other pedestrians.

Lastly, a lack of greenery was noted during Connaught school site visits. While greenery is certainly present around the school, there is a significant amount of unutilized space, which would lend itself well to an increase in greenery. Specifically, an increase in tree density around the school field would both increase comfort of students and reduce the noise pollution which significantly diminishes the desired natural feeling around the school.

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To visualize the traffic occurring around the school, a Vissim model, Existing Traffic Conditions – Beltline was created. This may be accessed through the QR code displayed.

3.2 Martindale

Based on the data received from Sustainable Calgary and Ever Active Schools [11], *Figure 2* shows the existing modal share used by students getting to École La Mosaïque. As shown, the highest percentage comes from school buses followed by cars (parent pick-up and drop-off), walking, and public transportation.

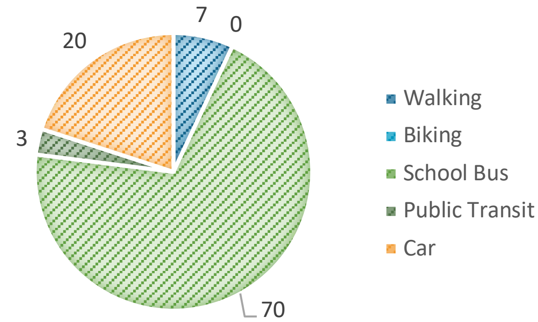

Figure 2: Modal Split for École La Mosaïque

From our site visit, we observed that drivers appear to frequently speed through the playground zone in front of the school. This is assumed to be due to the relatively straight and flat alignment of the road, giving drivers a false sense of safety. Therefore, our design options should include elements that make driving uncomfortable, invoking drivers to slow down and pay more attention to their surroundings.

Another issue observed is the surrounding intersections are a large distance away from the school itself. This makes the intersections undesirable to use as pedestrians will choose to cross in the middle of the street instead of taking the long detour away from the street to cross at an intersection. This can be quite dangerous as drivers may not be expecting pedestrians to be in the road outside of a marked crosswalk. Therefore, a potential solution is to provide a designated marked crossing on the road where pedestrians typically jaywalk, so that drivers are given visual warning and suspect they may need to stop for pedestrians.

Finally, Martindale Blvd is a busy collector road with through traffic that has no origin or destination in the nearby area. This may further contribute to unsafe situations around the school, as drivers may not realize they are in a school zone as they are just passing through. Therefore, our design should make this route less appealing, so that through traffic finds other routes, decreasing traffic immediately around the school.

The team utilized VISSIM to gain a better understanding of traffic behaviour around the school during student pickup and drop-off times. We built this simulation, [Existing Traffic Conditions – Martindale], using City of Calgary traffic counts and a manual vehicle count collected during site visits. The QR code can be used to view a video of our simulation.

3.3 Meridian

The data provided by Sustainable Calgary highlighted that most students attending OBK are driven to school by their parents or carpool with others. Few students use the school's bussing system and only three students take Calgary Transit [12]. These values are based off seventy-six responses to the survey and can be seen in *Figure 3*.

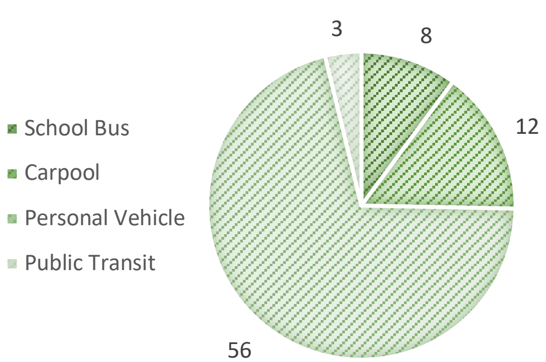

Figure 3: Modal Split for OBK School

Figure 4: Existing Parking Lot Traffic at OBK

The design of the existing layout of the parking lot prioritizes drop-off and pick-up of students by their parents. Approximately two-thirds of the lot are marked as "Drop Off and Go" zones, encouraging the use of the personal vehicle. The school has established a routine for drop-off and pick-up. Parents drive in from the North and South entrances, stop sporadically in the parking stalls or aisles to let students out, and then continue driving, exiting through the back alley onto 2nd Ave SE. Since over 90% of the students at OBK are driven, the parking lot becomes heavily congested at peak hours, especially as all cars are leaving through the single exit. This movement of vehicles is recreated in *Figure 4.* Additionally, the entrances of the school do not facilitate active travel as there is no sidewalk to the main entrance of the school meaning students would have to walk alongside the cars, until they reach the entrance of the building.

During site visits, vehicles were observed disregarding parking stall lines, avoiding speed bumps, and driving fast despite students walking close by. In addition to the sea of personal vehicles, five school buses enter the parking lot to drop off children. In the surveys conducted by Sustainable Calgary, many parents expressed concern over the high cost of the school's bus system [12]. This is reflected in the few children that were observed getting off the buses in the morning. Additionally, only one bus is present during pick-up, meaning perhaps even fewer students utilize this mode in the afternoon. During drop-off and pick-up, students walk along the thin parking lot medians to get to the entrance of the school because there is no adequate walkway. Furthermore, when students jump out of their parent's cars, they must traverse the oncoming traffic in the parking lot. Overall, the conditions in the parking lot during drop-off and pick-up were perceived to be very dangerous.

Following drop-off, the gates to the parking lot are closed and the space is converted into a tarmac for the kids to play on during recess. This area is outlined in red in *Figure 5*. The parking lot is painted with various games such as hopscotch, four-square and snakes and ladders, as seen in *Figure 7 and 8*. However, staff's vehicles are present in the center of the parking lot, so the space isn't focused on the student's play and learning. It remains a space they must share with vehicles. The redevelopment of a portion of the spur line to green sod next to the playground has allowed the students to have more space for themselves, as seen in *Figure 6*. However, this may come at an increase in maintenance costs as the grass needs to be mowed, watered, and fertilized.

Figure 5: Existing OBK Parking Lot Converted Tarmac

Figure 6: OBK Greenspace

Figure 7: Four Square Game on OBK Tarmac

Figure 8: Hopscotch Game on OBK Tarmac

Figure 9: Absence of 28 Street Southbound Sidewalk

Another major concern of the current layout of the OBK school is the absence of a sidewalk on the west side of 28th Street in front of the school. This area is highlighted by the red markings in *Figure 9*. There is just a slim patch of poorly maintained grass here, making it unsafe for anyone to walk here. There is a sidewalk on the east side of 28th Street that users may take; however, it lacks a safe crosswalk to the school. Additionally, due to the location of OBK being an industrial park, there are many vehicles and semi-trucks passing by at speeds that were perceived as uncomfortable during site visits. This creates an unsafe walking experience along 28th Street and does not encourage people to take active modes of transportation.

The team utilized the software VISSIM to build a model, [Existing Traffic Conditions – Meridian], showing the behaviour of traffic during pick-up and drop-off at the school. By using data from Calgary Traffic Counts and going on site visits; physically counting the vehicles entering the OBK School area, we were able to simulate the current conditions of traffic. The QR code on the right can also be used to access the simulation of current conditions.

4.0 Design Methodology

A detailed work plan was developed based on the proposed scope and requirements for this project. *Figure 10* below provides an overview of the methodology used to ultimately develop design alternatives followed by a detailed description of each step.

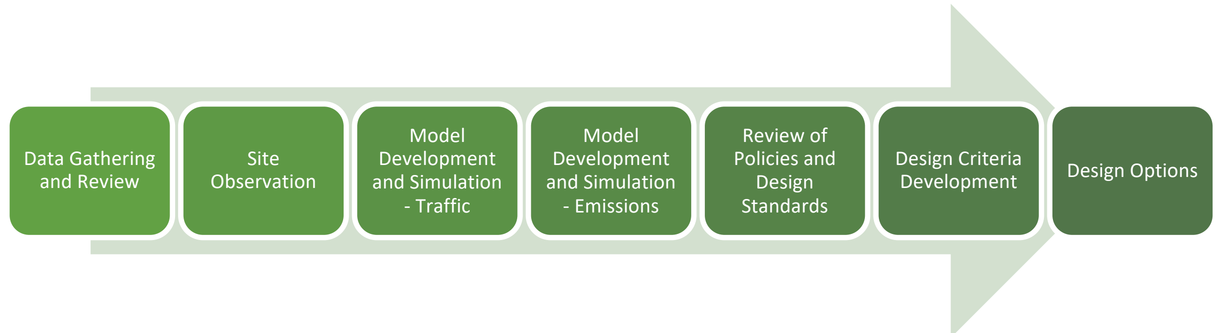

Figure 10: Design Methodology Flow Chart

Data Gathering and Review

Once the proposed scope in the contract was approved, relevant data such as student and parent surveys from the three schools [11]–[13] were reviewed to summarize the information. This formed an initial idea of the general information about each school such as current travel modes and site-specific challenges. Traffic count data was obtained from Calgary Traffic Counts System (CalTRACS) [14] and the volume recorded from these datasets were used as input for traffic modelling under existing conditions for each school. Furthermore, we also performed a data gap analysis which ensures that all required data is available. Otherwise, additional information and data was requested from the client.

Site Observation

To properly understand the concerns raised by parents and students, the team conducted site walkthroughs to gain greater understanding on the existing traffic conditions of each school under consideration. Some of the elements observed were the number of pedestrians using the nearest crosswalks to the schools, density of each travel mode used during commutes, and road safety issues such as jaywalking and perceived speeding. Additionally, manual traffic counts were also taken to properly calibrate the traffic models to current conditions.

Model Development and Simulation – Traffic

To quantify the range of speeds for each type of vehicle, we utilized the software PTV VISSIM [15] to model the existing traffic conditions. The model for each school was developed using the most updated aerial photo to replicate existing road geometry that will accurately show the current traffic flow. Using the data obtained from historical and manual traffic counts, a functional model was developed and later calibrated to simulate the real-time traffic conditions of each school. Speed ranges were determined from the results of simulation runs and then used as input for the emissions simulation.

Model Development and Simulation – Emissions

A preliminary estimate of CO_2 emissions was completed during the fall semester. This gave an initial value of how much the use of personal vehicles for school commutes, contributes to CO_2 emissions. A more detailed CO_2 emissions estimation was performed during the winter semester using the Motor Vehicle Emissions Simulator (MOVES) software created by the US Environmental Protection Agency to accurately project current and future CO_2 emissions. Input for this model was a combination of the results from VISSIM and the location information by which the schools are situated. An existing and future scenario was developed to show the extents of CO_2 emissions before and after the design option implementation.

Review of Policies and Design Standards

Prior to developing design alternatives, the team reviewed design standards and City policies to ensure the proposed interventions follow the up-to-date standards while incorporating the students' ideas on making the streets walkable and interactive. City standards such as the Design Guidelines for Subdivision Servicing [16] and NACTO Street Design for Kids [17] were reviewed to ensure that proposals aligned to standards and that improvements would engage end-users. Certain City policies such as Traffic Calming Policy [18] and Pedestrian Strategy Report [19] were also reviewed to get inspiration on traffic calming measures that could be used to make travel for all road users safer.

Design Criteria Development

A crucial component in design selection and rating is the development of design criteria. A design criterion is a set of attributes that guides engineers in designing specific solutions to problems and will help determine the optimum design option by means of scoring each alternative. Numerous discussions within the team were held to achieve common design criterion to rate respective proposed designs. Evaluation and scoring procedure can be found in *Section 6.2*.

Design Options

Developing design alternatives for each project was an iterative process. Initially at least two (2) conceptual designs per project area were developed. The team met weekly to discuss how to combine design components from conceptual designs to form three (3) preliminary design options. Based on these design options, industry and academic advisors were consulted to refine design work. This work was later scored based on the design criteria developed.

5.0 Preliminary Design Options

Numerous preliminary conceptual designs for the areas of study were generated based on the existing conditions that were observed and modeled. Additionally, survey data summarizing the kid's preferred street treatment was taken into consideration. This increases likelihood of engagement, as it contributes to a safe feeling around active mode of travel.

Conceptual designs were compiled and can be found in *Appendix A – Conceptual Designs.* These ultimately formed the three final designs to address the existing challenges of each project area effectively and sustainably.

5.1 Beltline

5.1.1 Traffic Signal / Sign Warrant Changes

The area around the Connaught School should have modifications implemented to the infrastructure that will encourage a change in behaviour. The three changes that apply to all conceptual designs are listed as follows:

1. Adjust Traffic Light Timing
2. Relocate School Zone Signage
3. Add Furnishing Zone

The first change proposed is extending the traffic light timing for the northbound and southbound lights on the 12th Avenue SW and 11th Street SW intersection. The current timing of the lights provides insufficient timing for elderly and young children to cross, leading some to jaywalk or run to cross during the designated time.

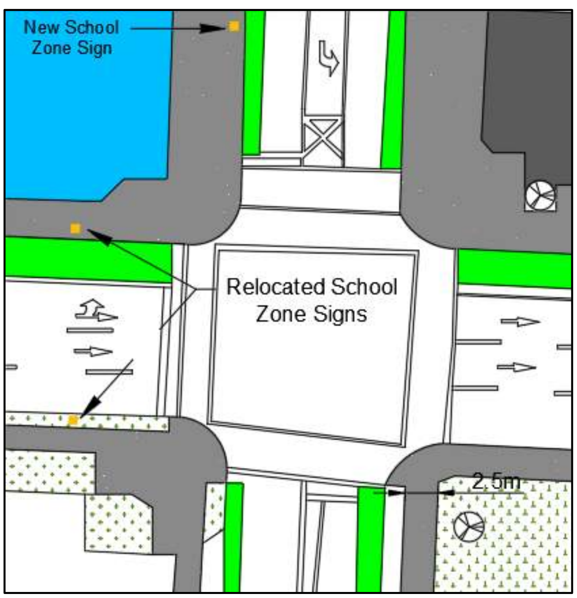

Figure 11: Connaught School Relocated Signs Example

The second alteration is the relocation and addition of school zone signage as seen in *Figure 11*. Currently, the school zone starts in the middle of the schoolyard due to the fencing around the premises as per suggestions from Guidelines for School and Playground Zones and Areas by Alberta Infrastructure and Transportation [20]. Due to this placement drivers tend to drive fast through the school zone. Relocating the signage to give more adequate warning will help ensure the safe crossing of the pedestrians in the area and possibly lower the speeds of vehicles to the appropriate 30 kilometers-per-hour.

Lastly, adding a furnishing zone along 8th Street SW between 11th Avenue SW and 10th Avenue SW is the last change. This would change the road to a three-lane road and create a buffer between automobiles and pedestrians, as it currently is intimidating for children commuting to the Connaught School.

5.1.2 Design Option 1

This first design transforms 10th Street SW and 13th Avenue SW bordering the Connaught School, into a mixed-use street, as seen in *Figure 12*. When analyzing the surveys provided by Ever Active Schools and Sustainable Calgary, it was observed that many guardians were against having children walk to the school due to the perceived hectic atmosphere [13]. This coincided with problems identified during site visits, such as a lack of foot traffic along 10th Street SW and a general feeling of monotony in the area.

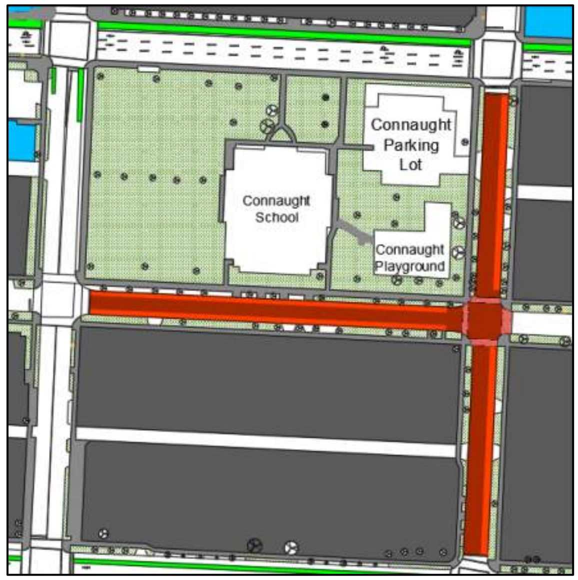

Figure 12: Connaught School Mixed-Use Street

The shared street would be constructed with varying colours of heavy-duty pavers to the grade of the existing sidewalks, as seen in *Figure 13*. This layout would promote walking from the south of the school by creating an enticing passage to the Connaught dog park, as well as the other shops around 14th Avenue SW. This incentive to safely explore around the school would enrich children's learning [4]. The pavers provide a change in texture, differentiating the area from the rest of the city. This is intended to increase awareness of vehicle operators. Importantly, the shared street will be subject to stricter speed limits, increasing safety both by reducing vehicular speeds, as well as discouraging a portion of vehicular traffic around the school. This deterrent will also inevitably reduce noise pollution and emissions around the school, further benefiting individuals participating in active modes of transportation.


Figure 13: Connaught School Pavers

5.1.3 Design Option 2

The second preliminary design consists of adding a permanent parking lane along 12th Avenue. Also, the construction of bulb-outs at the intersection of 13th Avenue and 10th Street, as seen in *Figure 14*. From surveys, parents indicated their concern around the 12th Avenue and 10th Street intersection [13]. Additionally, during site visits, a lack of adequate visibility, especially regarding children, was observed. The problem was primarily caused by an abundance of vehicles parking for pick-up and drop-off of students. The tall vehicles would often make children almost invisible to oncoming traffic. The parking of vehicles around schools also enhanced the difficulty to spot children, as sightlines are obscured.

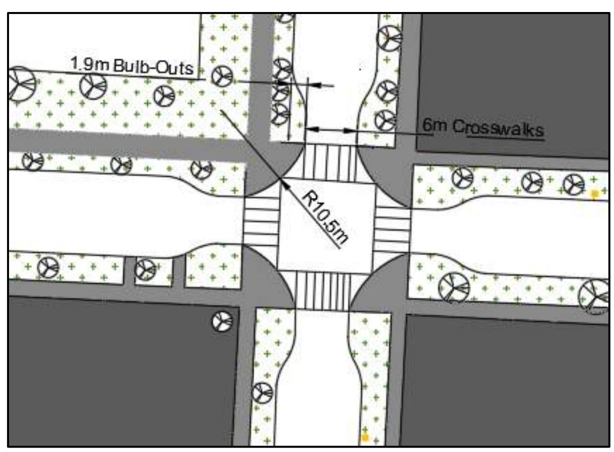

Figure 14: Connaught School Bulb-Outs

To ameliorate visibility in the area, a curb extension was proposed at the 13th Avenue and 10th Street intersection. The bulb-out would provide space for pedestrians to walk further out when attempting to cross a street, as well as shorten the crossing distance all together [17]. This provides better visibility to drivers, improving the overall safety of pedestrians. Additionally, marking crosswalks in all directions on 13th Avenue and 10th Street would supplement the bulb-outs.

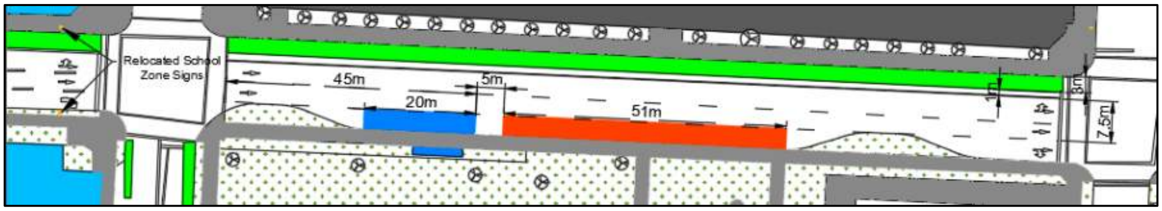

Figure 15: Permanent Parking Lane on 12th Avenue at Connaught School

A permanent parking lane along 12th Avenue, as seen in *Figure 15,* would provide a buffer for the adjacent sidewalk and reduce confusion regarding the current time-dependent functionality. Implementation of curb extensions to protect the current public bus stop provides opportunities to increase green space, as well as protection for parents dropping off their children. Even with the change to 12th Avenue, a large variation in traffic volume around the school is not expected, as the lane is currently being utilized by parents during rush hour to drop off their children. The design's goal is solely to make the process safer for all users of the road. It is important to note the possibility of vehicle users becoming discouraged from using 12th Avenue. This could lead to the unintended consequence of traffic congestion occurring on other roads in the downtown area such as 10th and 15th Avenue.

5.1.4 Design Option 3

The third conceptual design consists of a mid-block crossing halfway through 13th Avenue SW constructed with complementary sidewalk extensions, as seen in *Figure 16.* The addition of bike lanes along 10th and 11th Street SW was also approached in this design. The bicycle lanes would encourage cycling to children and adults alike surrounding the Connaught area. The main purpose of the proposed change is to connect the bicycle lanes along 12th Avenue SW and 14th Avenue SW to create a more complete biking network in downtown Calgary. The bicycle lanes would be protected by buffers on 10th Street SW and be implemented beside the sidewalk on 11th Street SW, due to the traffic volume on this road.

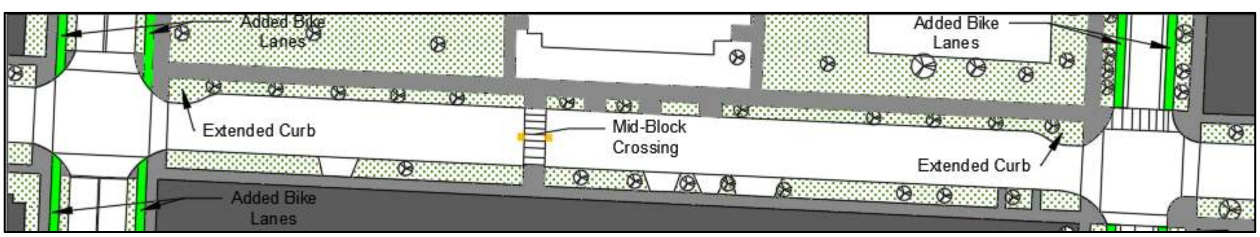

Figure 16: Mid-Block Crossing and Curb Extensions at Connaught School

During site visits, crossings between stopped vehicles on 13th Avenue SW were frequently observed. The proposed solution to this problem is the implementation of a raised, marked crosswalk in the center of 13th Avenue SW adjacent to the Connaught School. Additionally, a sidewalk extension implemented at the crossing would increase the visibility of pedestrians. Along with proper signage, the changes would provide a much safer street crossing, while not necessitating a significant alteration to pedestrian behavior.

5.1.5 *Summary of Conceptual Designs*

Table 2: Strength and Weakness Summary for Beltline – Connaught School Preliminary Designs

DESIGN NO.	STRENGTHS	WEAKNESSES
Basic Changes	1. Extending signal timing creates more time for children to cross, leading to less jaywalking and running to make the light 2. Clearer signage indicates the school zone better, reducing the possibility of speeding and creating safer crossings 3. The furnishing zone will create a buffer between the streets and the pedestrians making it safer for kids. The change will also provide space for greenery and seating, creating a more pleasant atmosphere.	1. There is the possibility of causing congestion with the traffic signal timing change during rush hour 2. Reducing the number of lanes along 8th Street may cause congestion during the busier hours of the day
Option 1	1. The shared street design will create a unique aesthetic around the school, creating a unique atmosphere 2. The shared street along the school helps create more modes of transportation readily available 3. The reduced speed encourages usage of the active modes of transportation while reducing car traffic, making the area safer for pedestrians	1. With the implementation comes the reduction of parking spaces, causing issues for residents in the area 2. Mixed use spaces may not be effectively used during the winter seasons due to the cold temperatures 3. Shared streets require reduced vehicular speeds, which may result in dissatisfaction among community members
Option 2	1. Increases safety for children and pedestrians along 12th Avenue with more walking space and space between the sidewalk and road 2. Creates a protected parking lane and reducing 12th Avenue to two lanes makes the traffic more predictable around the school	1. Possible increase in traffic congestion on 12th Avenue if drivers do not change their daily route 2. Increased traffic on other roads in downtown Calgary if drivers change their daily route
Option 3	1. Midblock crossing acts as a traffic calming measure as well as increases the safety of pedestrians that currently are jaywalking in the location 2. Provides cyclists more options to travel to the school safely	1. Makes snow removal in the winter more difficult with the midblock crosswalk and bicycle lanes needing clearing 2. Less parking space available due to the midblock crossing

5.2 Martindale

5.2.1 *Design Option 1 – Midblock Barrier Concept*

The intention of this design is to eliminate as much traffic as possible from Martindale Blvd in front of École La Mosaïque. By eliminating traffic on this section, no cars will be in the area to potentially collide with pedestrians. This design involves constructing a barrier that prevents through traffic from using Martindale Blvd as seen in *Figure 17*. The barrier forces traffic to use 64th Avenue NE instead or take active and public transportation.

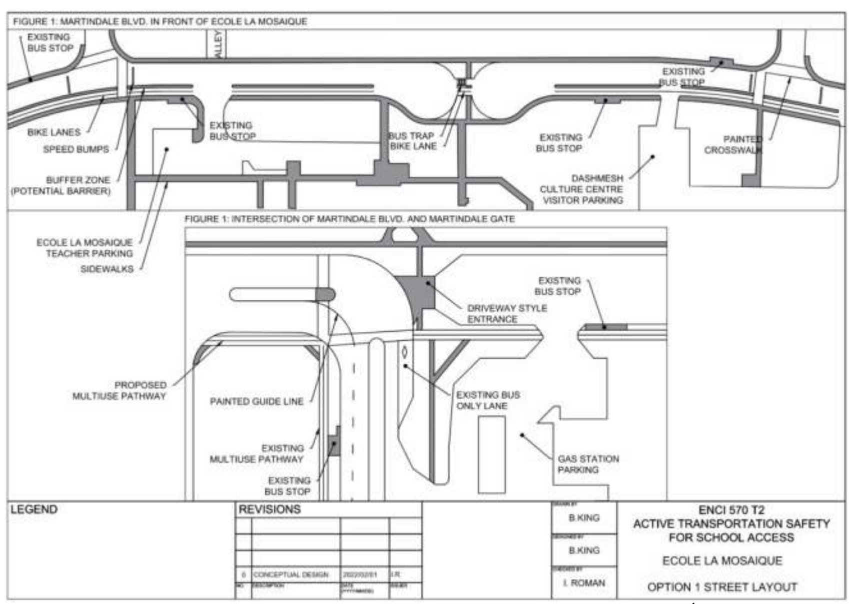

Figure 17: Mid-Block Barrier Concept at École La Mosaïque

The barrier involves the creation of opposing cul-de-sacs on each side of the car trap, forcing vehicles to turn around the way they came. A sidewalk would be constructed between the cul-de-sacs to allow pedestrians to cross the road mid-block. A car trap allows busses and emergency vehicles to pass through the barrier but will trap any smaller vehicles. There is also a bike lane added with a metal bollard on the centerline at each entrance that allows cyclists to cross the barrier without impedance.

In addition to the barrier, the intersection of Martindale Blvd and Martindale Gate is modified to force drivers towards 64th Avenue instead. The geometry is modified to make the turn from Martindale Blvd to the east and Martindale Gate the dominant action. The entrance into Martindale Blvd to the west is modified into a driveway style roadway, by narrowing the road, building the surface out of concrete instead of asphalt, raising the road to the elevation of the sidewalk, and eliminating the slip lane to improve pedestrian visibility. Finally, the south parking lane is converted into a bidirectional bike lane protected by plastic bollards.

5.2.2 Design Option 2 – Phased Traffic Calming Strategy

The main purpose of this design concept was to calm traffic nearby École La Mosaïque school for safety of students, their parents and guardians, staff, and community neighbors. The design involves extension of staff parking lot space up to the east side of the school building, allowing for vehicles such as school buses or picking-up/dropping-off-cars to park inside the parking lot so that there would not be such jam on Martindale Blvd. during peak hours. It also contains another entrance/exit at the other end (east end) for better flow of traffic for staff and parents.

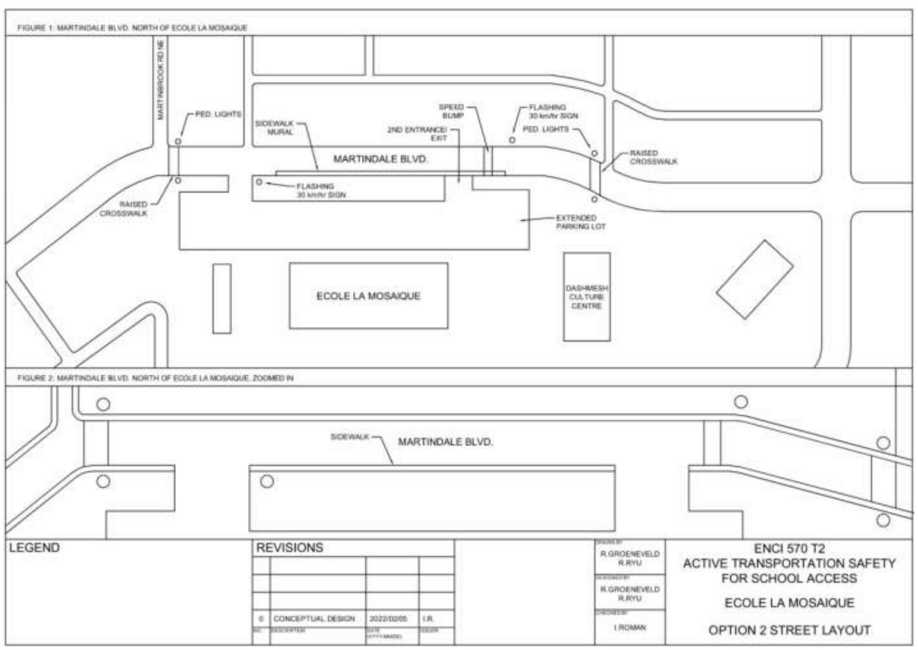

Figure 18: Phased Traffic Calming Strategy at École La Mosaïque

A speed bump, two raised crosswalks at either end of the school zone along with pedestrian lights and two flashing 30 kilometer-per-hour signs on Martindale Blvd. are added to the design for better calming of traffic. In total of three bumps, including the raised crosswalks, could potentially force motorists who do not intend on slowing down in school zones on Martindale Blvd. Additionally, for better visual aesthetics, an optional sidewalk mural is added for students and even neighbors to feel more inviting and safer around the school zone.

5.2.3 Design Option 3 – Shared Street Concept

Figure 19: Shared Street Concept #1

This design will involve converting a portion of Martindale Boulevard adjacent to the school into a shared street/space concept. This includes removal of the existing pavement infrastructure, sidewalks, curb, gutter, and some stormwater utilities, replacing them with permeable pavement and retention cells to promote sustainability by reducing the amount of impermeable surface and implementing sustainable ways of storing storm runoff. Another sustainable feature of this design highlighted in *Figure 19* and *Figure 20* is the incorporation of trees as a median in the road with the purpose of capturing some of the emissions from cars. The design will also rely on students' creative touch through the mural crosswalks. Another playground facility will also be implemented in the front green space to facilitate interaction for kids while waiting for bell time in the morning or waiting to board their school buses in the afternoon.

Figure 20: Shared Street Concept #2

The use of a shared space was found to be effective because it eliminates almost all the traffic signs on a particular strip of road which results in driver confusion which then makes them more cautious about their environment reducing their driving speed while passing through the area. Speed reduction can also happen while pedestrians continuously and randomly cross the street and/or bikers share the road with everyone which is attainable in this shared street/space concept.

5.2.4 Summary of Conceptual Designs

Table 33: Strength and Weakness Summary for Martindale – École La Mosaïque Preliminary Designs

DESIGN NO.	STRENGTHS	WEAKNESSES
Option 1	1. Elimination of through traffic in front of the school will greatly reduce the number of cars in front of the school, greatly reducing the possibility of collisions 2. Restricts car access while continuing to allow buses, pedestrians, and cyclists to pass through unobstructed 3. Can easily be modified with other traffic calming devices to further reduce vehicle speeds 4. Includes elements to separate cyclists from traffic, both in front of the school and elsewhere along Martindale Blvd.	1. Through-traffic may choose to use the back alley or Martinbrook Road NE to avoid the barrier, only redirecting traffic onto other side streets 2. The car trap may be inviting for curious kids to explore and play in, increasing the chance of a collision with a bus, who may have reduced visibility into the hole 3. Vehicles aren't necessarily forced to slow down 4. Requires downgrading of street 5. Expensive

Option 2	1. Extended parking lot could give better traffic calming strategy 2. Extended parking lot allows the residents north of the school to have some more privacy and room for their street parking 3. Second entrance/exit to parking lot makes easier access for school related vehicles to go in and out of school parking lot as there are two of the entrances 4. Flashing signs increase awareness of speed limit and when it is being exceeded and should not have pushback from the city as it would not impede traffic on the collector road 5. Raised crosswalks force drivers to slow down	1. Allowing vehicles to come into the extended parking lot close to the school causes the polluted air from those vehicles could get into the school building which can be harmful for school members 2. Taking the green space out and putting extended parking lot results in high cost to construct 3. The extended parking lot space could be waste during off-school period 4. The design does not really do anything to prevent jaywalking on Martindale Blvd 5. Raised crosswalks would require road closure, which may cause pushback from the city
Option 3	1. According to studies and projects, shared space has been very effective in reducing speeds, which would be helpful in this project area as this is currently a concern 2. Improved Street accessibility (i.e., reducing the number of jaywalking/jaywalkers in the street) and will encourage more of the active transportation (AT) mode 3. Sustainable features will ultimately contribute to mitigating the effects of climate change 4. Increased interactive space for the kids and residents through the introduction of a playground in the front green space and the street itself	1. High capital, operation and maintenance costs 2. May cause significant congestion within this strip of road due to limited driving space

5.3 Meridian

As the community of Meridian is an industrial park and OBK is an Islamic school, many students are commuting from neighbourhoods around Calgary. Due to this the focus for all three conceptual designs was providing a safe connection to the nearest LRT station, Franklin Station. The assumption was by improving the access to the train this could encourage aa combination of transport options. A large majority of the students attending OBK currently commute via personal vehicle. Transitioning this modal share to favor low carbon travel was the primary goal of all designs.

5.3.1 Design Option 1 – Back-Alley Catwalk

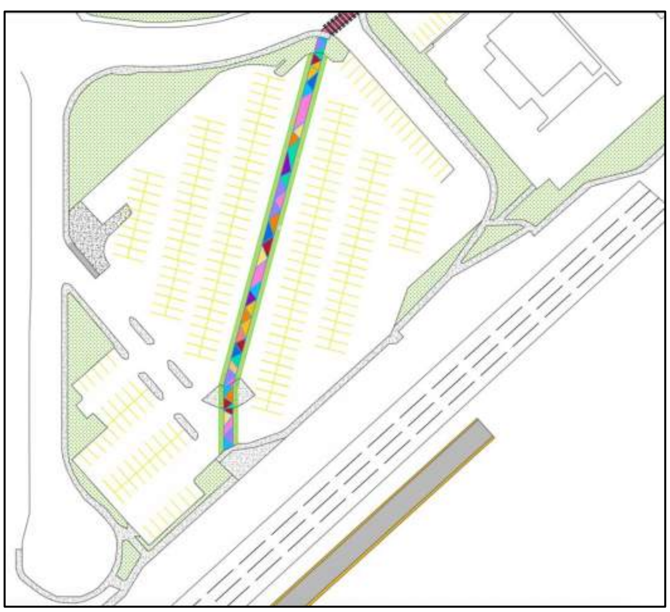

Figure 21: Diagonal Walkway at Franklin Station in Meridian

This design is built on the concept of utilizing the back alley as a connection between the Franklin LRT station and OBK School. The back alley would not allow any vehicles to enter, therefore it would be solely dedicated as a pedestrian catwalk. To provide a direct path for those using low carbon modes a diagonal walkway would be constructed in the Franklin Station Park & Ride Lot, as seen in *Figure 21*. This path is designed to be three meters wide with 1.5-meter-wide greenspace on either side. The diagonal walk is 136-meters long .

The walkway would adjust the configuration of the parking lot itself, therefore an alteration in the parking lines would be required. Currently there are 276 stalls available in the lot and following the reconfiguration there would be 248 stalls available.

The greenspace along the path would have lighting to ensure that users at all times of the day have adequate sight to enhance the feeling of security. Additionally, benches and disposal bins would be placed along the walk, to have the space endorse people to stay and spend time. Another important component would be the choice of vegetation planted in the greenspace. The design includes planting low maintenance and drought tolerant Karl Foerester Reed grass, as well as Blue Oat grass that is hardy to handle Calgary winters. Fescue grass and Dropmore Linden trees are pollinators when left to grow.

Planting native species that are low maintenance and weather tolerant leads to an overall healthy landscape. This supports local wildlife, as well as natural spaces in the area as it acts as seeds. A major positive to native species is the less care required compared to ornamental species [21]. Low maintenance is accompanied by a smaller maintenance budget and salvage of water.

Following the diagonal walkway, two raised crosswalks would be constructed to provide a continuous sidewalk from the path to the back-alley catwalk, as seen in *Figure 22*. The implementation of raised crosswalks involves the approach in the *Designing Streets for Kids*, “think from 95 cm” [17].

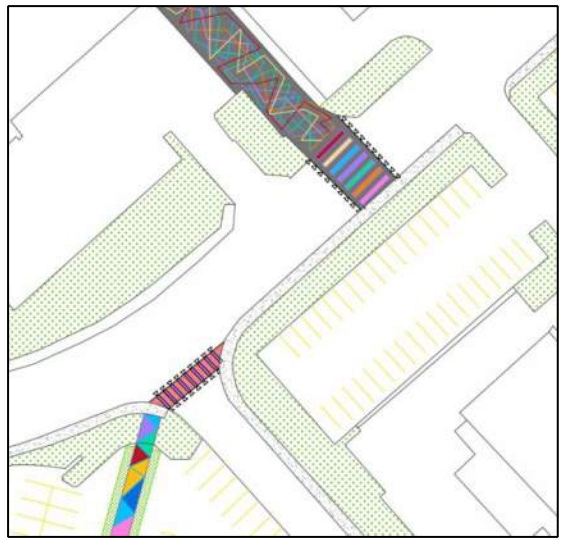

Figure 22: Raised Crosswalks in Meridian

Additionally, the north lots of the Swiss Chalet and Boston Pizza Restaurant adjacent to the Park and Ride Lot are suggested to be used as a drop-off and pick-up zone for parents. This would potentially warrant the installation of a mid-block crosswalk, as well as a mutual understanding with the school or the city for maintenance of that section of the parking lot.

This conceptual design also involves a reconfiguration of the parking lot as the back-alley typically used to exit the school parking lot would not be accessible via vehicle. Shown in *Figure 23*, the purple zone represents the bus zone, and the blue zone represents the Parent Drop-Off Zone. Parents and buses would enter from the north entrance and exit through the south. The back-alley catwalk would lead onto the tarmac of the school which would be separated from the parking lot by a picket-type fence, as shown in *Figure 24*. This would open this space to have games and benches for students to play and spend leisure time on. The tarmac would also connect directly to the field and the playground currently on the school site.

Figure 24: OBK Parking Lor Reconfiguration Design 1

Figure 23: OBK Delineated Drop-Off Zones Design 1

5.3.2 Design Option 2 – 28th Street Alterations

The second conceptual design approached for Meridian was built on the concept of utilizing 28th Street SE to access OBK school from the Franklin LRT train station. It is important to note that the Park & Ride diagonal walkway presented in the first design option would also be included in this design. *Figure 25* annotates the major adjustments involved in this design. Currently south and a portion north of 2nd Avenue SE, 28th Street SE has lanes that are 3.5-meters-wide. The intent of this design is to redistribute the road space to allocate area for a walkway that supports active modes.

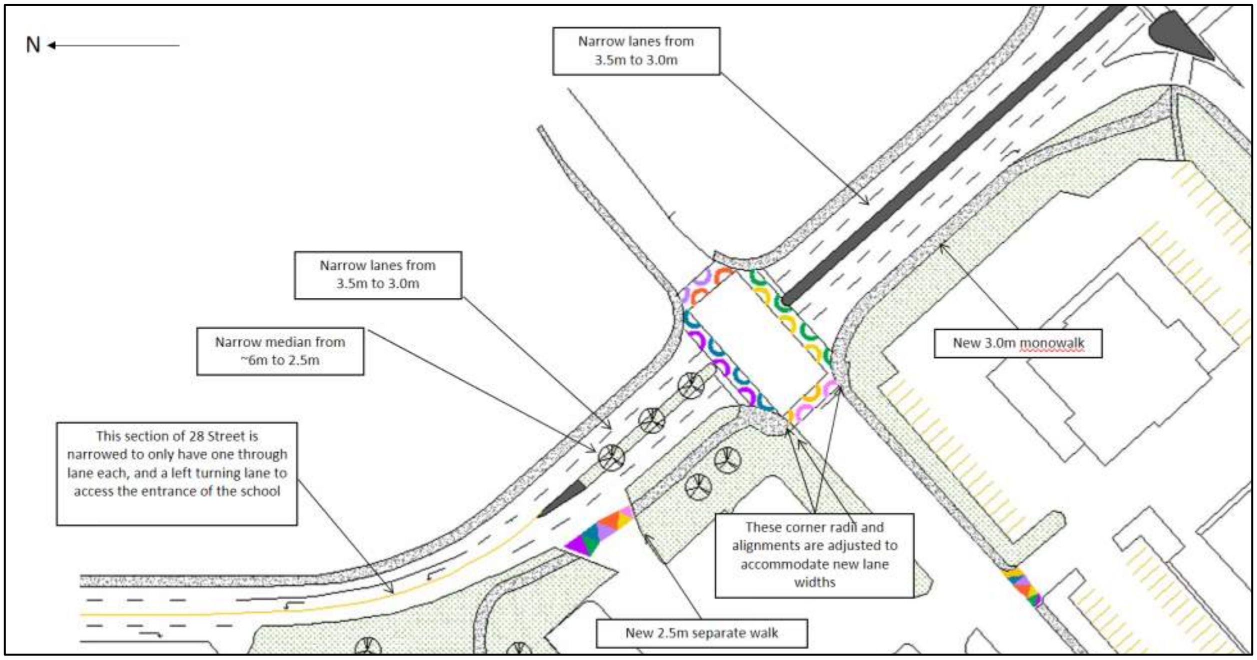

Figure 25: 28th Street Adjustments for OBK School Design 2

A 2.5-meter-wide separate walk would be constructed on the southbound side of 28th Street north of 2nd Avenue. Additionally, a 3.0-meter-wide monowalk added south of 2nd Avenue along southbound 28th Street. There would also be colourful crosswalks implemented along the entire path from the station to the school. This is intended to have the space be more inviting for kids as well as invoke greater attention of the crosswalks to drivers. Trees would also be planted in the narrowed median, as this will increase aesthetics in the area and attract users.

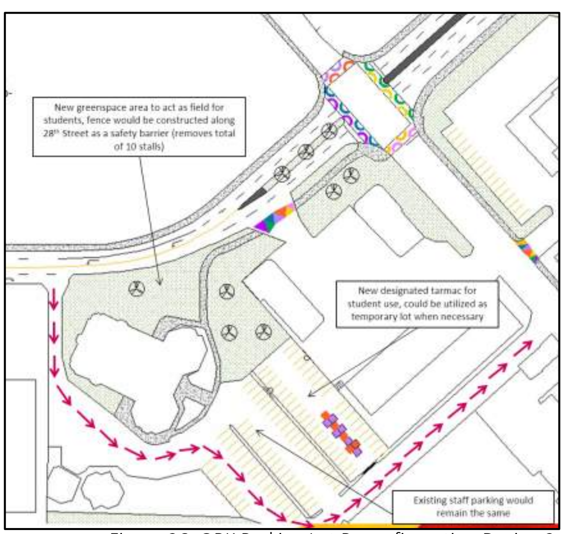

Figure 26: OBK Parking Lot Reconfiguration Design 2

To supply a direct path completely avoiding parking lot traffic for pedestrians, the south entrance of the parking lot would be converted to greenspace. This alteration can be seen in *Figure 26.* This would accompany the planting of trees and for the path to attach to the existing sidewalk of the OBK's entrance. This greenspace would serve in addition to space solely allocated to students, undisrupted from vehicles during pick-up, drop-off, and recess.

The south portion of the parking lot would also be altered to a tarmac area that prevents vehicle access. It would remain as pavement with a temporary barrier to allow access for parking in certain cases if needed. Although, on regular school days this area would be dedicated solely to students.

As the south entrance is altered, the traffic flow in the parking lot would be restricted compared to the current flow. The red arrows in *Figure 26* delineate the path automobiles and buses would take for pick-up and drop-off of students. Similar to the previous design option (*Meridian Design Option 1*), the north lots of the restaurants near-by would be allocated for pick-up and drop-off.

5.3.3 Design Option 3 – Spur Line Pathway

The third and final conceptual design for Meridian provides a path to the school from the LRT station via the abandoned spur line in the community. This is delineated in *Figure 27* by the red arrows. As shown, 27th Street SE located beside the Park and Ride Lot would be utilized, followed by a crossing on 2nd Avenue and further travelling north on the abandoned spur line to reach OBK school.

A major advantage to this direction of path is that significantly less traffic exists in this area compared to 28th Street. It would be an isolated path that students would be free to stay and play while using. Moreover, it would also be easier to construct pathways through this route because of less disruption to the traffic during the construction phase.

Figure 27: Meridian Design 3 Path

Figure 28: 27th Street Alterations Meridian Design 3

Figure 29: 3D Schematic of Meridian Design 3 Path

The design incorporates altering 27th Street to pedestrian only, restricting automobile access. The intersection of 27th Street and 2nd Ave would be barricaded with the use of large plant pots. This is represented in *Figure 28.* 27th Street would have painted murals on the pavement, as well as trees and benches added along the walkway. This is intended to make the area inviting for all age groups and become a point of interest in the community of Meridian. A mid-block crossing would be required to ensure students are able to safely cross 2nd Avenue. This would be a raised crosswalk to improve visibility and force vehicles to slow down. Vegetation will be added on each side of the road pathway leading to the 2nd Avenue intersection and in the area behind the school. Vegetation will include, trees, flowers, and bushes as well as benches.

To further incentivize students from using the route, a transparent glass shelter would be added along the route. This would exist from the LRT station to 2nd Avenue along 27th Street, as well as along the spur line path that would be constructed. The dark path on *Figure 29* indicates the shelter in the area behind the school area where the abandoned railway currently exists.

The area, as shown in *Figure 31,* behind the school can be fully converted into an area for the children with benches and tables, creating a more interactive environment.

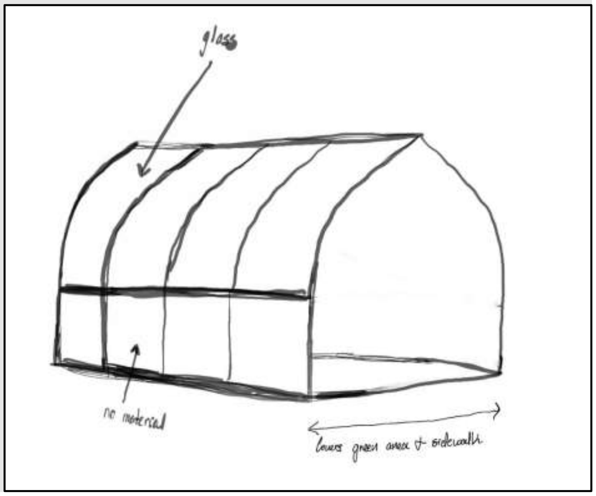

Figure 31: Shelter for Meridian Design 3

Figure 30: Meridian Design 3 Pathway

The shelter over the pathways, as seen in *Figure 30,* will ensure that the vegetation and murals will be well protected from harsh winter weather in Calgary. The design can help make the shelters attractive for the kids by adding colors, installing electric heaters, and having green plants inside the shelter.

5.3.4 Summary of Conceptual Designs

All three preliminary designs contributed to creating the final design for OBK school. By analyzing all options, we were able to highlight the important parts of each design and utilize them in our final design. The following strengths and weaknesses, displayed in *Table 4,* were employed during the selection process defined in *Section 6.0 – Design Matrix and Final Design Selection.*

Table 44: Strength and Weakness Summary for Meridian – OBK School Preliminary Designs

DESIGN NO.	STRENGTHS	WEAKNESSES
Option 1	1. Utilizes back-alley space that is private property therefore may be a cheaper and easier alteration 2. Parking lot area redistribution directly connects to existing playground and grass area 3. Path exists in less busy area than 28th Street, away from heavy amounts of traffic 4. Shortest walking distance from LRT station (approx. 464 meters)	1. Back-alley catwalk would only be used by students and not be applicable for other users in the area 2. Students would be required to cross bus and vehicle paths in the parking lot to reach the school entrance 3. Back-alley catwalk may not be considered as innovative, as already previously proposed 4. Requires acceptance of a mid-block crossing on 2nd Ave to have a safe route, may receive pushback from the city
Option 2	1. Involves the addition of a large area of greenspace directly near the school designated for students 2. Realignment of 28th Street will create a safer school zone, forcing vehicles to slow down and provides a designated left turning lane to prevent illegal left turns 3. With sidewalk constructed on the main road (transit collector) the walkway would likely be more used	1. New greenspace and tarmac area are not directly connected to existing field rea and playground 2. Path developed towards OBK is not shortest possible path 3. Unintended traffic consequences may be likely to occur due to the alteration of 28th Street SE
Option 3	1. Shelter is innovative and will ensure the vegetation and murals will be well protected from harsh winter weather 2. Utilizes unused area behind school, providing safe space away from busy traffic areas	1. Construction for shelter will be expensive 2. The route for children is longer compared to other designs (approx. 515 meters) 3. Large amount of public space required for alterations

6.0 Design Matrix and Final Design Selection

6.1 Criteria

As mentioned in *Section 5.0 – Preliminary Design Options* of the report, three conceptual designs were created for each neighbourhood under investigation. It was necessary to compare these designs to achieve a final design that best represented the objectives and intent of the project. This required the evaluation of the designs based on criteria deemed important to the purpose. A range of criteria was selected for each neighbourhood's design matrix, to properly assess the strengths and weaknesses of each design. The indicators utilized for evaluation are represented in *Table 5* below.

Table 5: Criteria for Selection Matrix with corresponding Definition and Ranking Process

CRITERIA	DEFINITION	RANKING PROCESS
Emissions / Sustainability	The impact of the design on vehicle emissions, specifically with regards to the emissions directly emitted at the school. Air pollution, location pick-up and drop-off separated. It is to maximize the lifetime of newly designed roadways and to meet their performance goals while restricting vehicle emissions.	The less emissions estimated to be produced, the higher the score.
Greenspace	This includes the level of permeable surfaces and consideration of pollinator species and vegetation.	The higher level of this incorporated in the design, will receive a higher score.
Street Design for Children	The measure of how well the design incorporates the *Ten Actions to Improve Streets for Children*[1] [17].	The more the design considers these components, the higher the score.
Initial Cost	The amount of capital needed for the design to be realized.	The lower the capital cost, the higher the score.
Safety and Active Transportation (AT) Connectivity	The ease of access between various locations within the design area and the interconnectivity between the design area and the pre-existing infrastructure. It triggers people to intend on walking or biking by creating desirable communities with less traffic, livelier streets, and cleaner air.	The safety of people participating in active transportation methods.
Improved Traffic Management	The combination of measures that serve to reduce traffic around the school and improve safety and reliability of the road transport system.	The higher level the design is deemed to reach, the higher the score.
Feasibility	The measure of how easily or conveniently the design can be constructed and utilized.	The easier the process is, the higher the score.
Aesthetics	The visual appeal of the design. It includes factors such as visual balance, color, pattern, scale, and shape. It is used to complement the roadways' usability to enhance its functionality with attractive layouts.	The more appealing, the higher the score.
Implementation Timeline	The amount of time required to properly construct and implement the design. It also includes number of activities and what they are to produce the design, so more activities mean longer time to implement.	The less time required, the higher the score.
Maintenance	The measure of how frequent the product requires to keeps its condition in a good state. Additionally, the simplicity of the maintenance, such as, easiness of snow removal, de-icing, landscaping, etc.	The less difficult to maintain, the higher the score.
Innovation	The level of novelty and "how outside of the box" the design is, to inspire brand new ideas that can be replicated elsewhere. It is to identify the neighborhoods' current environment and conditions and focuses on addressing needs of the users, especially students, with what is technology feasible and devising a viable business strategy.	The more innovative a design is, the higher the score.

As the Beltline, Martindale and Meridian are all distinct communities, the type of criteria included, and the corresponding weight assigned was adjusted depending on the unique needs of each given neighborhood. This is demonstrated in *Section 6.3* describing the specific criteria and weighting utilized for each neighbourhood.

[1] Think from 95 cm, disincentivize private vehicles, increase transit reliability, build wide and accessible sidewalks, add spaces for play and learning, provide safe cycling facilities, improve pedestrian crossings, lower speeds by design, add trees and landscaping, prioritize children in policies

6.2 Evaluation Method

Although each neighbourhood selected different criteria and weighting for the evaluation of the conceptual designs, the general ranking process remained consistent between each group. The weights were chosen to reflect the emphasis that criteria were given for that neighbourhood. The sum of all the weights totaled to 100 for each neighbourhood's matrix.

The ranking process involved dedicating a score from one to five for each design in the respective criteria category. One being a poor level achieved in that area and five being an outstanding level achieved. The three designs compared could be scored the same in a category or different, hence the choice to score from one to five, rather than rank according to one another (from one to three). This process of scoring in each category was heavily subjective. To minimize bias a consensus of the score had to be reached, involving discussion and justification of choices.

Once a score from one to five was determined in each category for each design the weighting was applied. This involved dividing the score indicated by five and multiplying this with the weight. This provided the percentage of the weight possible to allow for easier comparison, as the sum of all the weighted values is easily compared to the total of 100 points available.

6.3 Design Matrix Results

6.3.1 Beltline

Table 6 below presents the three conceptual designs for the Beltline neighbourhood scored and weighted. The designs were evaluated in eight different categories with specific weights allotted to each.

Table 66: Design Selection Matrix for Connaught School in Beltline

DESIGN NO.	EMISSIONS /SUSTAINABILITY		INITIAL COST		SAFETY AND AT CONNECTIVITY		IMPROVED TRAFFIC MANAGEMENT		AESTHETICS		IMPLEMENTATION ON TIMELINE		MAINTENANCE		INNOVATION		TOTAL
	20		7		25		14		12		5		5		12		
	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	
1	4.25	17	2.75	3.85	3.25	16.25	2.75	7.7	5	12	1.5	1.5	3	3	4	9.6	70.9
2	2.5	10	4.5	6.3	3	15	2.75	7.7	3.25	7.8	3.75	3.75	3.25	3.25	2.5	6	59.8
3	3	12	3.75	5.25	4.25	21.25	3	8.4	2.5	6	2.5	2.5	2.5	2.5	2.5	6	63.9

As seen the first design option received the highest score, with a 70.9 out of 100. The second and third conceptual design options explored received lower scores, 59.8 and 63.9, respectively.

6.3.2 Martindale

Table 7 below shows the weighted rubric for Martindale, evaluating the three conceptual designs with eight different categories.

Table 77: Design Selection Matrix for École La Mosaïque in Martindale

DESIGN NO.	EMISSIONS /SUSTAINABILITY		INITIAL COST		SAFETY AND AT CONNECTIVITY		IMPROVED TRAFFIC MANAGEMENT		AESTHETICS		IMPLEMENTATION TIMELINE		MAINTENANCE		INNOVATION		**TOTAL**
	15		9		16		14		10		12		11		13		
	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	
1	3	9	2	3.6	5	16	5	14	4	8	3	7.2	2	4.4	4	10.4	72.6
2	1	3	3	5.4	3	9.6	3	8.4	3	6	4	9.6	4	8.8	2	5.2	56
3	4	12	1	1.8	4	12.8	4	11.2	5	10	1	2.4	1	2.2	5	13	65.4

As seen the first design option received the highest score, with a 72.6 out of 100. The second and third conceptual design options explored received lower scores, 56 and 65.4, respectively.

6.3.3 Meridian

The weighted rubric for Meridian evaluated the three (3) conceptual designs within eleven (11) different categories. These categories were as follows: emissions/sustainability, greenspace, street design for children, initial cost, safety and active transportation connectivity, improved traffic management, feasibility, aesthetics, implementation timeline, maintenance, and innovation.

Each category was allotted a certain value of points, depending on the level of importance the category is deemed to have in the Meridian conceptual design goals. For example, the most heavily weighted category in the scoring system is *Street Design for Children.* This is rationalized, as the entirety of the project is to focus on promoting children to use active modes of transportation when travelling to school. *Aesthetics* and *innovation* are weighted the least of all eleven categories. These two areas of the designs are important to consider but will not greatly affect the success of the designs given the scope and focus of the project.

Table 8 below represents the matrix evaluating the three conceptual designs for Meridian. Please note the "S" column stands for the score received out of five, and the "W" column represents the weight achieved based on the overall criteria weight provided.

Table 88: Design Selection Matrix for OBK School in Meridian

DESIGN NO.	EMISSIONS /SUSTAINABILITY		GREENSPACE		STREET DESIGN FOR CHILDREN		INITIAL COST		SAFETY AND AT CONNECTIVITY		IMPROVED TRAFFIC MANAGEMENT		FEASIBILITY		AESTHETICS		IMPLEMENTATION TIMELINE		MAINTENANCE		INNOVATION		**TOTAL**
	12		6		16		8		14		12		8		4		10		6		4		
	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	
1	3	7.2	4	4.8	3	9.6	3	4.8	3	8.4	4	9.6	3	4.8	4	3.2	4	8	3	3.6	4	3.2	67.2
2	3	7.2	3	3.6	3	9.6	4	6.4	4	11.2	4	9.6	3	4.8	4	3.2	3	6	5	6	3	2.4	70
3	3	7.2	5	6	4	12.8	2	3.2	3	8.4	3	7.2	2	3.2	4	3.2	2	4	3	3.6	5	4	62.8

As seen from the rubric shown in *Table 8*, the second design scored the highest, with a total of 70 points. This is in comparison with the first and third design, scoring 67.2 and 62.8, respectively. The second conceptual design, with focus on the realignment of 28th Street SE, was further developed and investigated as the final design for OBK.

7.0 Detailed Design of Proposed Interventions

Following the selection of the conceptual design for each neighbourhood, the designs were further developed. This involved the creation of final design drawings in AutoCAD, as well as the use of SketchUp to produce 3D renderings. Each school and neighbourhood had specific needs and challenge that led to a diverse approach for all designs. These are further discussed in *Section 7.1, 7.2, and 7.3.*

7.1 Beltline

7.1.1 Design Description

Section 6.3.1 indicates the first preliminary conceptual design as the final design for the Beltline. A detailed design for the mixed street was sketched through AutoCAD. Please refer to *Appendix B – Beltline Final Design Package* to this drawing package. The shared-street final proposed design can be categorized into two main areas:

1. 13th Avenue and 10th Street Mixed-Use Street Implementation
2. 12th Street SW Safety Improvements

Area 1 - 13th Avenue and 10th Street Mixed-Use Street Implementation

This area of the proposed design consists of a street of pavers along 13th Avenue SW and 10th Street SW near Connaught School that allows for higher pedestrian freedom as seen in *Figure 32*. The mixed-use street requires an increase in road elevation to match the current sidewalk grade. The brick road would aid in permeability, ensuring that the street is walkable even on rainy days. Additionally, the red color of the bricks adds a unique atmosphere to the area and a differentiating surface texture.

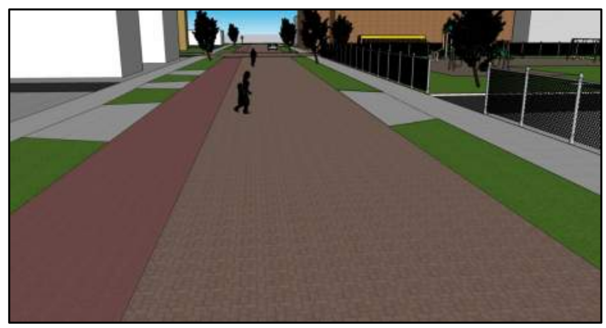

Figure 32: Beltline Final Design Shared Street

Street furniture is to be added in the form of benches, murals, and play spaces. Additionally, the ability of business to spill over into the sidewalk and food trucks would provide an incentive for people to walk around and stay in the Connaught area as demonstrated in the following figure. A cross-section displaying the attributes of this design can been seen in *Figure 33.*

Figure 33: Beltline Shared Street Cross-Section

Area 2 – Safety Improvements on 12th Street

Several safety improvements are needed along 12th Street. The first one is an improved placement of the school zone signs, as seen in *Figure 34*. These signs will make drivers reduce speeds before entering the block where the school is located, improving the safety of pedestrians. A suggestion for the relocation of school zone signs on 12th Avenue are shown in the figure below.

Figure 34: Beltline Proposed School Sign Locations

Another improvement comes in the form of altering the available time for pedestrians to cross 12th Street. As the foot traffic around the Connaught school has a higher percentage of children, accommodating a younger demographic is pertinent to improving the mobility of children. To that end, increasing the green time for pedestrian crossing would create a safer environment for pedestrians, especially children and the elderly.

SCAN ME

Vissim Video

SCAN ME

SketchUp Video

For a better look at the design please view the following videos, one showing how traffic interacts with it in Vissim, and the other showing more detail in SketchUp.

7.2 Martindale

7.2.1 Design Description

Based on École's selection matrix from *Section 6.3.2*, Design Option 1 was the selected design based on the scores for each option and this alternative will be detailed further. Detailed design for the midblock barrier concept was sketched through AutoCAD and can be found by *Appendix C – Martindale Final Design Package*.

The proposed design to facilitate active travel modes can be categorized into three areas:

1 Martindale Boulevard Midblock Barrier	2 Exclusive Bike Lanes	3 Martindale Boulevard / Martindale Gate Diversion Plan

Area 1 – Martindale Boulevard Midblock Barrier

Adding a mid-block barrier on Martindale Boulevard adjacent to École La Mosaïque school and a bi-directional bike lane with plastic bollards in the south parking lane of Martindale Boulevard. The mid-block barrier design is to force drivers to use other routes as most of the traffic on Martindale Boulevard is through traffic. The major change shown in *Figure 35* is the addition of two opposing cul-de-sacs to make vehicles turn around the way they came. It also allows only buses and fire trucks to cross to encourage using active or public transportation and for drivers to use 64th Avenue instead, which is the main collector road located south of Martindale Boulevard.

The addition of a bi-directional bike lane and plastic bollard barrier is shown in *Figure 36* and is meant for cyclists travelling through the south parking lane to feel safer which could ultimately increase the number of people using active transportation. We suggest the remaining north parking lane be 'permit only' to ensure residents around the area have enough parking. By doing so, this may force parents/guardians to park farther away, hence encouraging other modes of transport and reducing emissions directly near the school.

A detailed 3D rendering, Martindale – Martindale Blvd Mid-Block Barrier was created to visually comprehend the design proposed.

Figure 36: Martindale Opposing Cul-De-Sacs

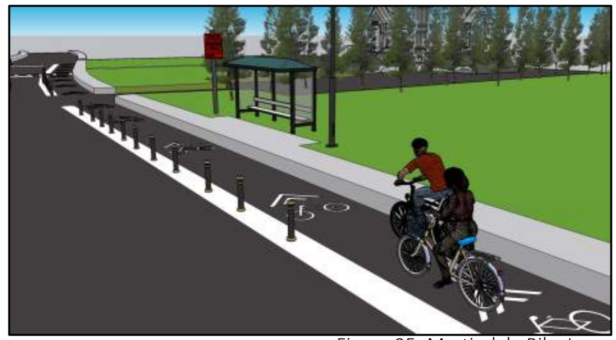

Figure 35: Martindale Bike Lane

Area 2 – Exclusive Bike Lanes

As already stated in the previous area, an exclusive bi-directional bike lane will be proposed along Martindale Boulevard which extends from Martindale LRT station to Falconridge Boulevard. This will ensure the continuity of a biking network within the community with potential connections to other neighborhoods such as Taradale and Castleridge. To ensure the safety of cyclists, plastic bollards will barricade this exclusive lane. This creates a safety barrier between cyclists and motor vehicles, warning automobiles of the designated bike lane.

Area 3 – Martindale Boulevard / Martindale Gate Diversion Plan

The intersection of Martindale Gate and Martindale Boulevard will be altered to divert traffic from going through the east of Martindale Boulevard. Our design contains a concrete surface raised to the grade of the sidewalk on the entrance onto eastbound Martindale Boulevard as shown in *Figure 37 and 38*. This makes the turn from westbound Martindale Blvd. to Martindale Gate easier and decreases driver confusion.

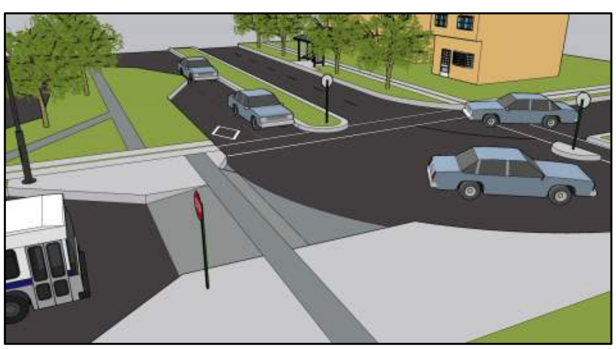

Figure 37: Isometric #1 of Martindale Diversion

Figure 38: Isometric #2 of Martindale Diversion

This proposed design for the Martindale Gate and Martindale Blvd intersection was modeled in SketchUp, and can be seen through, Martindale – Intersection Diversion Plan.

7.3 Meridian

7.3.1 Design Description

As indicated in *Section 6.3.3* the second conceptual design for Meridian was determined to be the final design that was further developed. This primarily involved the creation of final design drawings in AutoCAD that can be seen in *Appendix D – Meridian Final Design Package.*

The designs approached, as previously mentioned, focus on providing a safe and inviting route from the Franklin station to Omar Bin Al-Khattab. The final design alters the space on 28th Street SE to enhance the likelihood of students using active modes.

The components of the design can be examined in three major areas of proposed changes to the transportation area in Meridian. These are as follows:

1 Franklin Station Park & Ride Proposed Walkway	2 28th Street SE Alterations	3 OBK Parking Lot Alterations

Area 1 – Franklin Station Park & Ride Proposed Walkway

This area for the proposed final design consisted of providing a direct walkway towards 28th Street in the existing Franklin Station parking lot, as seen in *Figure 39*. The addition of this diagonal walkway requires a reconfiguration of parking stalls in the lot. The walkway is intended to be constructed as a 3.0-meter-wide multi-use asphalt pathway with fun designs painted on the surface. It would be above the grade of the parking lot, therefore requiring a concrete curb on each side of the 1.5-meter-wide landscaped areas adjacent to the walkway.

Figure 39: Isometric View of Diagonal Walkway at Franklin Station

These landscaped areas, cross-section displayed in *Figure 40,* would have lamp posts placed along the entire walkway to ensure the area is well lit when necessary. Adequate lighting is extremely important to aid in an environment that provides a sense of security. For a portion of the school year, children would be arriving to school prior to sunrise, enhancing the need to have lighting provided in this area. Benches would be placed for an area to rest and stay along the walkway, an important aspect in the *Designing Streets for Kids Guide* [17]. In addition to these items, trees and native pollinator species would be planted to create positive interaction with nature and provide shade and privacy from the vehicles in the lot. For further detail on the specific plant species that would be implemented, please refer to *Section 5.3.1.*

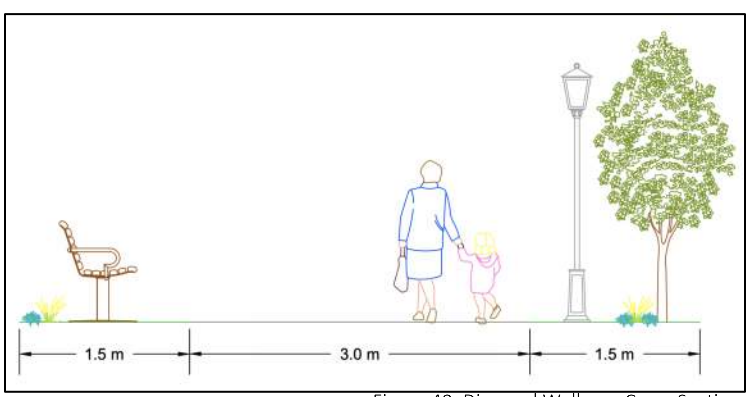

Figure 40: Diagonal Walkway Cross-Section

Finally, a 3.0-meter-wide raised crosswalk would be constructed to cross the block between the Park and Ride area and restaurant block directly east of the lot. Utilizing raised crosswalks is important to provide a continuous sidewalk for children to use while walking. Having the crossing elevated above the grade of the road provides an important safety measure, creating an environment where children utilizing it are seen easier by moving vehicles in the area.

<u>Area 2 – 28th Street SE Alterations</u>

Currently, there is no sidewalk available for use on the southbound side of 28th Street SE in Meridian. This area of the proposed design is altering 28th Street by primarily narrowing the lanes and median, as seen in *Figure 41.* This will provide room for a separate walk linking people walking to the school. The alignment of the 2.5-meter-wide monowalk on the northbound side of 28th Street would remain. The lanes directly north of the 2nd Avenue and 28th Street intersection are currently 3.5-meters wide, as well as the section of road between this intersection and Memorial Drive. Therefore, the design requires for these lanes to be reduced to 3.0-meters-wide instead.

Figure 41: 28th Street and 2nd Avenue Proposed Intersection in Meridian

In addition, the existing median would be narrowed to 2.5-meters wide from the current 6.0-meter width. This new alignment would cause the vehicles to cross into the left turning lane and through lane, rather than the through lane and right turning lane when travelling south towards Memorial Drive. This realignment opens space for the construction of a 2.5-meter-wide concrete separate walk to be constructed 2.5-meters from the southbound curb north of 2nd Avenue. In addition to this walk, a 3.0-meter wide monowalk would be added in the southbound section of 28th Street, between 2nd Avenue SE and Memorial Drive. All crosswalks along the path would be painted in colourful design to enhance the aesthetics and strengthen usership of the infrastructure placed, as seen in *Figure 41.* This will create a more welcoming environment as well as invoke interest around Meridian, as this intersection is a major hub for the industrial park.

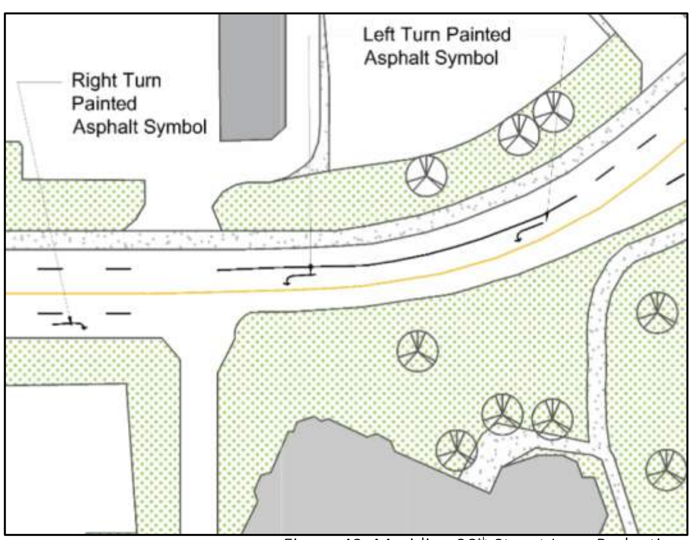

Figure 42: Meridian 28th Street Lane Reduction

Currently, further north on 28th Street the lanes naturally narrow to 3.0-meters. These widths remain consistent in the proposed design, although to ensure room is adequate for a separate walk there is a reduction from four to three lanes, as seen in *Figure 42*. The center lane would be a dedicated left turn lane for northbound. As the southbound traffic is forced to only one lane momentarily, the west most lane prior to the entrance of OBK would only be dedicated to turning right into the school lot. To accommodate a smooth transition of traffic into proper lanes, signage warning the new lane designations would be placed at appropriate distances from the transition.

The change in lane designations is intended to increase the safety of the 28th Street in the school zone, forcing vehicles to slow down and pay more attention. This area was specifically observed to be a problem area during pick-up and drop-off times at the school. As seen in *Figure 43,* currently left turns into the south entrance of the OBK parking lot are prohibited, although parents would disregard this road sign. Eliminating the south entrance and designating a left turning lane for entering the north entrance will minimize confusion between drivers and prevent illegal turns from happening.

Figure 43: Illegal Left Turn Sign on Meridian

The design also incorporates the planting of trees in the new 2.5-meter wide median. A separate walk was chosen rather than a monowalk, as it provides space between those using active modes and vehicles, to serve as a safety buffer. This adds a component of safety, especially when the sidewalk is primarily intended to be used by school children.

Area 3 – OBK Parking Lot Alterations

The final area of the proposed design is the redistribution of space in the OBK parking lot. The addition of the separate walk on 28th Street leads towards the south entrance of the school parking lot. In the proposed design the south entrance of the school is closed from vehicles and converted into a greenspace, as seen in *Figure 44*. The separate walk would directly connect to the sidewalk around the school. The greenspace will serve as an area for the children to stay and play before and after school. Visual and physical access to greenery is principal to well-being [22].


Figure 44: Isometric View of Proposed OBK Parking Lot

Figure 45: Proposed OBK Parking Area Allocation

In addition to the conversion of this area, the southernmost section of the parking lot will be utilized as a tarmac for the kids, restricting access to vehicles on regular school days. The barricade used to stop vehicles from entering this area is intended to be moveable, either with the installation of removable bollards or a gate. Therefore, when an event occurs at the school that requires a higher demand for permanent parking spaces, this area can be reverted to its current use. The middle section of the lot will remain as an area for the staff to park. As the new greenspace and tarmac does not directly connect to the existing playground, a raised 3.0-meter crosswalk would be constructed to provide a continuous visible sidewalk for students to utilize. These elements are shown in *Figure 45.*

A significant goal of this project is to remove emissions from occurring directly near the school site, as this creates a harmful environment centered around a place intended for the safety and education of children. For example, asthma, a debilitating respiratory disease that particularly affects children, is exacerbated by the release of pollutants from idling and moving vehicles [22]. Therefore, a suggestion with this design is to reroute the pick-up and drop-off location for parents of older school children to occur in the northern lots of the Boston Pizza and Swiss Chalet located in Meridian. This would require a shared used agreement, that for certain time periods of school days these sections of the parking lot would be used by parents. An example of the parking signs that could be used in these areas of the lot are shown in *Figure 46.* The school bus system would remain the same with drop-off and pick-up occurring within the school parking lot.

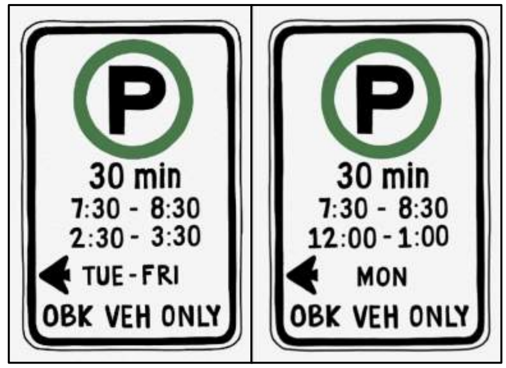

Figure 46: Shared Use Proposed Parking Signs

Use the QR code to view a complete 3D simulation of the proposed designs for OBK and Meridian. An alternate link to this rendering can be found here.

7.3.2 Final Remarks

Providing a direct safe path towards the school from the LRT station is intended to promote students to use active modes of travel to OBK school. As noted by L. Jackson "*provision of properly designed walkways through a mixed-use, human-scaled urban environment increases pedestrian activity"* [14, p. 196]. A limitation of this path is that it is not the shortest possible journey towards the school from the station. Although, a benefit is the alteration of the transit collector road 28th Street may be utilized by more users in Meridian than just students of OBK.

The shared use agreement to have a portion of the restaurant parking lot would require to be accompanied by a benefit for the companies to allow use of their property. A possible incentive could be the agreement for OBK and the City to provide maintenance of the lot for a period of the year.

Overall, the combination of proposed modifications to this area of Meridian is intended to promote the use of active transportation for students attending OBK. Unintended consequences, such as an increase in traffic due to the reduction of lanes would have to be further assessed. Although, as the traffic volumes on this road are currently not alarmingly high the concern for this is low.

In general, the designs proposed may also create a different point of view on how we can design and interact with industrial spaces. Typically, industrial parks can be seen as mundane areas of the city, only used for practical purposes, and primarily consisting of pavement and concrete. The surface treatments and building area in these areas can cause heat island effect. Industrial areas are typically only visited when necessary and viewed as solely a place for industry and work. This generally can create a negative relationship with these areas, causing an interesting obstacle for OBK, as schools typically do not exist in these zones. As previously mentioned, only 2% of schools are in industrial parks in Calgary. Therefore, implementing natural greenspace is a low impact development strategy that aligns with the initiatives set in the Calgary Climate Resilience Strategy [23]. As well implementing colour and different attractions, such as the painted crosswalks, aid towards bettering the transport relationship with industrial parks.

8.0 Neighbourhood Active Transportation Network (NATN) Plan

A Neighbourhood Active Transportation Network (NATN) is defined by Sustainable Calgary as a map of infrastructure that prioritizes people walking or biking in a convenient, safe, and enjoyable way as it connects them with local destinations [24]. NATNs should connect residential, educational, and business areas as well as public transportation stations [24]. The routes should be safe, direct, and well maintained. Such ways to create safe routes, is the inclusion of lighting, signage, adequate lane width and mode separation [24]. Active transportation modes will be encouraged by creating convenient connections that are universally accessible, well maintained, and clear of snow [24].

Our team joins Sustainable Calgary in encouraging the City of Calgary to implement NATN policy; seamless active transportation networks built throughout neighborhoods with priority over automobile infrastructure. The current state of many neighbourhoods in Calgary drives an inequality between different modes of transportation. Implementing an NATN approach intends to provide greater incentive to actively travel and lean to a transportation plan that supports all modes equally. This initiative will work towards addressing the climate emergency, improving the quality of life of Calgarians, providing opportunities to pursue active healthy lifestyles, and reducing the cost to grow and maintain our city [24].

8.1 Beltline

As Beltline is located immediately to the South of Calgary's Downtown and is sometimes considered part of Downtown, the area has some unique challenges. By analyzing GIS data and the surveys provided by Ever Active Schools and Sustainable Calgary, our group suggests some changes to promote an active mode of transportation throughout the community. *Figure 47* below is the current NATN of the Connaught area while the *Table 9* summarizes the proposed activities for potential infrastructure upgrades, street redesign, and maintaining the existing active transportation network:

Figure 47: Current Beltline NATN near the Connaught School

Table 99: NATN Proposed Changes for the Community of Beltline

ACTION	PROPOSED CHANGE
Widen Existing Sidewalks	The survey data provided by Ever Active Schools and Sustainable Calgary, revealed that people have concern walking and crossing around the Beltline area. Reviewing the GIS data for the Beltline Community, some of the sidewalks around the neighborhood need to be widened to reduce pedestrian crossing distances and to increase the pedestrian space. Sidewalk extensions physically and visually narrow the roadway while increasing the available waiting space. Specifically, the sidewalk along 8th street SW should be widened to promote walking to the school and around the Beltline area.
Upgrade Streets to Mixed-Use Streets	As Beltline is one of the densely populated neighborhoods of the city, upgrading streets to mixed-use streets will ensure a pedestrian-priority street. The road should be designed for slow travel speeds where pedestrians, cyclists, and motorists all share the right of way. Similar to the proposed shared street design for 10th Street and 13th Avenue, the street from nearby c-train station to Beltline Connaught School should be upgraded. Shared streets can be designed and managed in a variety of different ways to balance the needs of all users while enhancing the safety, aesthetics, and overall experience of the street.
Improved Crosswalk Design	The published surveys and GIS data show that many intersections are very difficult to cross along the beltline area. To improve crosswalks and pedestrian safety, crosswalks should be upgraded with reflective crosswalk signs, flashing lights, and protected intersections to make them more visible to drivers. As a result, drivers will have more time to reach the crosswalk traffic even in heavy rain or at night. The proposed upgrade should also be designed to assist visually impaired pedestrians from veering out of the crosswalk's safety.

8.2 Martindale

Upon reviewing the available GIS data for the community of Martindale, the existing active transportation network was reviewed for discontinuities, potential infrastructure upgrades, and/or provision of a street redesign. *Table 10* summarizes the proposed activities to maintain the existing active transportation network:

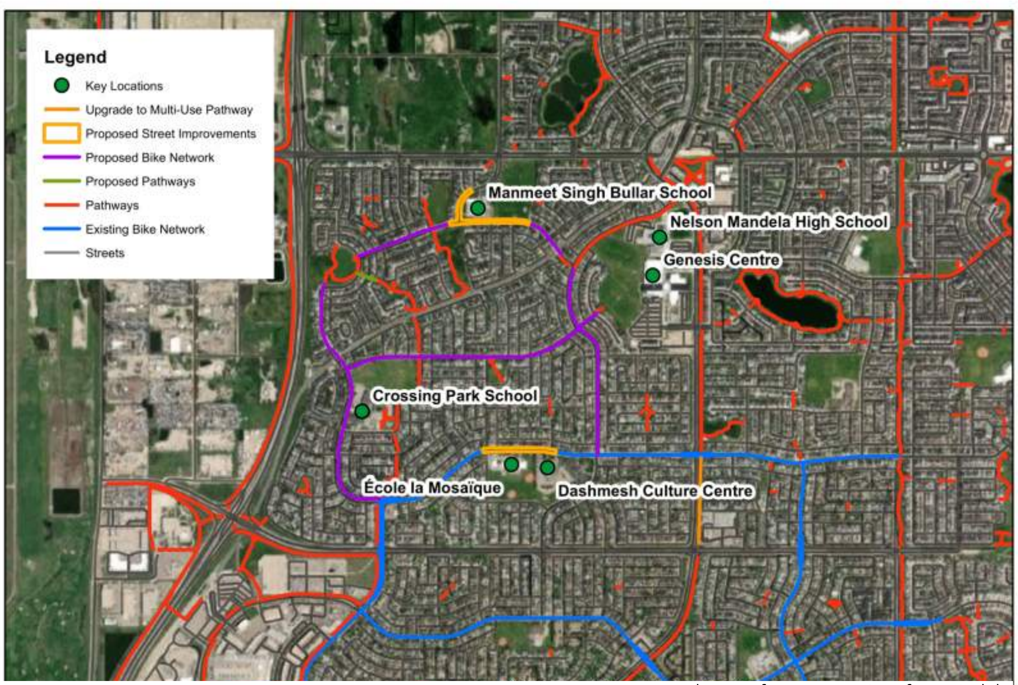

Figure 48: Proposed NATN for Community of Martindale

Table 1010: NATN Proposed Changes for the Community of Martindale

ACTION	PROPOSED CHANGE
Manmeet Singh Bullar School Street Redesign	Manmeet Singh Bullar School was also considered part of the Sustainable Calgary project, Stepping Towards a Greener Tomorrow, along with the three main schools studied in this report. Upon reviewing the survey data of this school, it shares many of the same issues and challenges as Ecole La Mosaique. A street redesign like the one proposed for Ecole La Mosaique will be needed. A combination of traffic calming measures (vertical/horizontal deflections) will be implemented to address the existing challenges and to make active travel modes safer for kids.
Upgrade Existing Sidewalks to Multi-use Pathways	To provide a shared alignment for both walkers and bikers, existing sidewalks from Martindale Gate/Martindale Boulevard to the Martindale LRT Station must be upgraded to multi-use pathways to provide continuity in the existing bike network in the community. The sidewalk along Falconridge Boulevard from 64 Avenue to Tararidge Circle must also be upgraded to a multi-use pathway to connect to the existing multi-use pathway along the boulevard.
Martindale Bike Network	Reviewing the GIS data, infrastructure for walking was well established in this community, but cycling infrastructure is lacking. The proposed bike network will go around Martindale Boulevard and a connection between Martin Crossing Drive and Martindale Drive. This network ensures the bike network continuity with the existing network in the community. Given that this network is provided, it connects bike paths not just from Martindale but also to neighbouring communities such as Taradale and Castleridge.

8.3 Meridian

The current conditions of the NATN in Meridian, shown in *Figure 50,* is unique due to the area being an industrial park. Understanding the weaknesses of the current community plan is paramount to create a more diverse and productive network. Travel via automobile is clearly prioritized in this community. This is represented by the following observations:

1. The existence of walkways available in Meridian is very limited, delineated in pink and red in the *Figure 50* on the following page.
2. Sidewalks and pathways available are disproportionately spaced throughout the community; that is, primarily all of them are situated in the southern region of Meridian near Memorial Drive.
3. The bus network is lacking connection through active modes of transportation
4. Almost the entirety of Meridian is paved, with very little areas designated as greenspace. It is important to note that this greenspace is defined as areas intently designed to be a more permeable surface, such as a field or park. Areas of grass and trees exist in Meridian, but only to fill the area between one area of pavement to another.

The proposed alterations to the NATN are shown in *Figure 49.*

Figure 49: Current Meridian NATN

Figure 50: Proposed Meridian NATN

Table 1111: NATN Proposed Changes for the Community of Meridian

ACTION	PROPOSED CHANGE
Extended Pathway Connecting all Bus Stops	Extension of the walkway from the south side of the school entrance, i.e., connecting bus stops from the 28th Street to 5th Ave with a mid-connection to 14th Ave walkway. This will encourage active modes of travel for the people around the Meridian community.
Franklin Station Park & Ride Proposed Walkway	Construction of a direct walkway towards 28th Street (and hence OBK School) in the existing Franklin Station Park & Ride parking lot. The addition of this diagonal walkway requires a reconfiguration of parking stalls in the lot. The walkway is intended to be constructed as a 3.0-meter multi-use asphalt pathway with fun designs painted on the surface. It would be above the grade of the parking lot, therefore requiring a concrete curb on each side of the 1.5-meter landscaped areas adjacent to the walkway.
28th Street SE Alterations	Alteration of 28th Street by primarily narrowing the lanes and median to provide room for a separate walk linking people walking to the school. The alignment of the 2.5-meter monowalk on the northbound side of 28th Street would remain. This realignment allows for the addition of a 2.5-meter-wide concrete separate walk to be constructed 2.5-meters from the southbound curb north of 2nd Avenue.

9.0 Cost Estimates and Timeline

The cost estimate is a comprehensive estimate intended to clearly define project cost elements, associated parameters, and current pricing. Depending on the estimate of the cost of designs, appropriate timelines were outlined for each community and that also shows when the construction of the projects are 'ideally' started and finished.

9.1 Cost Estimate Methodology and Assumptions

Methods and Assumptions:

Published Alberta Transportation Cumulative Unit Price Averages [25] have been used with modification in cases where there was material difference in the volumes or level of effort associated with that item. Adjustments were made to take into consideration of the increase or decrease in effort required for similar items of work. Where published Alberta Transportation data did not exist, other methods of determining unit prices were obtained, such as looking up in other material websites or textbooks, etc.

Appropriate areas and length measurements required based on the items needed for the construction of the design were obtained through the AutoCAD developed, as well as Google Earth. In addition, to determine the construction specifications of the applicable items the City of Calgary Road Construction 2015 Standard Specifications were applied [26].

Material Assumptions:

The geotechnical exploration shows that the quality and quantity of materials needed to construct roads/landscaping of each neighborhood are needed to be purchased and brought to the site. Overall, for all three neighborhoods needing to reconstruct the roadways, paving materials such as gravel, sand, and asphalt, etc. are assumed to be the primary materials for construction.

Contingency, Engineering and Construction:

A contingency factor of 20% and engineering and construction factor of 15% of total direct cost for all three neighborhoods are utilized to reflect the current level of study and knowledge. Because of any unforeseen mistakes or incidents, engineering judgement has been used to reduce contingency.

9.2 Cost Estimate Results

Following the detailed cost estimate exercise, utilizing assumptions and methodology discussed in *Section 9.1*, preliminary cost estimates were developed for each neighbourhood. *Table 12* below indicates the values achieved for the final interventions and improvements.

Table 12: Cost Estimate Value Determined for Each Neighbourhood

BELTINE – CONNAUGHT SCHOOL	MARTINDALE – ÉCOLE LA MOSAÏQUE	MERIDIAN – OBK SCHOOL
$226,875	$171,000	$644,666

Details for project activities, unit prices and calculations can be found at *Appendix E – Preliminary Construction Cost Estimates.*

9.3 Implementation Timeline and Construction

9.3.1 Beltline

Using the knowledge from previous project management courses the group believes that the construction for the proposed design in Beltline spans of a timeline of approximately four months, starting on July 2023 to October 2023. To reduce the inconvenience that construction causes residents in the area, 13th Avenue and 10th Street will have sections of them worked on at a time so homes can still be accessed. A general schematic of main construction principles noted for this design are shown in *Figure 51.*

Figure 51: Construction Schematic for Proposed Beltline – Connaught School Design

9.3.2 Martindale

Based on typical length of each activity proposed on our cost estimate, an implementation timeline was also developed and can be accessed by *Appendix F – Martindale Proposed Implementation Timeline*. We assumed that construction would start by July 2022 and *Table 13* below summarizes important milestones of how our proposed design will be implemented.

Table 1313: Milestone Summary for Martindale

Date	Milestone
Week of July 4, 2022	Start of Midblock Barrier Construction
Week of September 9, 2022	Completion of Midblock Barrier Construction
Week of September 12, 2022	Start of Martindale Gate / Martindale Boulevard Improvements
Week of October 14, 2022	Overall Project Completion

Lastly, *Figure 52* below illustrates potential construction issues that may be encountered prior to and during the construction phase.

Figure 52: Martindale Potential Construction Issues

9.3.3 Meridian

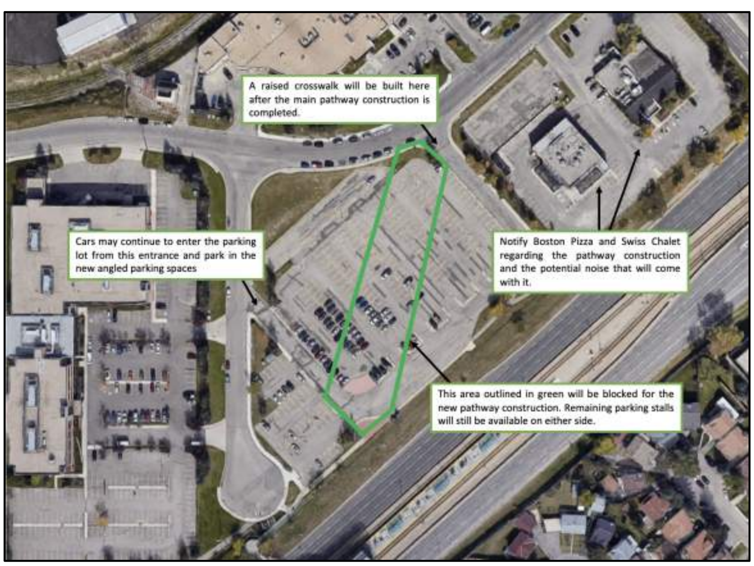

Figure 53: Franklin Station Park & Ride Potential Construction Issues

As shown in *Figure 53,* the area outlined in green will be closed off for construction. The major construction around this area will be that of the diagonal walkway followed by the repainting of stall lines.

The walkway is intended to be constructed as a 3.0-meter multi-use asphalt pathway. It would be above the grade of the parking lot, therefore requiring a concrete curb on each side of the 1.5-meter landscaped areas adjacent to the walkway.

For the construction of the monowalk and re-alignment of 28th St, the area outlined in green on Figure 54 will be blocked off. The North entrance and exit on 2nd Ave will remain open. The construction process will also require the closer of one lane from 28 St southbound. This will leave one lane still functional and allow for through traffic to continue.

Figure 54: Meridian 28th Street Potential Construction Issues

From the knowledge gained in project management courses, our team believes that the construction will take one construction season. This will be from the first week of July 2023 and finishing in October 2023. During the months of July and August, while school is no longer in session because of summer break, the parking lot alterations would occur.

10.0 Emissions

10.1 Background

The Motor Vehicle Emission Simulator (MOVES) was selected to assess the current and future carbon dioxide (CO_2) emissions for each of the three schools. MOVES was created by the US Environmental Protection Agency (EPA) to accurately estimate emissions. This software allows emissions to be estimated over different areas or modelling domains, and for this project, the County scale was used. This scale allows a more refined user input for motor vehicle activity. The input variables include Vehicle Miles Travelled, Road Type Distribution, Source Type Population, Age Distribution, Speed Distribution, Fuel Data, and Meteorology Data. *Figure 55* illustrates a typical input screen for the software.

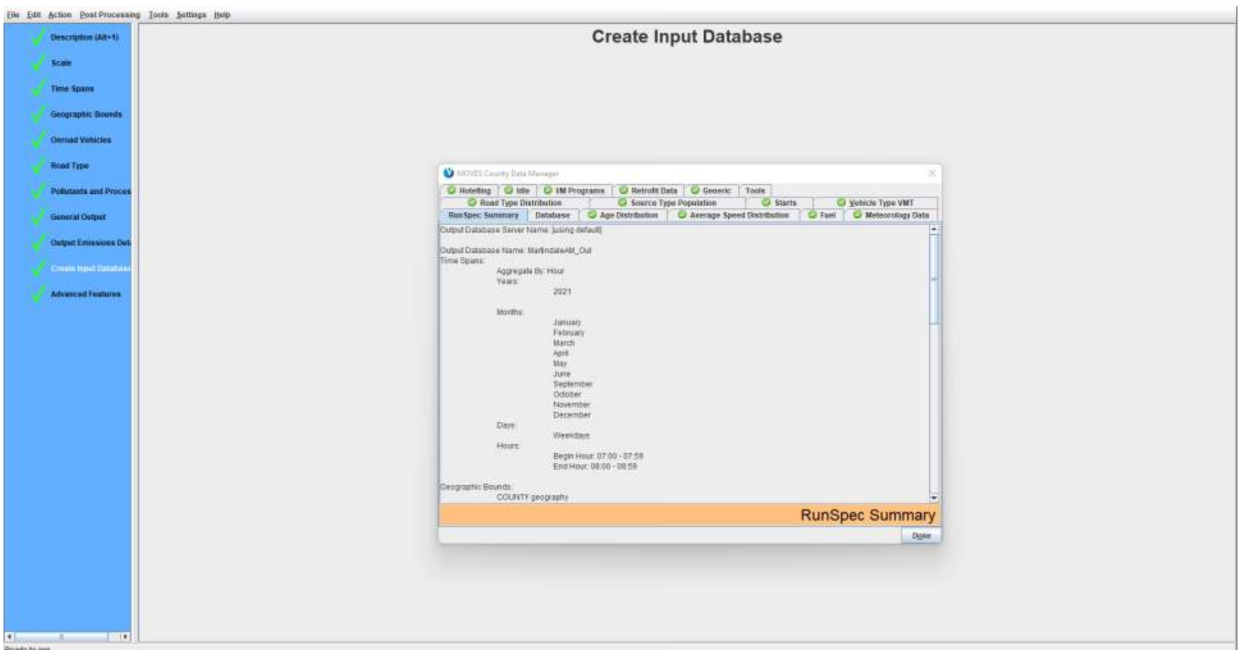

Figure 55: MOVES Typical Input Screen

10.2 Current Emissions Modeling Process

The Vehicle Miles Travelled were carried over from the preliminary emissions calculations performed in the Fall Semester. This process involved collecting the average travel times and distances from surrounding areas and neighbourhoods in Calgary to the schools via Google Maps. Once collected, average distances were calculated by grouping the travel times into increasing bins of 10 minutes.

Data was provided for the Connaught School in Beltline and École La Mosaïque in Martindale on the average time students spent commuting to and from school. These percentages were considered when estimating the CO_2 emissions for these schools. Although, for OBK in Meridian this same information was unavailable. Therefore, the assumption that 35% of students took less than 20 minutes on their commute and the remaining took greater than 20 minutes was utilized. This was based on the distribution (total number) of areas in relativity to the distance and travel time intervals, with the likelihood that more students commute certain times as there were more areas in Calgary within that time interval. For Meridian and Beltline, it was assumed that the bus would be taking the maximum average distance calculated, and for Martindale, information was used from the FrancoSud schoolboard to determine an approximate distance [27].

The road type distribution was assumed to all be Urban Unrestricted, as all roads that were used in this simulation were assumed to be arterials, collector roads, or local roads within the city. The source type population was also carried over from the Fall Semester preliminary emissions calculations. For Meridian and Beltline, this was based on a traffic count that was conducted during the site visit. A combined approach was used for Martindale. For this school, the percentages of students who use each method of transportation were used in combination with the capacity of the school to estimate the approximate number of cars used. Finally, the number of buses was observed during a site visit.

The default MOVES data was used for vehicle age distribution, assuming that ages of Canadian cars are similar to the ages of American cars. Speed Distribution was determined using Google Maps to find and analyze the route from each neighbourhood to the corresponding school. Using the speed limit for each road suggested by Google Maps, an average speed distribution was developed. For fuel data, it was assumed that all school buses use diesel, and all passenger cars use gasoline. Lastly, data of the average monthly temperature for the last 10 years for Calgary and humidity in the last year for Calgary were used for meteorology data [28][29].

10.3 Future Emissions Modeling Process

There was uncertainty on how many children would transfer over to mainly use active modes of transportation through the implementation of our designs. Therefore, to best demonstrate the potential change the intervention and improvement could have, a range of different scenarios was considered. To better gauge the potential impact of the designs we suggest a survey with parents and children to be conducted. Due to time constraints this was not possible within the scope of our project.

The only inputs to the model that were changed for simulating future emissions were the Vehicle Miles Travelled and the Source Type Population. For the Source Type Population, the reduction in the number of cars and school buses was found by applying a scaling factor that was proportional to the increase in students that would begin walking. The Vehicle Miles Traveled were then calculated again using the same method used for the current emissions. Once these adjustments were applied, the software simulation was run for each future scenario. Although the movement of students was shifted towards walking in this analysis, walking and cycling can be considered interchangeable, as life cycle costs of bicycle manufacturing were not considered.

10.4 Emissions Results

The process described above achieved projected and estimated emissions results for each neighbourhood. With the methods used for each neighbourhood, conclusive results were achieved. These are represented for each neighbourhood in the following sections, *10.4.1, 10.4.2, and 10.4.3.* These results provide a representation for the level of impact design that invokes a shift in modal share can have.

10.4.1 Beltline

Data input unique to the Beltline neighbourhood can be seen in the following table, *Table 14.* These values for each parameter helped build the MOVES model for the estimated Connaught School emissions.

Table 1414: MOVES Onroad Data Input for Connaught School

PARAMETER	DEFINITION	EXISTING CONDITION SCENARIO VALUE(S)/RANGE(S)	FUTURE CONDITION SCENARIO VALUE(S)/RANGE(S)
Vehicle Miles Travelled	Total distance traveled by all vehicles from the communities within the catchment of the school	*Cars:* 215.5 miles *Buses:* 14.05 miles	*Cars:* 173.18 to 103.21 miles *Buses:* 14.05 miles
Road Type Distribution	Road classification on which vehicles travel to and from the school	Local roads, collector roads, arterials	Local roads, collector roads, arterials
Speed Distribution	Average speed bins of vehicles that travel to and from the school	Speed Bin 6-13 (22.5 to 62.5 mph)	Speed Bin 6-13 (22.5 to 62.5 mph)
Source Type Population	Type of vehicles that travel to and from the school	36 cars and 1 bus	29 to 16 cars; 1 bus
Age Distribution	Vehicle age of vehicles that travel to and from the school	New to 30 years (both vehicle types)	New to 30 years (both vehicle types)
Fuel Data	Specific fuel type for each vehicle type used for travel	*Cars:* gasoline *Buses:* diesel	*Cars:* gasoline *Buses:* diesel
Meteorology Data	Local temperature and humidity [28][29]	*Temperature:* 16.7 F to 57.2 F *Average Humidity:* 48% to 70%	*Temperature:* 16.7 F to 57.2 F *Average Humidity:* 48% to 70%

Figure 56 shows the monthly existing emissions for Beltline Connaught School. The month of December has the least emissions compared to other months, at about 1.2 tonnes of CO_2 equivalents. June seemingly has the most emissions, at about 1.9 tonnes of CO_2 equivalents.

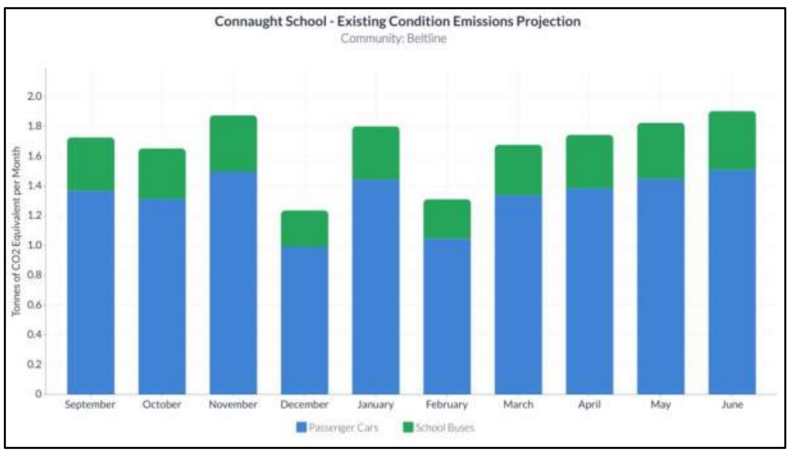

Figure 56: Connaught School – Existing Conditions Emissions Projection

Figure 57 (on the following page) shows the projected future emissions for the Beltline area. The Beltline area has much lower carbon emissions than the other two schools, as about 45% of students walk to the school currently. This is assumed to be the case because the location of the school is downtown with high density residential places around the area.

As ideas have been proposed to redesign the streets around the area in accordance with the design standards and guidelines such as Design Guidelines for Subdivision Servicing [16], students and parents are expected to use the active mode of transportation more frequently. Residents of the neighborhood are also expected to use active modes of transportation, because of the traffic calming measures that will be undertaken with the change. This will eventually help to reduce the carbon footprint of the area.

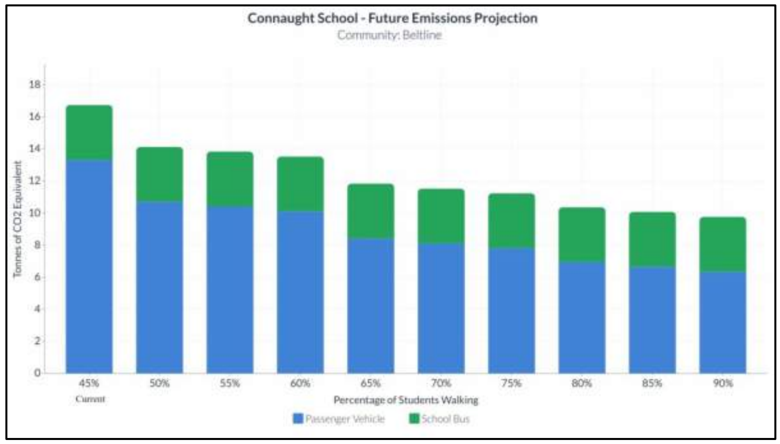

Figure 57: Connaught School – Future Emissions Projection

10.4.2 Martindale

Data input unique to the neighbourhood of Martindale can be seen in the following table, *Table 15.* These values for each parameter helped build the MOVES model for the estimated École La Mosaïque emissions.

Table 1515: MOVES Onroad Data Input for École La Mosaïque

PARAMETER	DEFINITION	EXISTING CONDITION SCENARIO VALUE(S)/RANGE(S)	FUTURE CONDITION SCENARIO VALUE(S)/RANGE(S)
Vehicle Miles Travelled	Total distance traveled by all vehicles from the communities within the catchment of the school	*Cars:* 342.24 miles *Buses:* 74.56 miles	*Cars:* 186.05 to 330.26 miles *Buses:* 40.06 to 72.1 miles
Road Type Distribution	Road classification on which vehicles travel to and from the school	Local roads, collector roads, arterials	Local roads, collector roads, arterials
Speed Distribution	Average speed bins of vehicles that travel to and from the school	Speed Bin 6-13 (22.5 to 62.5 mph)	Speed Bin 6-13 (22.5 to 62.5 mph)
Source Type Population	Type of vehicles that travel to and from the school	74 cars and 6 buses	40 to 70 cars; 4 to 6 buses
Age Distribution	Vehicle age of vehicles that travel to and from the school	New to 30 years (both vehicle types)	New to 30 years (both vehicle types)
Fuel Data	Specific fuel type for each vehicle type used for travel	*Cars:* gasoline *Buses:* diesel	*Cars:* gasoline *Buses:* diesel
Meteorology Data	Local temperature and humidity [28][29]	*Temperature:* 16.7 F to 57.2 F *Average Humidity:* 48% to 70%	*Temperature:* 16.7 F to 57.2 F *Average Humidity:* 48% to 70%

Figure 58 shows the amount of CO2 emissions for École La Mosaïque during the school year. The months with the highest emissions have the highest number of school days, and the months with the lowest numbers generally have the fewest number of school days (e.g. December).

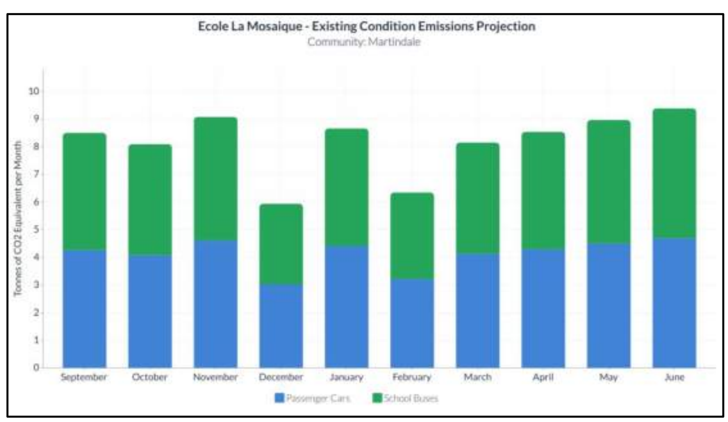

Figure 58: École La Mosaïque – Existing Condition Emissions Projection

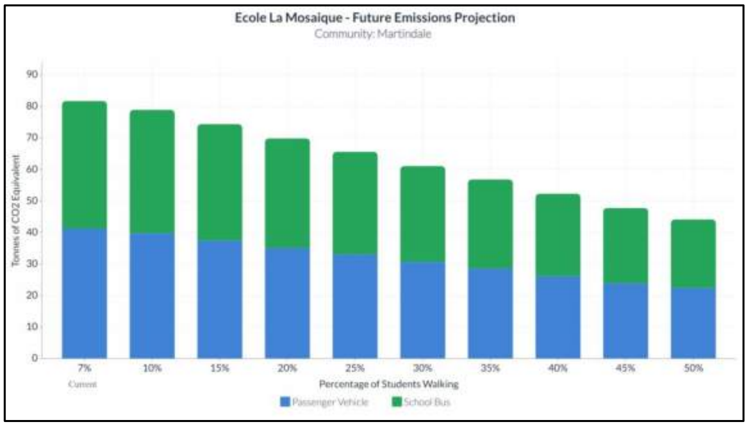

Figure 59: École La Mosaïque – Future Emissions Projection

Figure 59 shows the projection of future emissions for École La Mosaïque, considering that the proposed street design will shift commutes to more active modes of travel. As more students use an active mode of travel, emissions decrease. Theoretically, if 50% or more of the student population travel by either walking and/or cycling, CO2 emissions equivalent to 87 barrels or more of oil would be saved [30].

Given that climate change is causing the temperatures to rise, a sensitivity analysis for temperature was performed for this school. The results of this analysis showed that up to a certain point, higher temperatures will cause emissions to decrease, but after this point, emissions will begin to increase again. A simulation scenario was also performed for age distribution, with cars moving towards newer ages. This test showed that newer cars create fewer emissions, and if there is a shift toward newer vehicles with more sustainable technology, emissions will decrease.

10.4.3 Meridian

Data input unique to the Meridian community can be seen in the following table, *Table 16.* These values for each parameter helped build the MOVES model for the estimated OBK School emissions.

Table 1616: MOVES Onroad Data Input for OBK

PARAMETER	DEFINITION	EXISTING CONDITION SCENARIO VALUE(S)/RANGE(S)	FUTURE CONDITION SCENARIO VALUE(S)/RANGE(S)
Vehicle Miles Travelled	Total distance traveled by all vehicles from the communities within the catchment of the school	*Cars: 2390.85* miles *Buses:* 48 miles	*Cars:* 1196.84 to 1190.42 miles *Buses:* 38.40 to 28.8 miles
Road Type Distribution	Road classification on which vehicles travel to and from the school	Local roads, collector roads, arterials	Local roads, collector roads, arterials
Speed Distribution	Average speed bins of vehicles that travel to and from the school	Speed Bin 6-13 (22.5 to 62.5 mph)	Speed Bin 6-13 (22.5 to 62.5 mph)
Source Type Population	Type of vehicles that travel to and from the school	246 cars and 5 buses	123 to 246 cars; 5 to 3 buses
Age Distribution	Vehicle age of vehicles that travel to and from the school	New to 30 years (both vehicle types)	New to 30 years (both vehicle types)
Fuel Data	Specific fuel type for each vehicle type used for travel	*Cars:* gasoline *Buses:* diesel	*Cars:* gasoline *Buses:* diesel
Meteorology Data	Local temperature and humidity [28][29]	*Temperature:* 16.7 F to 57.2 F *Average Humidity:* 48% to 70%	*Temperature:* 16.7 F to 57.2 F *Average Humidity:* 48% to 70%

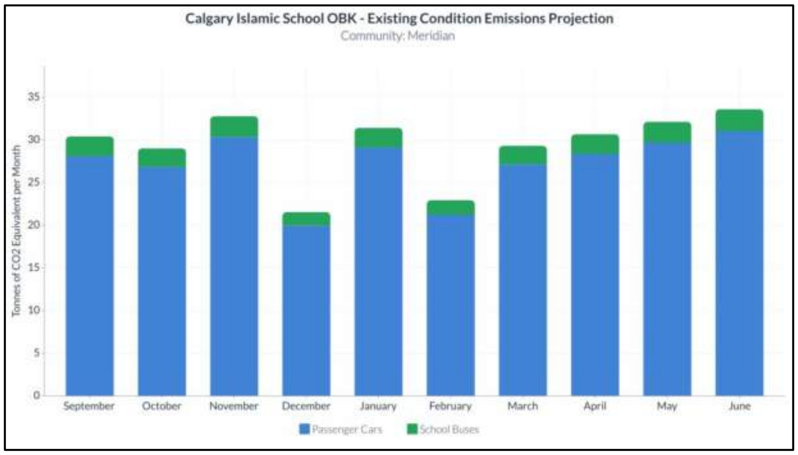

Figure 60: OBK – Existing Condition Emissions Projection

Figure 60 shows the current emissions. Here the figure shows us the CO_2 Emissions of the present school area. We can see daily emissions are higher in colder months like December, January, and February and less in warmer months like May, June, and September. This figure shows the monthly emissions for OBK School. The months that have the highest number of school days have the greatest emissions.

Figure 61 shows the projected future emission based on different scenarios. For Meridian, as observed from the above graph, the emissions are comparatively higher for OBK than the other school areas. This can be explained by the following two reasons:

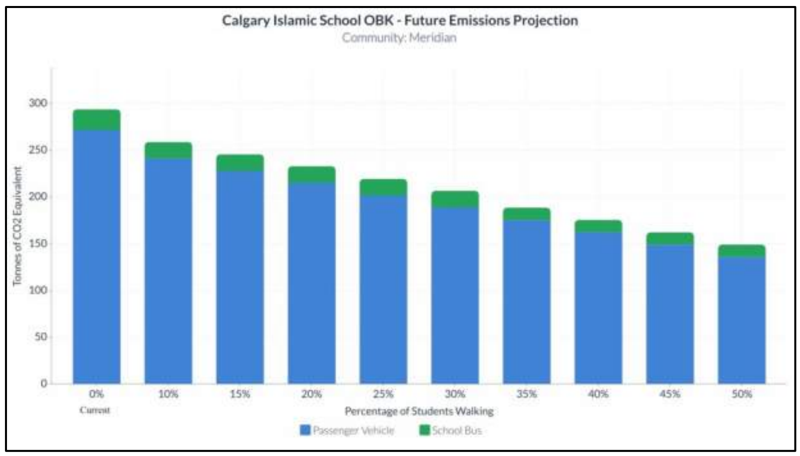

Figure 61: OBK – Future Emissions Projection

1. OBK is in an industrial park area, where people only travel to rather than live within. This forces a greater share of people needing to travel from long distances as residential areas are in further neighbourhoods. Most of the students are commuting via personal vehicles as their primary mode of transportation.
2. OBK is a private Islamic school, therefore, the school is more of a commuter school. This differs from schools in the public or separate system as typically those are considered designation schools, with a certain zone with boundaries. The students attending OBK may be from neighbourhoods all over Calgary.

10.5 Conclusions

From the existing and future scenarios presented, as expected with a lower number of vehicles and vehicle miles traveled, CO_2 emissions decrease. This demonstrates that the proposed designs to shift transport to more active forms can have an impact on carbon emissions. As seen for each school, as more students walk or bike instead of being driven via passenger vehicle or school bus, CO_2 emissions decrease accordingly. Connaught School in the Beltline has the highest percentage of students who currently walk to school, and the least vehicles and vehicle miles traveled, therefore it also has the smallest number of emissions. Since École La Mosaïque only has some students who walk, a large school bus program, but also a significant portion of students driven in passenger vehicles, source type population and vehicle miles traveled are higher, and emissions are also higher. OBK is a school with large commutes and has no students who currently walk to school and many who are driven in passenger vehicles. Accordingly, it has the highest source type population for passenger cars, and the highest VMT, leading to OBK being the school with the highest carbon emissions. These simulations show that walking and biking are the most sustainable options for transport, and it is important to have infrastructure that caters to those who utilize these methods.

11.0 Recommendations

11.1 Encouragement and Education

The team recognizes our project is highly dependent on a change in human behavior. People's decisions are often influenced by their status quo bias [31]. That is, they prefer routine as change is often scary [32]. In our case, persuading parents, and staff to shift from using a personal vehicle to utilizing active travel modes can be difficult. That is why we recommend incorporating the Five E's of School Travel Planning [33]. They are as follows:

1. Education – Teaching and learning about the benefits of active school travel
2. Encouragement – Partnerships and services supporting active school travel
3. Engineering – Physical changes to the environment
4. Enforcement – Healthy School Policy; work with Bylaw & Calgary Police Services
5. Evaluation – Assessing the impact of any changes or projects

Our final designs cover the third "E", engineering, by making changes to existing infrastructure and adding additional traffic design features. The encouragement part is strongly lead by organizations such as Sustainable Calgary and Ever Active Schools that provide schools with the opportunity to address school travel planning issues [34]. These organizations also connect schools with community and municipal parties to gain support in the implementation of plans [34]. Through these connections with organizations, schools better understand the relationship between vehicle congestion and idling, with poor air quality. They can identify the benefits active travel has in helping the environment, especially in the school's direct surrounding area. Promotional programs emphasize active travel as a convenient and healthy travel option [35].

We have identified the most important element of School Travel Planning's Es to be education. Through the education of both students and parents, we hope to spark conversations regarding active transportation. We propose an "Active Travel to School Day" where students would be encouraged to walk, wheel, bike, or take public transportation to school. There could be a common location where teachers meet their students, and they could travel to school together to ensure the students feel safe. This could be the foundation for a Walking/Wheeling Buddy program that would give leadership opportunities to older students as they could guide their younger peers to and from school. Safety concerns, whether real or perceived, are a major deterrent to active travel [35]. Active travel needs to feel safe. A way to achieve this is by following the principle of "safety in numbers" [35]. The more people walking and biking, the more aware drivers are. Therefore, safety and promotion of active travel go hand in hand [35].

Following the active commute to school, lesson plans could include traffic safety education, air quality education, and awareness events. These lessons could enlighten students on the current climate crisis and help them make the connection between vehicle emissions and the change in climate. Involving youth in the conversation on how to make climate conscious decisions is key to changing human behaviour in this generation. The intention is that students will go home and talk about what they learnt, and parents may feel more inclined to let their kids actively commute to and from school.

11.2 Zoning and Land Use

The way neighborhoods and communities are built directly affects frequency of active travel [35]. This is because the design of communities determines if trip origins and destinations are close enough to encourage walking, wheeling, and biking [35]. Additionally, street connectivity is associated with more active travel to school [35]. Higher connectivity streets have smaller, short blocks, and offer shorter, more pleasant routes [35]. These features appeal to human's desires to take the shortest path and feel safe.

Through the study of three schools in Calgary, our team discovered the significant role community development plays in promoting active travel. For example, the Connaught School in the Beltline, is closely surrounded by many amenities such as residential buildings, shops, offices, services and more, all within short distances of one another. Therefore, it makes sense that out of the three schools under study, Connaught has the highest percentage (73%) of its students taking active modes of transportation to and from school [13]. In comparison, 90% of students use personal vehicles to commute to and from Omar Bin Al-Khattab School in Meridian [12]. This has been identified this as a zoning issue. Meridian is in an industrial park, meaning there are no residents living in the neighbourhood itself.

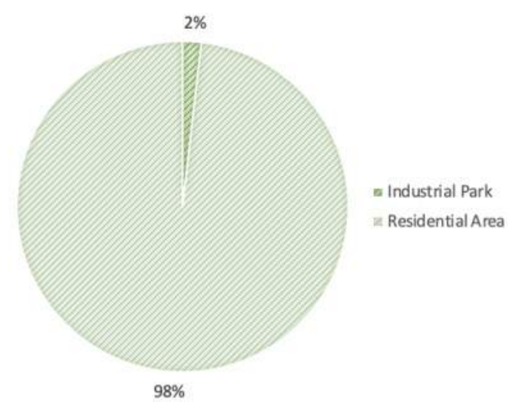

Figure 62: Percentage of Schools in Calgary Industrial Parks

Through research, our team found that only 2% of schools in Calgary are in industrial parks, as seen in *Figure 62*. Of that 2%, all of them are private schools. This leads our team to question zoning regulations in Calgary. In new community developments there is always designated land for schools involved with the Separate and Public-school boards, but never private schools. This forces private schools to purchase land in areas such as industrial parks where there is less transit-oriented development, street connectivity, and amenities. It is no surprise then, that students and staff from OBK choose not to travel actively. Active travel modes can be increased by sustainably conscious community urban design and land use policies [35]. Our team recommends a revisit of zoning regulations and building codes of the City of Calgary. Schools should be in communities with transit-oriented developments, high street connectivity, high density and more stores and jobs within walking distance of where people live [35]. The physical, social, environmental, and economic benefits attributed to active school commutes should incentivize this change. Studying innovative infrastructure measures such as pilot projects like ours may help achieve design standards that prioritize active travel over the personal automobile [35].

Furthermore, our team's investigations further clarified that urban sprawl works against active transportation. As neighborhoods get further away from city centers, there is more distance to travel to goods and services. Typically, if a trip is under 20 minutes, people will choose to walk [24]. Between 20 to 30 minutes, people are more inclined to cycle [24]. Trips longer than 30 minutes, cause active modes to decline in favor of driving [24]. Therefore, higher density neighborhoods facilitate active travel modes and neighborhood active transportation network developments. NATNs and specific retrofits may come at a high capital cost however, perhaps money should stop going towards building new highways and instead be put towards improving the conditions of existing infrastructure. Providing convenient, safe, and connected walking and biking infrastructure promotes active travel as it is the first layer of protection between pedestrians and cars.

Lastly, our team discovered the benefits of permeable surfaces and pollinator species through our conversations with industry advisors. By incorporating these elements into our final designs, we can tackle multiple global issues at a time.

Impervious surfaces like asphalt and concrete on roads and driveways prevent rainwater from seeping through and replenishing groundwater aquifers [36]. Stormwater runoff washes pollutants like oil, road salt, chemicals, and trash into waterways which can negatively affect our drinking water supplies and aquatic life [36]. By capturing stormwater through permeable surfaces, we can replenish groundwater resources; allowing us to meet the demands of industry and communities while maintaining rich biodiversity [36]. Therefore, we propose the use of permeable pavers, asphalt, and concrete in our designs.

Next, our group also encourages the use of pollinator species in the integration of our designs. Such species include fescue and blue oat grasses which are also low maintenance and resilient against Calgary's harsh climate. The use of *native* pollinator species such as these decreases the adverse effects and costs of landscape maintenance while also supporting the local culture of Alberta.

12.0 Conclusion

Through the execution of this project, we have learnt that an individual's decision to take active modes of transportation is not only determined by their personal needs, preferences, and attitudes, but also by influences from their physical and social environments [35]. Providing convenient, safe, and connected walking and biking infrastructure promotes active travel as it is the first layer of protection between pedestrians and motor vehicles [35]. We focused on children as the primary users of streets and pathways. This forced us to challenge the status quo as modern cities are designed for cars and the adult white male. Through our proposed engineered designs in combination with recommendations on education and land use policies, our team is confident active travel use will increase at the three schools under study.

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Appendix A – Conceptual Designs

Brainstorming Ideas:

1) To implement traffic calming measures, one simple option could be to implement green pylons down along 11th street on the side adjacent to the school area. As we believe that 11th street undertakes enough traffic, it warrants the increase of traffic calming measures to ensure the safety of pedestrians, cyclists and children near the school zone.

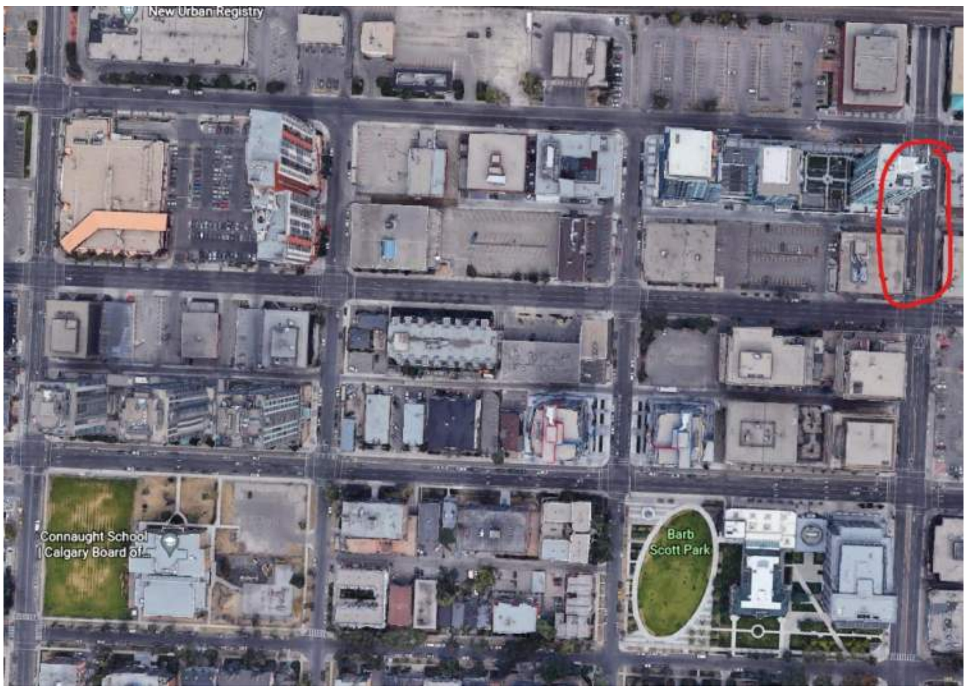
2) Another proposed idea could be redesigning 10th street, shown to the right of the school in the picture above. In this theoretical design, half of the road would remain open for parking lot access, while the other half of the road would be redesigned to include more open space for the pedestrians, cyclists and children from the school zone. The top section of the road, which connects to 12th Avenue, would remain open but not as a thru intersection. Instead, the road will remain open for cars to access the parking lot and back alley between 12th Avenue and 13th Avenue. The bottom section of 10th street, which connects to 13th Avenue, would be fenced off so vehicles driving along 13th Avenue could only turn southbound on 10th street.

Design #	Design Description	Design Advantages	Design Disadvantages
For all	• 11th to 10th avenue increase sidewalk width along 8th street. Increase greenery, benches with extra room when possible. • Put the school zone signs earlier on 12th and 13th avenue to ensure people can adjust their speeds. • Increase traffic light timing for north and south bound on 12th avenue intersections • Advertise the school bus services as some parents didn't even know if they were in the zone for it.	• Clearer signage indicates the school zone better • The greenery will create a buffer between the streets and the pedestrians making it safer for kids • Creates more time for children to cross	• Less room for cars with the curbs extending on 8th street • May cause congestion with the traffic light timing changing.
1	Turn 10th & 11th Street into mixed-use streets from 12th to 14th avenue. Increase street furniture and implement engaging surfaces such as murals, and other art. Allow businesses to spill out on the sidewalks where possible.	• Increases aesthetics • More modes of transportation readily available • Encourages more use of mixed modes of transportation, reducing car traffic	• Reduced parking spaces • Mixed use spaces may not be effectively used during winter season • Could create more congestion on other roads with cars not wanting to take the mixed-use street. • Mixed-use streets require reduced vehicular speeds, which could result in dissatisfaction of community members.

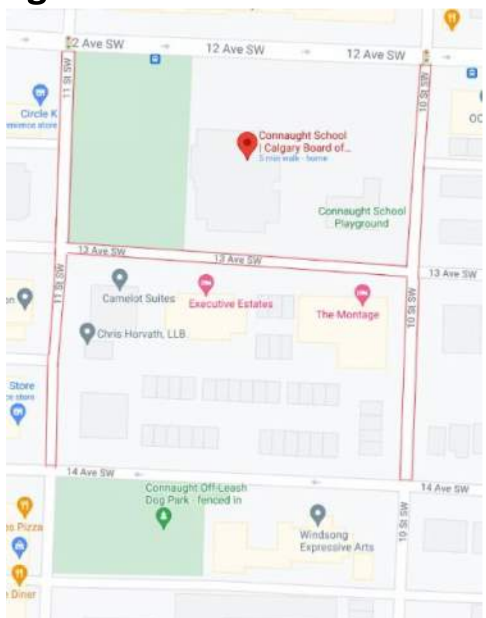
2	Raised Sidewalks with vibrant colors. Bicycle lanes along 13th avenue and 10th and 11th street. On 11th street separate it from the road by putting it next to the sidewalk but indicate it with a different colour. No air cushion is needed on tenth street along the school since there is a no parking zone and not much traffic. However, an air cushion could be implemented on the side opposite the school.	• Raised Sidewalks force cars to slow down increasing safety for pedestrians. • The vibrant colors make drivers more aware of where pedestrians can cross. • Gives bicycles more ways to travel to the school safely.	• More difficult to clear snow in the winter with the raised sidewalks and is more work with the bicycle lanes.
3	Extended curbs along the sidewalks around the school. Pinch point in the middle of 13th avenue by the school. 10th and 11th street are given the same bicycle lanes as design 2.	• Pinch point acts as a traffic calming measure, as well as increases safety of pedestrians crossing 13th avenue. • Bicycle lanes encourage active transport, and cars parking between motor vehicle lanes and bicycle lanes provide safety in the form of a barrier.	• Higher difficulty maintaining bicycle lanes and pinch points when compared to simple roads and sidewalks. • Less parking space due to pinch point.
4	Reduce 12th avenue lanes to 2 lanes get rid of one street parking by the school. Add a drop off point on 10th street where the grass is, essentially making the primary entrance of the school on the east side not the north.	• Removing the parking lane along 12th avenue may help to improve traffic flow since stop & go is reduced next to school. • Removing a traffic lane from 12th avenue effectively makes the crosswalk to the other side of the avenue shorter, making it safer and less stressful for pedestrians. • Increased safety for children and	• Possible Increased traffic congestion on 12th avenue if drivers don't change their daily route. • Increased traffic on other roads in downtown if drivers change their daily route. • Less parking space due to reduced lanes.

		pedestrians along 12th ave with more walking space and barrier between sidewalk and road • More space for greenery.	

The graphic below shows where the sidewalk should be widened along 8th street with respect to the school.



Design 1 Cross sections and area:



Design 2 and 3 Cross sections:

Design 4:

Design 5 cross sections and area:

Curb extensions on 12 Ave.

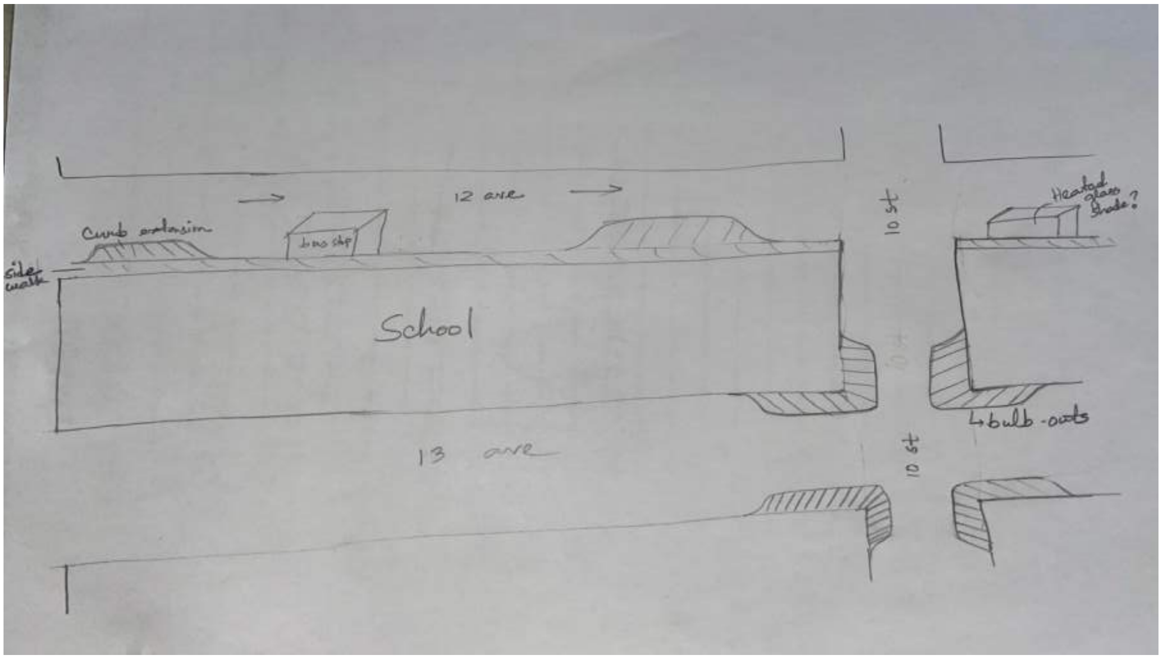
Heated glass shade with food stalls.

Curb bulb-outs on 13 Ave 10 St which is one of the areas of concern for crossing.

Possible idea: have three curb extensions along 12th ave, so one section is dedicated to the bus and the other section is dedicated for cars

Painted area for bus.

12th street very important, may have unintended consequences, we should mention it in the final presentation (if we pick it)



Design 6:

Increased tree density around the school.

More lights to provide visibility and comfort at night.

Rain shelter at the bus stop adjacent the school.

Widen the North entrance facing sidewalk by giving up some of the school space. Allows people to be farther away from vehicles and provides much needed space at the bus stop.

Narrow lane width to reduce vehicular speeds on 12th avenue.

Raise sidewalks to improve visibility.

ENCI 570 T2 Group

Martindale – Ecolé La Mosaïque

Preliminary (Conceptual) Design Options

Design No.	Description	Advantages	Disadvantages
1	Installation of curb extensions at both intersections as shown; repaint the existing crosswalks; install bike sharing indicator on pavement; install speed display device before the school zone sign	• Improved pedestrian visibility at the crosswalks which in turn gives ample of time for the motorists to yield • Lowers speed of motorists at cross walks which means safer pedestrian crossing and shortens the distance pedestrians will cross • Depending on the new area of the extended curb, it may be developed to a multi-purpose space	• Larger vehicles (e.g., school bus, transit, trucks) may have difficulty to turn where the curb will be extended (crossing the street center line) • Other key infrastructure such as catch basins and catch basin leads may be relocated and extended depending on the extent at which the curb will be extended; this will increase the overall cost of the infrastructure (plus the speed display device) • May impede cyclists who shares the road
2	Shared Space Concept – see attached illustration for full details	• Reduces the sign confusion with the motorists which could make them to slowly drive • Will significantly narrow down the driving lane (in both directions) which ultimately leads to safer street with slow moving vehicle • Increased accessibility for walkers and bikers • Jaywalking may be lessened due to more space for other road users other than personal vehicles • Will be a sustainable infrastructure given the *best management practices* (i.e., permeable pavement, retention cells, etc.) will be installed to manage stormwater run	• May pose challenge with emergency vehicle (ambulance, fire trucks, etc.) access • There might still be collision risk with walkers and bikers if the vehicles can't slow enough to yield for them • High capital costs if thinking about replacing a huge amount pavement, stormwater management features and any required vegetation • Harder to be maintained during heavy snowfall events
3	• Extend the Curbs by the crosswalks • Install flashing pedestrian lights • Install Flashing sign each direction with the 30 km/h speed limit on it (When max speed is exceeded, it shows the message "Slow Down") • Sidewalk Mural	• Increases pedestrian safety • Increases awareness of speed limit and when it is being exceeded • Should not have pushback from the City, as it would not impede traffic on the collector road	• No physical barriers to prevent speeding • Does nothing to prevent jaywalking
4	• Raise the Crosswalks (Note: According to the 2014 Complete Streets Guide, raised crosswalks are permitted for collector roads)	• Increases pedestrian safety • Raised crosswalk forces drivers to slow down • Increases awareness of speed limit and when it is being exceeded	• Does nothing to prevent jaywalking • High Cost

	• Install Flashing sign each direction with the 30 km/h speed limit on it (When max speed is exceeded, it shows the message “Slow Down”) • Sidewalk Mural		• Raised crosswalks would require road closure, which may cause pushback from the City
5	• Install Speed Cushions to slow down vehicles (Note: According to the 2014 Complete Streets Guide, speed cushions are permitted for collector roads, but if there is city pushback this can be removed from the design) • Install Flashing sign each direction with the 30 km/h speed limit on it (When max speed is exceeded, it shows the message “Slow Down” • Install a new crosswalk midway through the block with pedestrian lights • Sidewalk Mural	• Prevents Jaywalking • Speed cushions force drivers to slow down • Increases awareness of speed limit and when it is being exceeded	• High Cost • Speed Cushion installation would require road closure, which may cause pushback from the City
6	• Take out the green space area where buses usually drop off/pick up students and make the space wider for buses to park. • Take out the green space beside the parking lot and extend the space with paved and colorful pavements for school bus to have enough space to park. • Paint the space with colorful theme about safety. • Install raised crosswalks at the intersection with other roads. • Raise the yellow line median to prevent vehicles from going to the opposite direction. • Install 2 speed bumps on Martindale Boulevard area to prevent motorists from speeding. • Install poles (~1 m height) on the sidewalks close to bus parking space so	• Could ultimately prevent vehicles from speeding higher than the posted maximum speed around the school zone overall. • Residents north of school can have their parallel parking space for them as the school buses go into school area. • Improved aesthetics. • Sidewalk widths are widened. • Easier access for school buses to go in and out of school parking lot as there are two entrance/exits.	• Drivers may make U-turns at either end of the school zone. • As pedestrians cannot jay-walk, walking distances from other side of the road to the school are increased. • Could be waste of space during off-school period. • Costly.

	that vehicles cannot go over the sidewalks. • Add another entrance/exit for easier entering and exiting.		
7	**Through Traffic Barrier** This design involves adding a barrier mid street so that no through traffic can use the road. Any traffic entering the road must only exit from the way they came in. The barriers can be planters to increase the aesthetics. The road has been modified to become a cul-de-sac on either end of the barriers to aide cars in performing u-turns. There is also a bus trap in the barrier, allowing buses to pass through the barrier, while any cars that attempt to bypass the barrier will fall in and get stuck. A protected bike lane through this section of the road, with one sidewalk to the west converted to a separated bike path to the LRT station and will connect to the bike path along Martindale Drive to the east. This design will require downgrading Martindale Blvd. in front of the school from a collector road and encouraging traffic to redirect to Martindale Drive and Martindale Gate and use 64 Ave NE to cross the community.	• Elimination of through traffic in front of the school will greatly reduce the number of cars in front of the school, greatly reducing the possibility of collisions • Restricts car access while continuing to allow busses, pedestrians, and cyclists to pass through unobstructed • Can easily be modified with other traffic calming devices to further reduce vehicle speeds • Includes elements to separate cyclists from traffic, both in front of the school and elsewhere along Martindale Blvd.	• Through traffic may choose to use the back alley or Martinbrook Road NE to avoid the barrier, only redirecting traffic onto other side streets • Parking is still abundant • Car trap may be inviting for curious kids to explore and play in, increasing the chance of a collision with a bus, who may have reduced visibility into the hole • Vehicles aren't necessarily forced to slow down • Requires downgrading of street • Expensive
8	**Chicane and Continuous Sidewalks** This design involves adding islands in the road to narrow it and create multiple chicanes. By turning the road from straight to windy, traffic will be slowed, and drivers will be forced to pay attention to their surroundings. Intersections will have crosswalks modified into continuous sidewalks, which raises traffic to the pedestrian's level, further slowing vehicles and giving the message that cars are a guest in the pedestrian space and should give right of way. Another raised crosswalk has been added to the middle of the block, decreasing the distance between crosswalks	• Drivers forced to slow down while driving through • Parking for parents eliminated • Busses and children protected by physical barrier • Natural implements increase aesthetics of area for kids • Continuous sidewalks make crossing safer by bringing cars up to the sidewalk level • Midblock crossing encourages safer crossing when far from intersections	• Through traffic still exists • Active transport is not encouraged by design • Expensive

	across the street and discouraging pedestrians from crossing outside of designated crosswalks. Trees, rocks, and other natural objects can be added in these islands to make the area feel more natural and attractive to kids. A protected bus loading zone provides a barrier between busses and traffic, in addition to further narrowing this road. This design greatly reduces the amount of parking available, so adding a permitted parking zone will save parking for residents and forcing parents to park further away during pick up and drop off, discouraging the use of cars. This design will require downgrading Martindale Blvd. in front of the school from a collector road and encouraging traffic to redirect to Martindale Drive and Martindale Gate and use 64 Ave NE to cross the community.		
9	The street is replaced with a shared space, where all modes of transportation share the same area instead of being separated. Natural barriers allow for higher aesthetics towards children and the creation of pedestrian only items where cars cannot enter. Roundabouts at the intersection on either end of the street segment slow down traffic before they enter the space. On the school side, playground equipment and other fun items can be installed to give kids an area to play in between the end of school and school bus departure. This design will require downgrading Martindale Blvd. in front of the school from a collector road and encouraging traffic to redirect to Martindale Drive and Martindale Gate and use 64 Ave NE to cross the community.	• Drivers forced to slow down while sharing the road with pedestrians • Parking for parents eliminated • Natural implements increase aesthetics of area for kids • No jaywalking when the whole road is accessible to pedestrians • Student can modify the area to fit exactly into what the kids find safe and inviting • Turning the area into a park will make it a destination for kids at the school and in the community to socialize, play, and be active.	• Expensive • People living on the street have reduced road access in front of their house. • If designed poorly, or drivers do not respect the shared zone, can turn into a more dangerous design • May discourage active transportation if perceived as more dangerous by parents and/or children

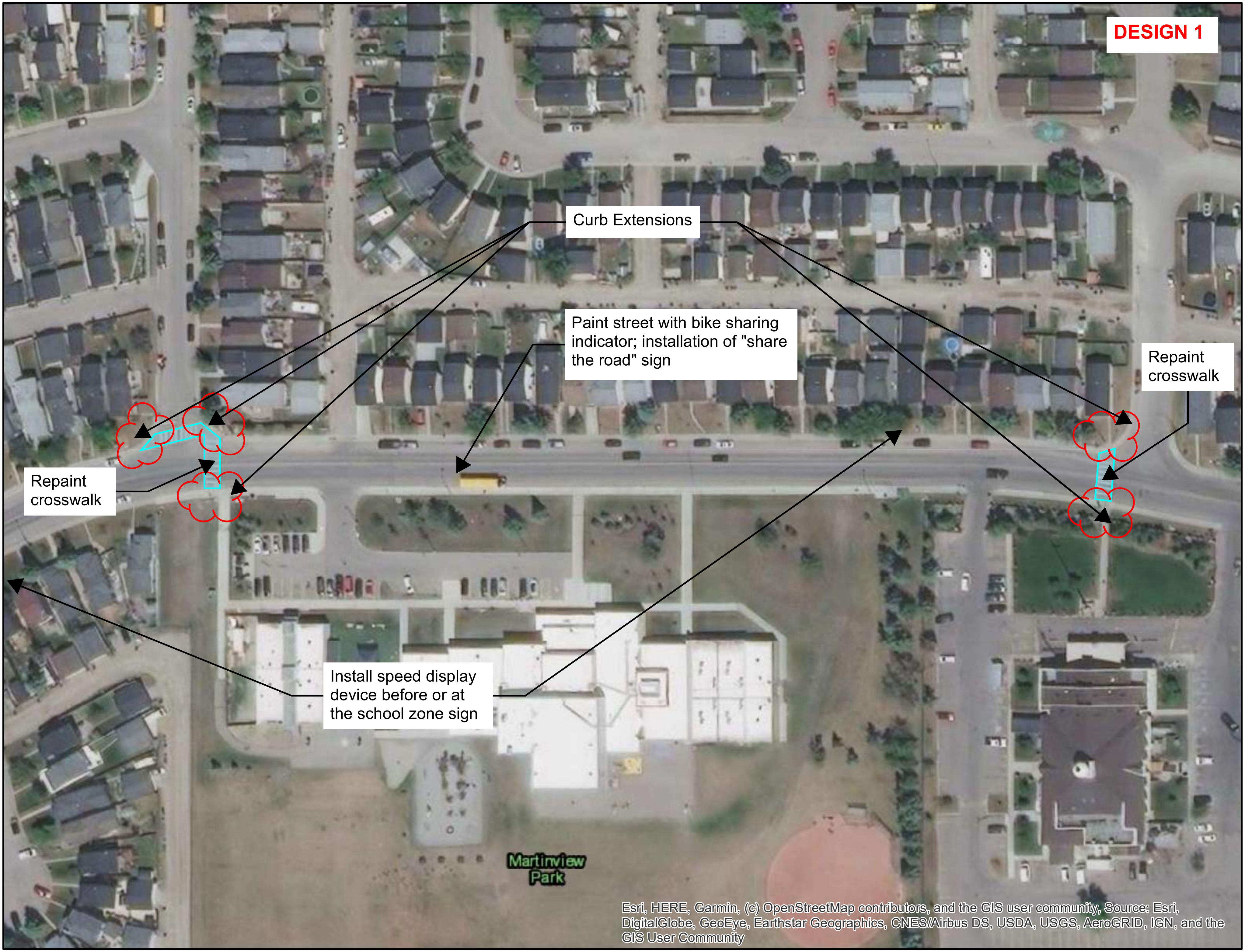
REFERENCES

NACTO – Designing Streets for Kids

City of Calgary Policies: Traffic Calming (2010), Bicycle Policy and Needs (2008), Pedestrian Policy (2008)

City of Calgary Design Guide for Subdivision Servicing (2014)

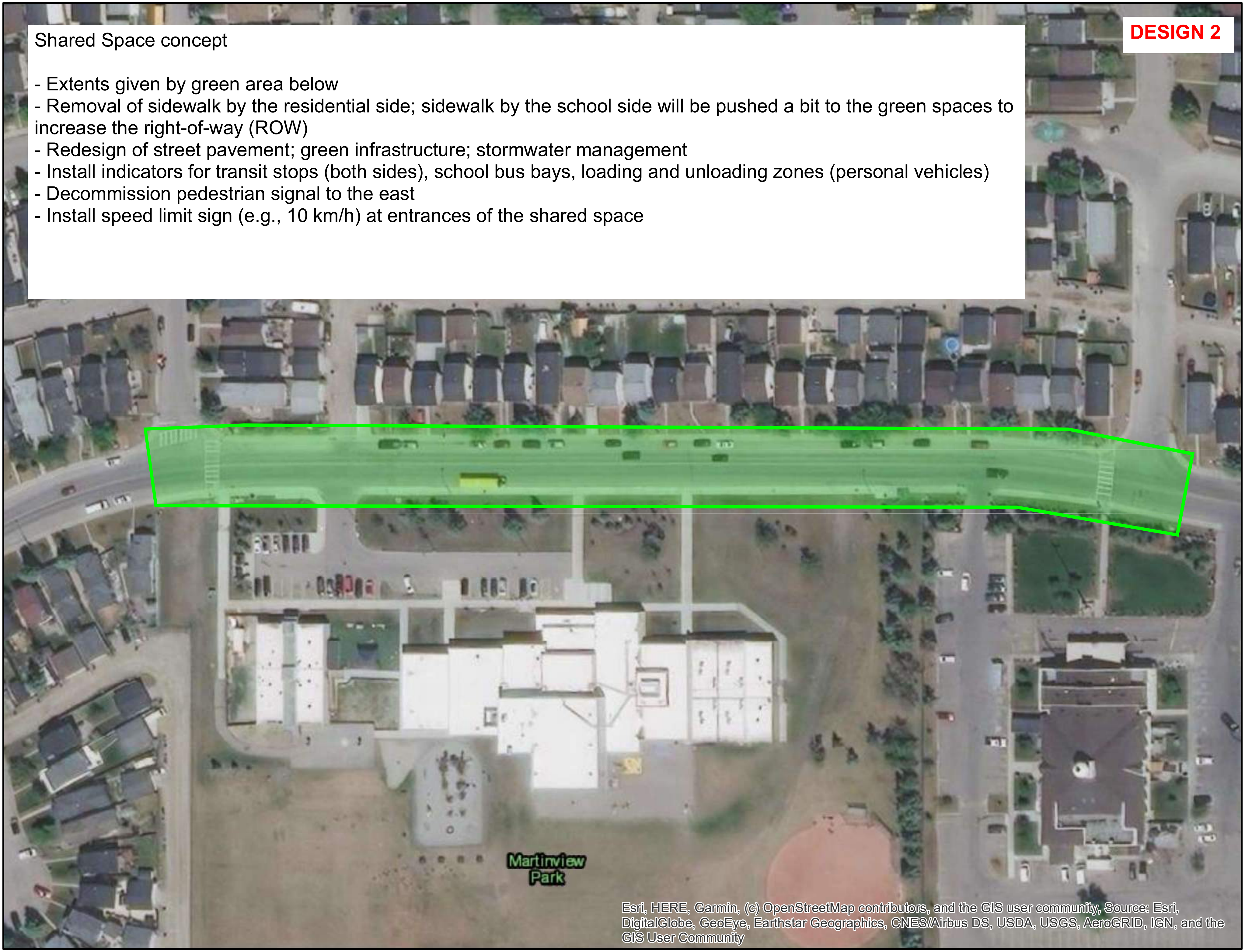
ITE Traffic Calming Measures


DESIGN 1
Curb Extensions
Paint street with bike sharing indicator; installation of "share the road" sign
Repaint crosswalk
Repaint crosswalk
Install speed display device before or at the school zone sign
Martinview Park
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

DESIGN 2

Shared Space concept

- Extents given by green area below
- Removal of sidewalk by the residential side; sidewalk by the school side will be pushed a bit to the green spaces to increase the right-of-way (ROW)
- Redesign of street pavement; green infrastructure; stormwater management
- Install indicators for transit stops (both sides), school bus bays, loading and unloading zones (personal vehicles)
- Decommission pedestrian signal to the east
- Install speed limit sign (e.g., 10 km/h) at entrances of the shared space



DESIGN 3

Pedestrian Lights
Curb Extensions
Flashing 30km/hr sign
Flashing 30km/hr sign
Pedestrian Lights
Curb Extensions
Sidewalk Mural
The City of Calgary

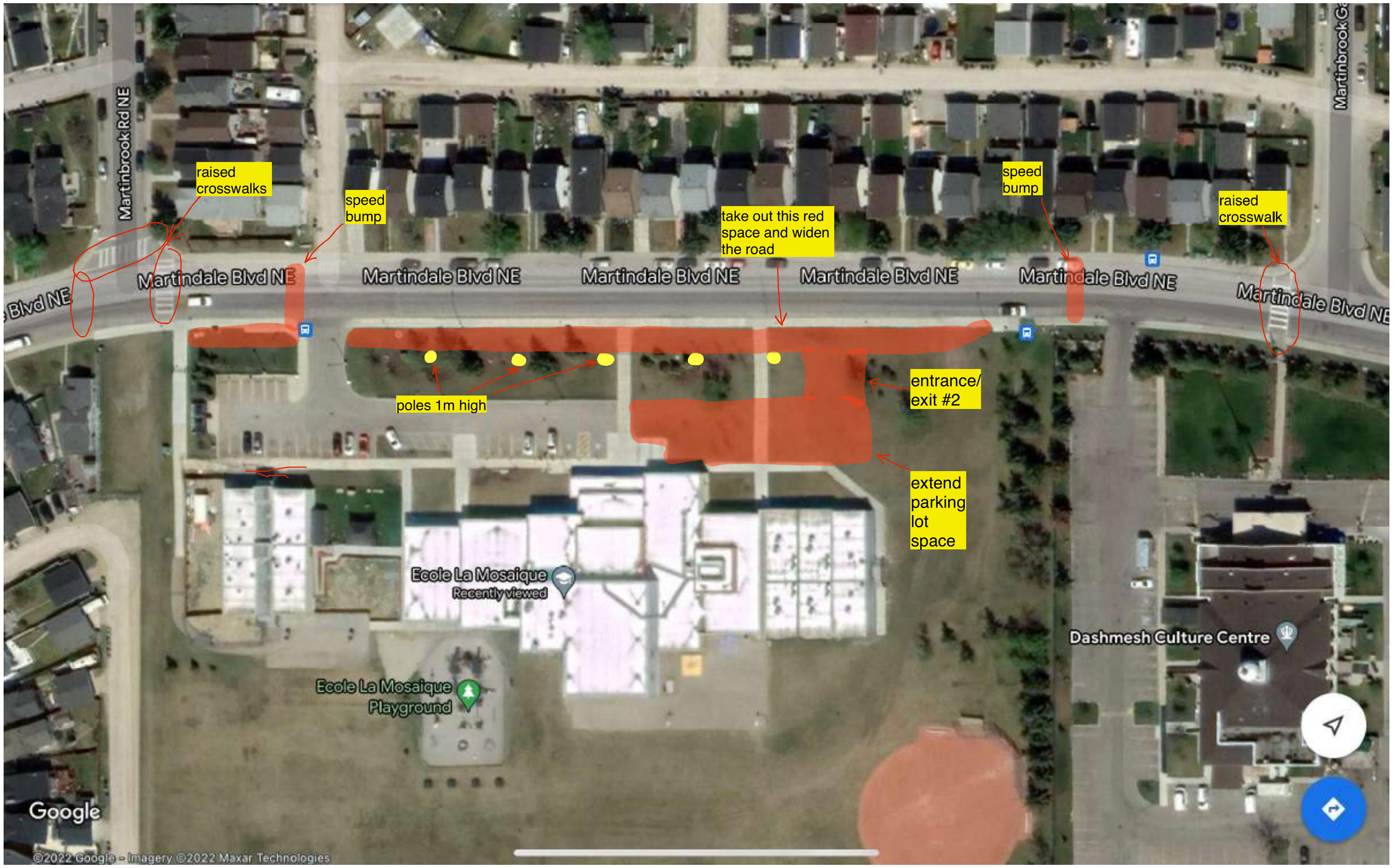
DESIGN 4

Raised Crosswalk
Flashing 30km/hr sign
Flashing 30km/hr sign
Raised Crosswalk
Sidewalk Mural
The City of Calgary

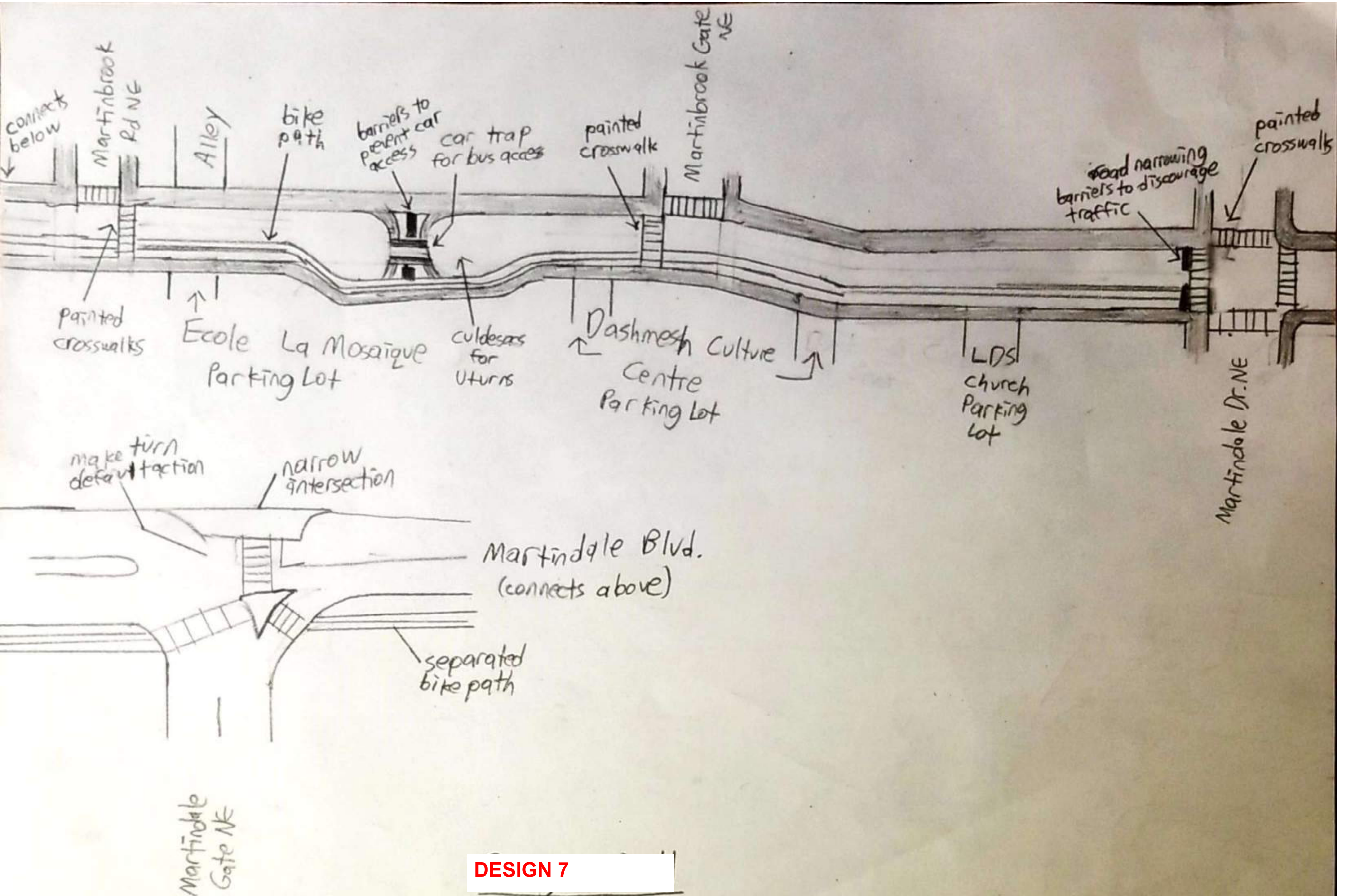
DESIGN 5


Speed Cushions
Flashing 30km/hr sign
Midblock Crosswalk
Flashing 30km/hr sign
Speed Cushions
Sidewalk Mural
The City of Calgary

DESIGN 6

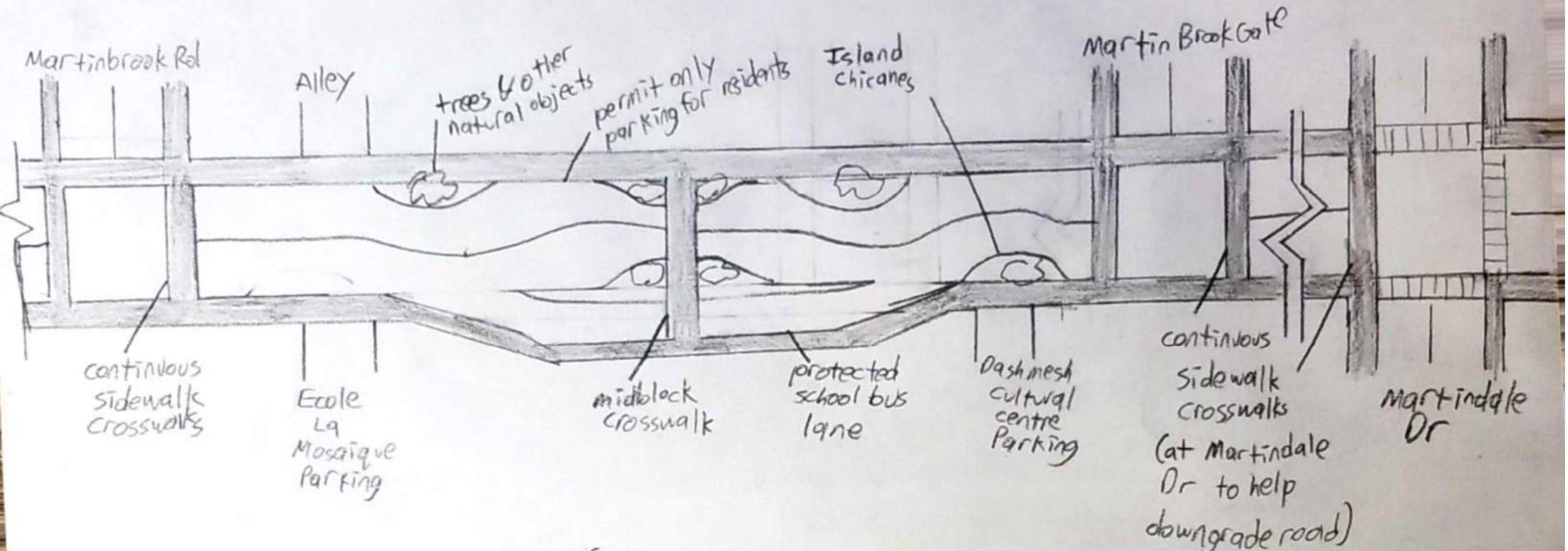


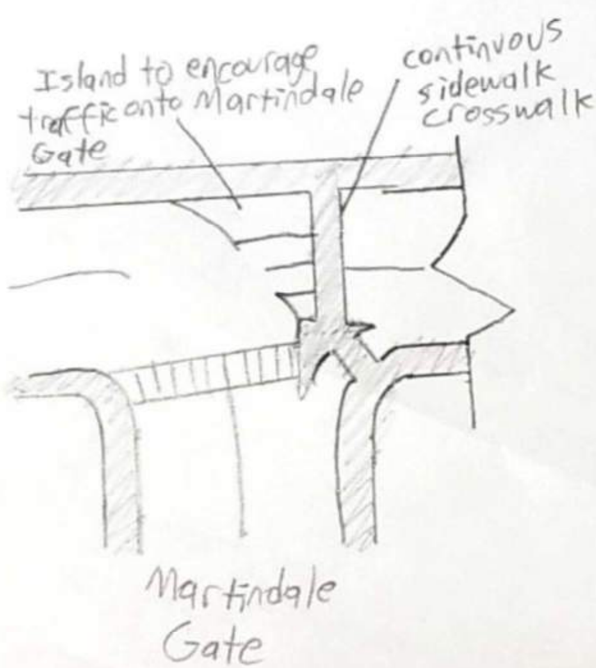
raised crosswalks
speed bump
take out this red space and widen the road
speed bump
raised crosswalk
Martinbrook Rd NE
Martinbrook Ga
Blvd NE
Martindale Blvd NE
Martindale Blvd NE
Martindale Blvd NE
Martindale Blvd NE
Martindale Blvd NE
Martindale Blvd NE
entrance/ exit #2
poles 1m high
extend parking lot space
Ecole La Mosaique
Recently viewed
Ecole La Mosaique Playground
Dashmesh Culture Centre
Google
©2022 Google · Imagery ©2022 Maxar Technologies



DESIGN 7

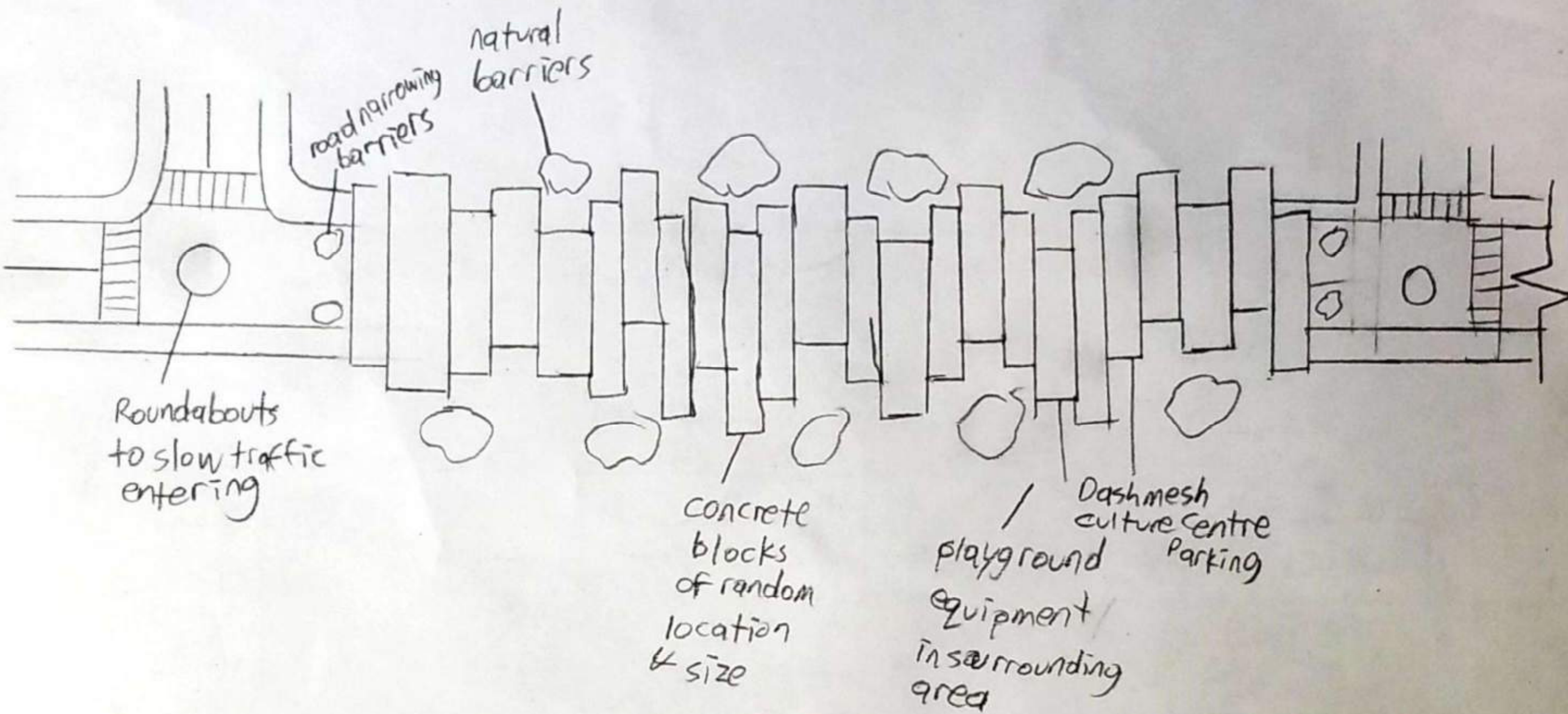
Through Traffic Barrier





DESIGN 8

Chicanes & continuous sidewalks



Martindale Dr
& Martindale Gate:
same redirection
barries as Option
4 or 5

DESIGN 9 Shared Space Street

Meridian (OBK Islamic School) Conceptual Design Ideas and Components

OBK existing in the industrial park Meridian, east of central Calgary, poses a unique problem for encouragement of low carbon trips to school. Schools existing in residential neighbourhoods typically will have children from that neighbourhood or nearby accessing that school, whereas this is not necessarily the case for OBK. Due to this constraint, our designs will primarily focus on designing the link between the school to the nearest LRT station, Franklin Station. This will hopefully encourage students to utilize the public transportation system in combination with walking and biking to commute to and from OBK.

Figure 1

Following is a list of different conceptual design idea components, along with a description and visuals for further understanding. These concepts can work in combinations with one another, as well as replacements or additions of one another. For example, *Concept No. 7* could exist in every combination of design, whereas *Concept No. 9* and *Concept No. 10* would not exist together and rather be in replacement of one another.

Concept Idea No. 1 – Alter Franklin LRT Station Park and Ride Lot

Figure 2

Converting the Franklin LRT Station parking lot to allow for a diagonal crosswalk for walking and biking, as seen in *Figure 1*. This crosswalk creates a short cut for users to reach the school. Grass and trees on either side to create a sense of "protection." There could be benches and activities along this crossing as well.

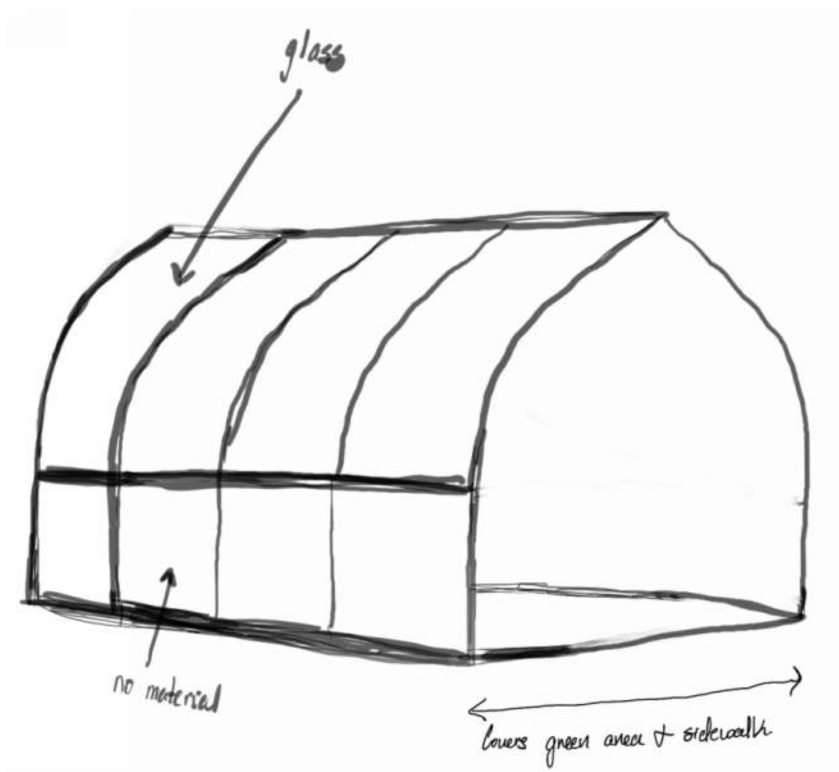
Some parking stalls would be removed or converted to accommodate the new path created. Reconfiguration of the parking stalls would be required. Angled parking could potentially be used along the path or throughout the lot. A combination of parking stall configurations could also be entertained. Additionally, an additional entrance will be made to allow access to the right side of the parking lot. This can be seen in *Figure 2*.

Figure 3

Additionally, off the ramp from the bridge of the LRT station, a wider sidewalk could be implemented by removing some stalls. This would further separate users from the incoming buses/personal vehicle traffic. This area can be seen in *Figure 2* in the pink lines.

Concept Idea No. 2 – Reallocate One End of Park and Ride Lot to be a Greenspace

This idea involves the reallocation of some space in the current Park & Ride Lot to be converted to a greenspace. This could have a pathway providing access from the station to 2nd Avenue. It could also include a garden with benches, to provide a place to rest and play. Following are sketches of potential shelters that could be built for this area, to protect children and people of all ages, from the outdoor elements during all seasons. These shelters prevent snow fall from disrupting the green space below.



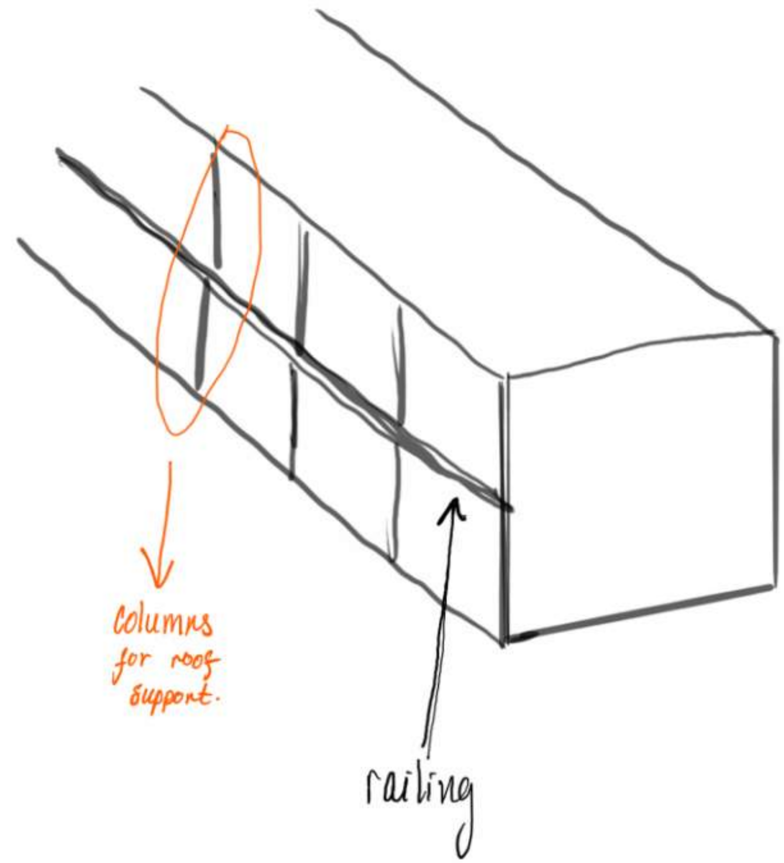


Figure 4

Concept Idea No. 3 – Utilize Shared Space at Specific Times of the Day with Restaurants adjacent to Park and Ride Lot

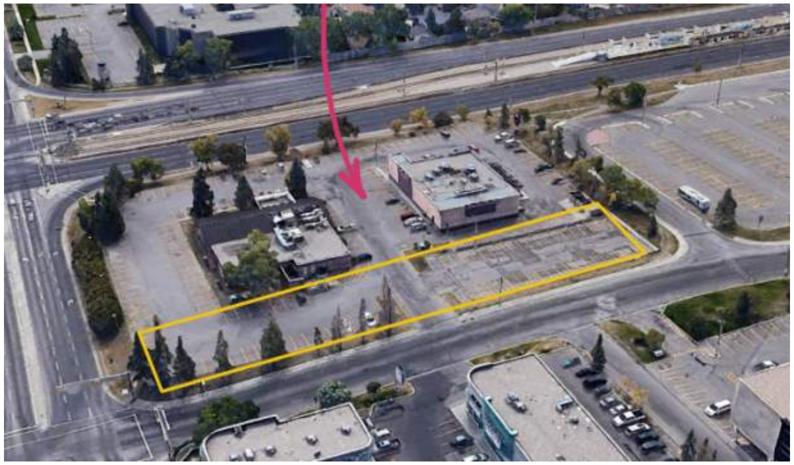


Figure 5

Figure 5 shows parking stalls from the restaurants adjacent to the Park & Ride Lot, Boston Pizza and Swiss Chalet, that could be used as additional parking for the Park & Ride if the catwalk has been implemented. The restaurants are open from 11am-10pm so the parking spaces could be used for transit users from 5am-6pm when the restaurants are less busy.

Concept Idea No. 4 – Painted Crosswalk with Blinking Sign across 2nd Avenue

Figure 6

Figure 6 shows crosswalks leading from the LRT station towards the back alley of the school that could be used as a catwalk.
These crosswalks could incorporate combinations of the following components:

"Ladder" style crosswalks are commonly used around elementary schools because they are more visible. "Pedestrian corridors" to allow users walking and biking to have the right of way when they activate the lights. According to the Complete Streets policy, the Rectangular Rapid Flash Beacons (RRFB) are solar-powered and use LED lights and are less costly to install and operate.

Celia mentioned that curb extensions were rejected on 2nd Ave due to its designation as a collector road. However, if there were any way around this, we would suggest them on the exit of the Park & Ride and at the intersection of 28th St and 2nd Ave.

Additionally, raised crosswalks allow for small children to be raised a couple inches for increased visibility. This aligns with the NACTO *Designing Streets for Kids* Guideline principle to "think from 95 cm." Children are short and experience their surroundings closer to the ground, making them less visible to drivers. Raised crosswalks not only force drivers to slow down but allow for children wanting to cross the street be more visible.

A mid-block crosswalk was also rejected based on warrants for 2nd Ave but if there is any way around this, we think it would be beneficial to have one connect to the back alley leading towards the school that could potentially act as a catwalk.

Lastly, adequate lightning at both crosswalks would be essential as in the Fall and Winter, the mornings are quite dark and it will be difficult to spot road users.

Concept Idea No. 5 – Construct Sidewalk on 28th Street Southbound

Currently, a 2.5 m monowalk exists on the northbound section of 28th St. that passes the school. As there is no sidewalk on the southbound section of the street that is directly adjacent to OBK school, ideally, one potentially could be constructed for safe walking access to the school.

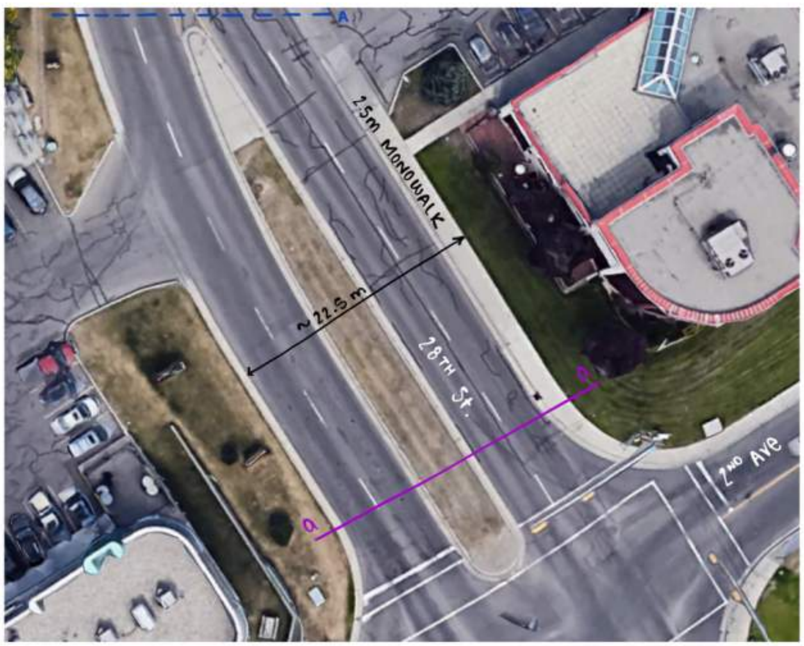


Figure 7

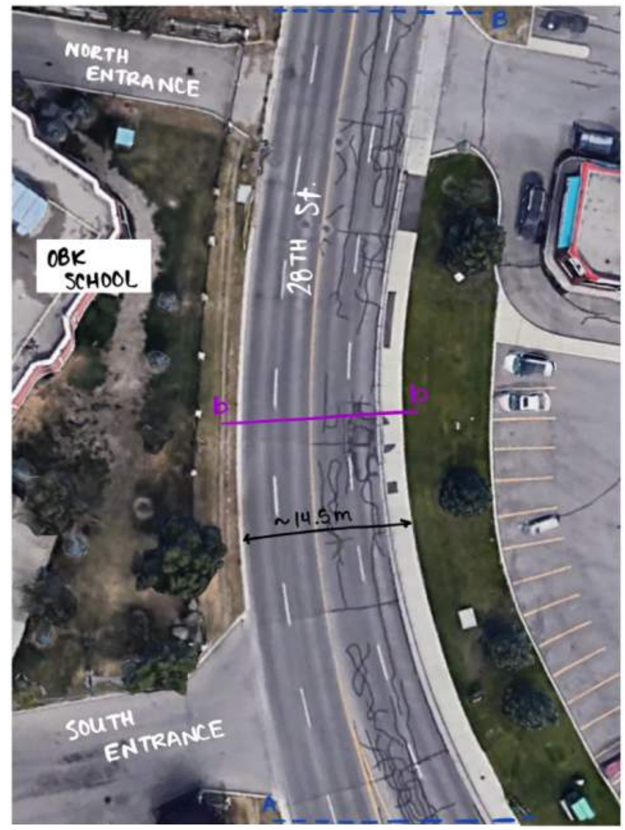
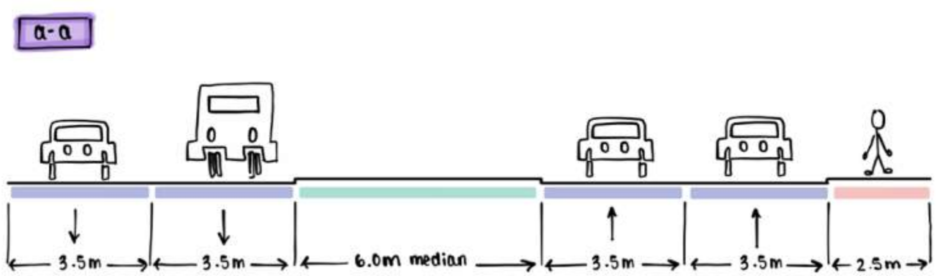
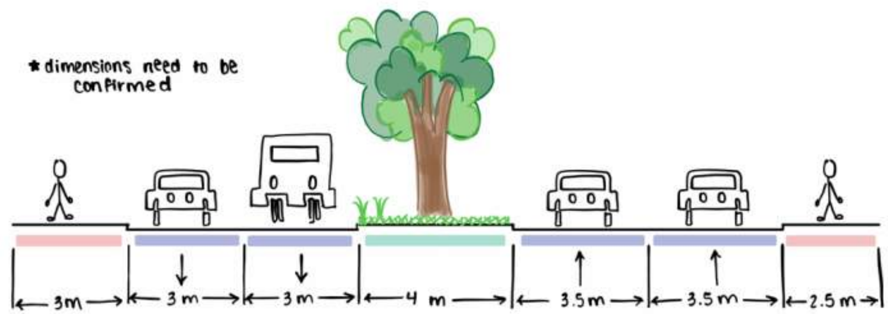
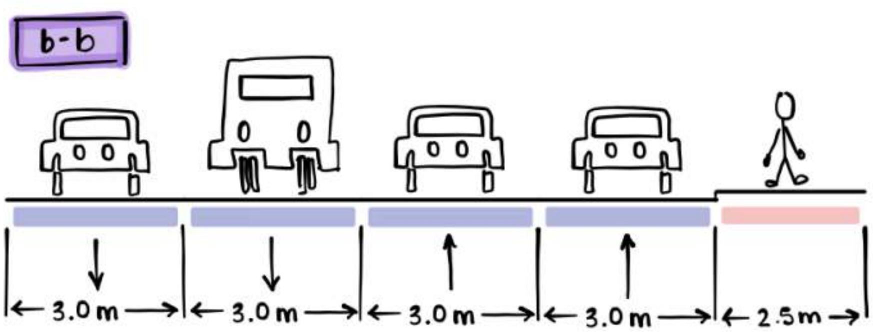
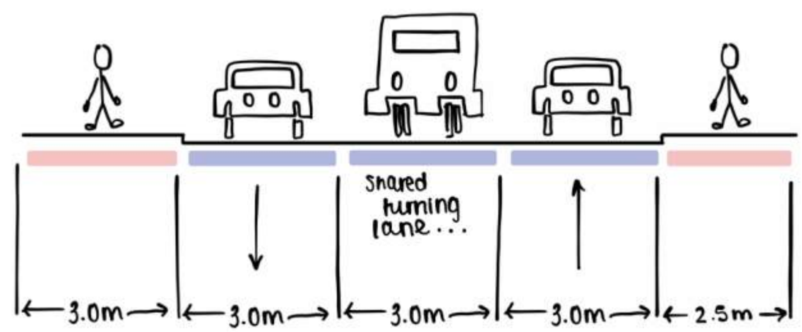


Figure 8

Following in *Table 1* with existing and potential cross-sections of 28th Street if a 3.0 m monowalk was to be constructed on the southbound end. These potential cross-sections are preliminary as dimensions have not been confirmed to properly align with adjacent intersections and the street. If this design concept is to be further pursued the constructability and feasibility will be analyzed.

Table 1: Preliminary Visuals of Existing and Potential Cross-Sections

Existing (Approximate) Cross-Sections of 28th Street	Potential Proposed Cross-Sections of 28th Street
	
	

Another aspect to take note of is the potential to have this proposed southbound monowalk to be extended all the way to Centre Ave, north of OBK. This would be beneficial as continuous sidewalks will further promote walking in the area. If this is not possible, the monowalk should at least reach the south entrance of the OBK school to provide access to this key destination.

Concept Idea No. 6 – Fix Median Obstructing Crosswalk at 28th Street and 2nd Avenue Intersection (AN ABSOLUTE MUST…)

Figure 9

Concept Idea No. 7 – Painted Crosswalks at 28th Street and 2nd Avenue Intersection

The crosswalks at the intersection of 28th Street and 2nd Avenue could be redesigned to have fun and colourful paint, while still having clearly defined features of a crosswalk. The crossing of 2nd Avenue on the southbound side of 28th Street would be most pertinent to be painted, as this is most likely the crossing to be utilized to approach OBK from the Franklin Station. Although ideally all four crosswalks at this intersection would be painted bright colours to stand out. This intersection has a decent amount of traffic daily, as it belongs to one of the main streets existing in the industrial park and is directly off Memorial Drive. There is potential to have art in this area as a staple to the area, with hopes to encourage children and caregivers to walk and bike in the area.

Concept Idea No. 8 – Access Decommissioned Spur Line for Path to OBK

The CP Rail abandoned line exists directly behind OBK property and can provide another access route from the Franklin LRT Station. This would require a redevelopment of this portion of the tracks, along with the addition of some crosswalks on 2nd Avenue to ensure that children are able to safely cross the road and access the area. Crosswalks would follow similar ideas to those present in *Concept Idea No. 4*. Adequate lighting would be necessary to provide a feeling of safety in this isolated area.

Additionally, from the LRT Station bridge, a redesigned sidewalk could go along the designated bus entrance.

Figure 10

Concept Idea No. 9 – Transform Back Alley Exit from OBK into Catwalk for Walking & Biking Only

Figure 11

The idea here is to convert the back alley into a catwalk where students coming from the LRT Station can walk and feel safe as they are removed from the heavy traffic of 28th St. This catwalk could potentially lead into an area of repurposed parking lot – now a tarmac. There could be basketball hoops, hopscotch, tetherball, and other activities in this area for students to play and hangout.
To separate the parking lot and the tarmac there could be a small picket fence or something similar.

This new tarmac would connect easily to the playground and the new field that has been put in.

Additionally, median walkways can be put in on either side of the staff parking to allow people to walk towards the school without traversing the parking lot.

From there, elevated ladder crosswalks with patrollers would lead staff and students towards the school.

The cars would enter from the North entrance and circle around and drop their kids off in front of the school before exiting through the south entrance. Other options would be for parents to drop their kids off on 2nd Ave so they could come into school grounds using the catwalk. This would hopefully limit the number of parents circling within the parking lot potentially causing distress for people walking towards the school.

Concept Idea No. 10 – Reallocate South Entrance of OBK Parking Lot for Walking & Biking Only

Figure 12

The south entrance to the school would be blocked from any vehicle traffic and be solely dedicated to students and caregivers that are walking and biking. This would hopefully be accompanied by a tarmac that would serve as a safe meeting and play area for students permanently. This is highlighted in blue in *Figure 12.*

Vehicles and school buses would enter from the north entrance and exit through the back alley currently used. This would be a one way to eliminate and confusion. Space for drop-off and pick-up would efficiently be allocated, with the potential to have caregivers enter designated lanes to in the parking lot to minimize congestion.

This concept design would benefit from a combination with *Concept Design No. 5*, as the students would be accessing the front of school by foot or bike. This requires a safe and encouraging path up 28th Street, delineated by the highlighted purple area in *Figure 12.*

Concept No. 7 would also combine well with this design component.

An alternative to the tarmac could be some space reallocated to greenspace, accompanied with the planting of trees.

The 10 conceptual design components described above have unique advantages and disadvantages. These are discussed in the table below:

Concept Idea No.	*Advantages*	*Disadvantages*
1	- Encourages use of Public Transit - Creates a shortcut and safe space cutting through the parking lot	- Eliminates parking stalls that could be used for those using the Park & Ride
2	- Provides an attraction to the LRT Station - A place to gather	- Could be difficult and costly to maintain
3	- Makes up for stalls lost in Concept Idea No.1 - Allows for the Park & Ride to be retrofitted	- Assuming Boston Pizza and Swiss Chalet would be willing to give up a good portion of their parking space for the Park & Ride
4	- Provides safe routes for students to get from the Franklin Station to the school - Enhanced safety may encourage more students to use public transit	- Current warrants and road designations that prevent mid-block crosswalks from being installed on 2nd Ave
5	- Provides a safe route for students to enter school grounds, close to the school's entrance so they avoid contact with cars - Redistributes median width to sidewalk to allow more space for students to walk without being too close to traffic	- Children are exposed to higher traffic volumes along 28th St - Potential issues with the alignment of lanes
6	- Removes tripping hazard - Provides island in middle of crosswalk for users, allowing crossing to happen in two stages - Safest and most adaptable engineering tool for improving street crossings	
7	- Artistic and aesthetic element, engaging and inviting for children - Catches the eye	- Primarily aesthetic element over safety and/or redesign - Necessary to be in combination with other components
8	- Scenic route is highly possible - Secluded area safe from any traffic for large portion of trip	- Long (roundabout) distance to OBK
9	- Proposed tarmac area connects to existing playground and field - Efficient path from train station to school via proposed catwalk	- Students would have to cross vehicle path to get to from tarmac to school
10	- Students staying in the tarmac area do not have to cross vehicle paths to go to and from the school and designated tarmac area - Can utilize existing signals at intersection for crosswalk	- Tarmac not connected to existing playground/grass area - Parking lot capacity reduced - Longer walking distance along 28th Street than other options

LEGEND

- TREE
- TABLE
- BENCH
- GREEN SPACE
- CONCRETE SIDEWALK

REVISIONS

NO.	CONCEPTUAL DESIGN NUMBER TWO	DATE (2022/02/24)	A.Z.

DRAWN BY: A.Zambrano

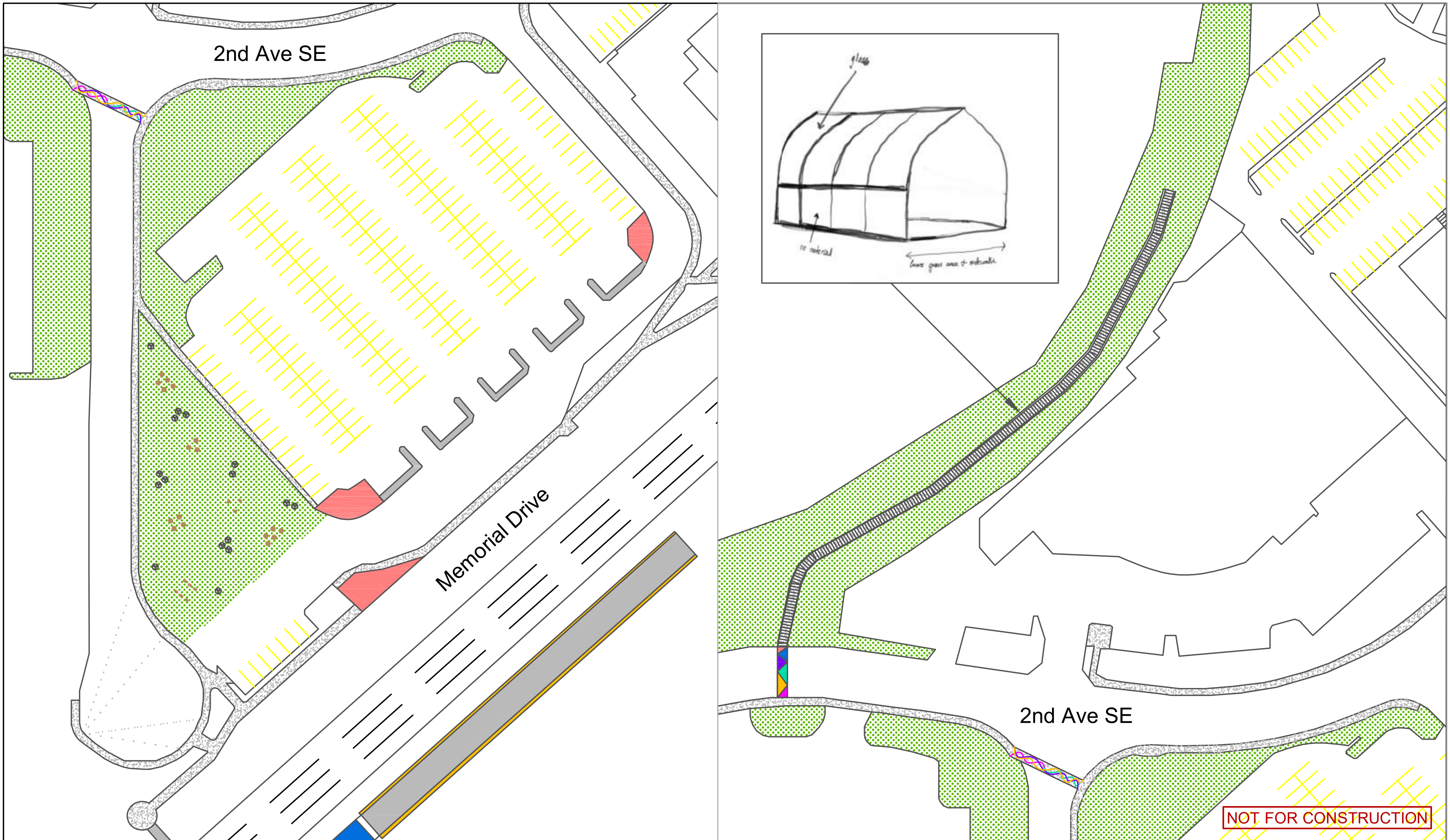
DESIGNED BY: A.Zambrano

CHECKED BY: A.Ambrogiano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

DESIGN OPTION #2



LEGEND

- TREE
- TABLE
- BENCH
- GREEN SPACE
- CONCRETE SIDEWALK

REVISIONS

NO.	CONCEPTUAL DESIGN NUMBER THREE	DATE (2022/02/25)	AZ

DRAWN BY
A.Zambrano

DESIGNED BY
A.Khan

CHECKED BY
S.Subedi

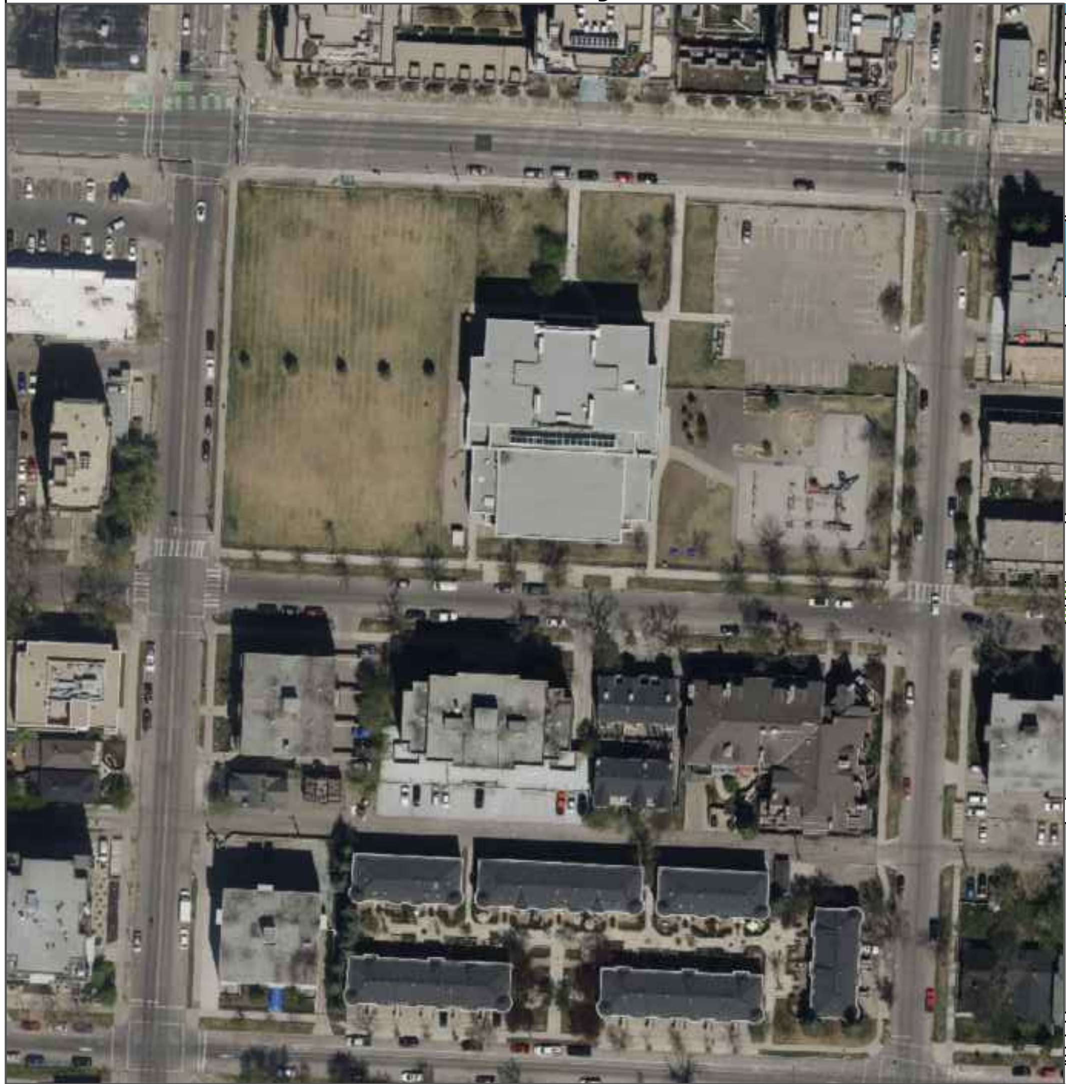
ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

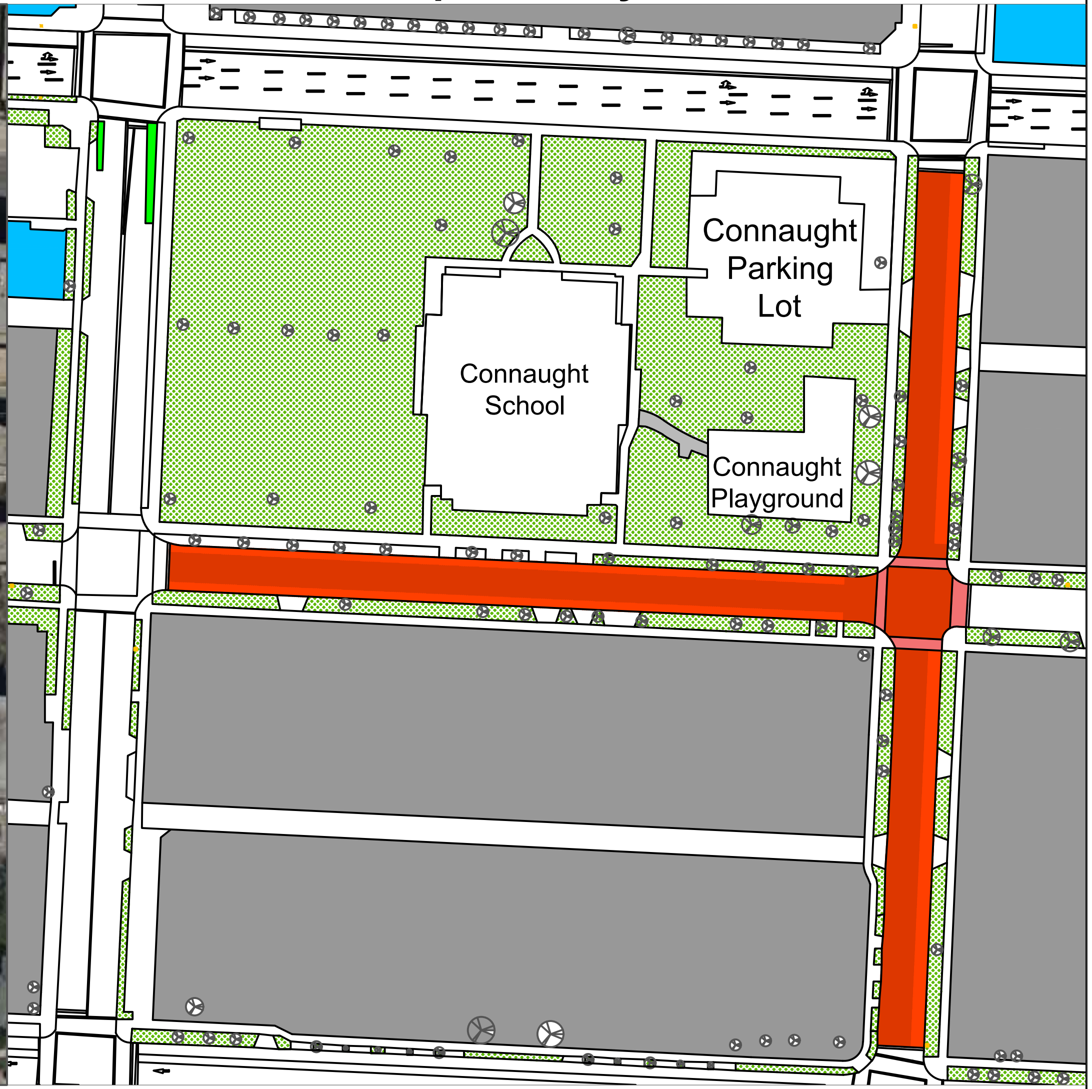
DESIGN OPTION #3

Appendix B – Beltline Final Design Package

Current Layout



Proposed Layout



NOT FOR CONSTRUCTION

LEGEND

- Bike Lanes
- Commercial Space
- Residential Space
- Sidewalk
- Trees
- Traffic Signs
- Green Space
- Shared Street
- Marked Parking Lanes

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
2	FINAL DESIGN	2022/03/16	S.O.
1	50% DESIGN	2022/03/10	S.O.

N

1:1600

DRAWN BY
Sutton Olmstead

DESIGNED BY
Strahinja Radakovic

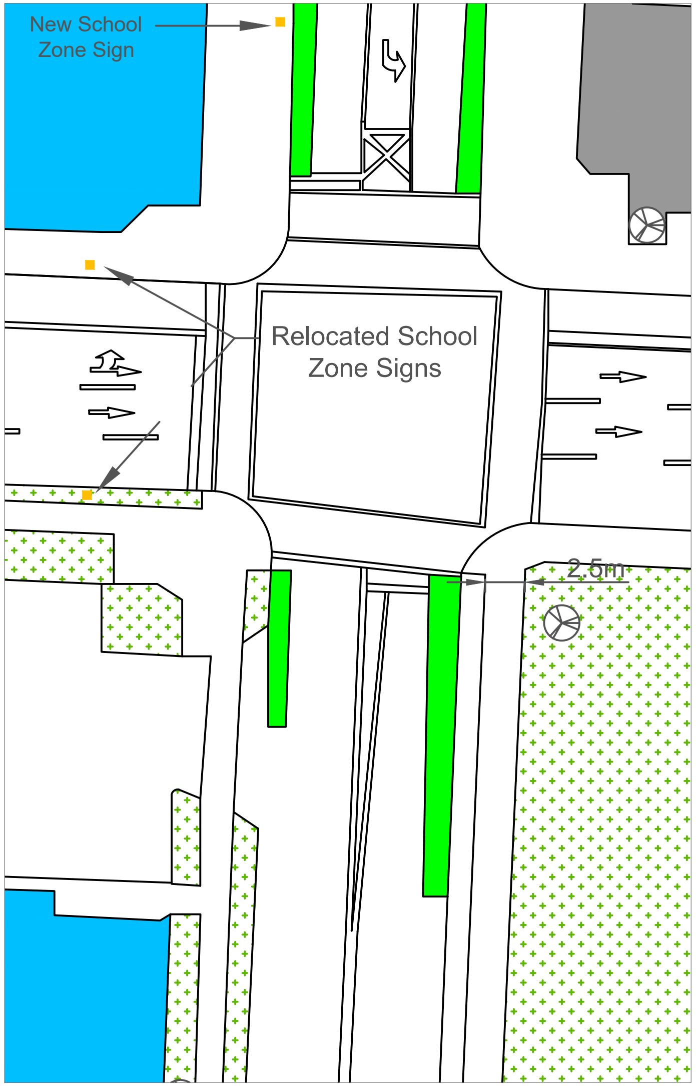
CHECKED BY
Strahinja Radakovic

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

Connaught School - Beltline Area

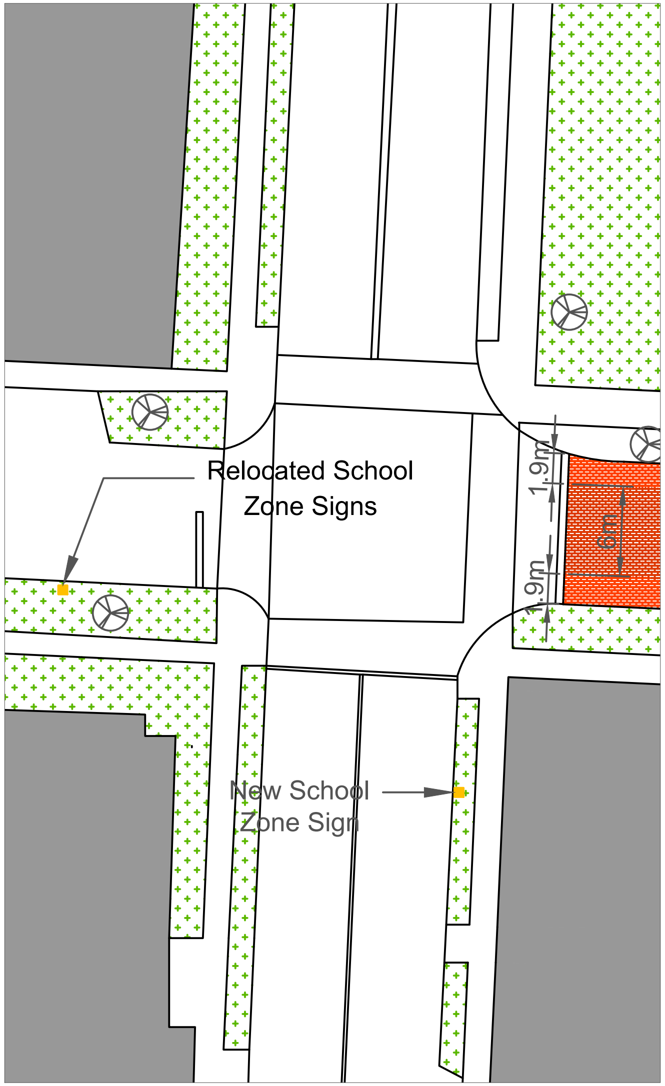
Proposed Site Layout

11th Street and 12th Avenue Changes



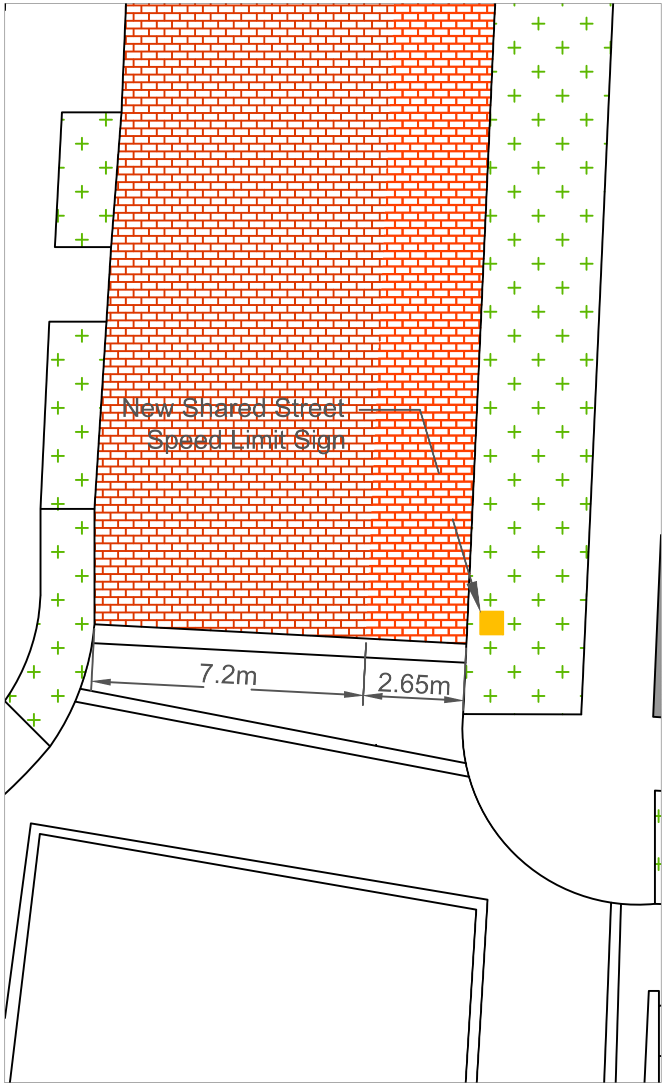
1:500

11th Street and 13th Avenue Changes



1:500

10th Street and 14th Avenue Changes



1:200

NOT FOR CONSTRUCTION

LEGEND

- Trees
- Bike Lanes
- Traffic Signs
- Commercial Space
- Green Space
- Residential Space
- Shared Street
- Sidewalk
- Marked Parking Lanes

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
2	FINAL DESIGN	2022/03/16	S.O.
1	50% DESIGN	2022/03/10	S.O.

N

DRAWN BY
Sutton Olmstead

DESIGNED BY
Strahinja Radakovic

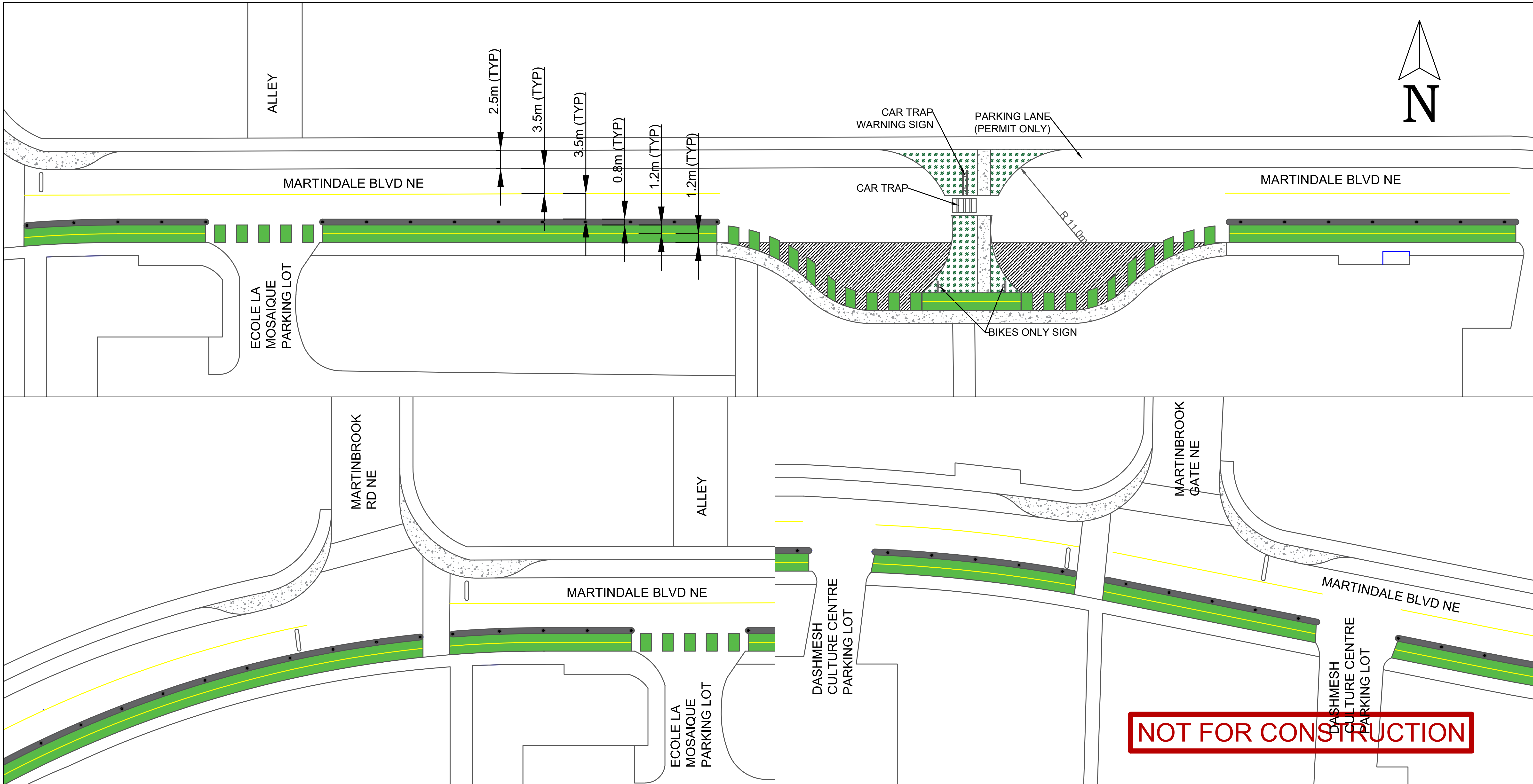
CHECKED BY
Strahinja Radakovic

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

Connaught School - Beltline Area

Proposed Changes Close-ups

Appendix C – Martindale Final Design Package



LEGEND

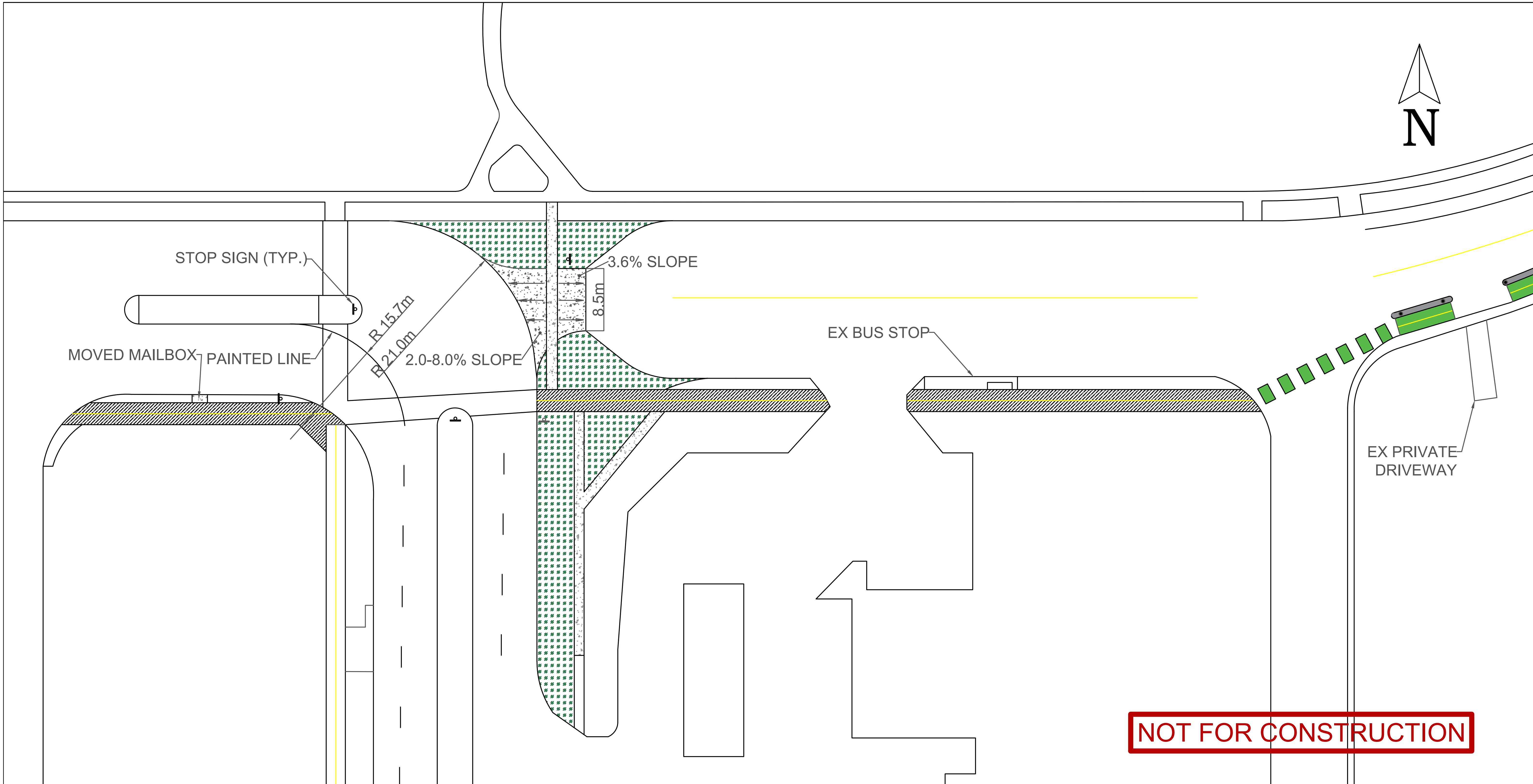
- PROPOSED LANDSCAPING
- PROPOSED SIDEWALK
- PROPOSED ROAD CONCRETE
- PROPOSED SPEED BUMP
- PROPOSED ASPHALT
- PROPOSED BIKE LANES
- PROPOSED BIKE CROSSING
- PROPOSED BOLLARD BARRIER

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
3	80% DESIGN	2022/03/22	I.R.
2	50% DESIGN	2022/03/11	I.R.
1	30% DESIGN	2022/02/04	I.R.
0	CONCEPTUAL DESIGN	2022/02/01	I.R.

DRAWN BY: B. KING
DESIGNED BY: B. KING
CHECKED BY: I. ROMAN

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS
ECOLE LA MOSAIQUE
PROPOSED STREET IMPROVEMENT - PLAN VIEW
(1:500)



LEGEND

PROPOSED LANDSCAPING
PROPOSED SIDEWALK
PROPOSED ROAD CONCRETE
EXISTING MULTI USE PATH
PROPOSED MULTI USE PATH
PROPOSED BIKE LANES
PROPOSED BIKE CROSSING
PROPOSED BOLLARD BARRIER
SLOPE LINE

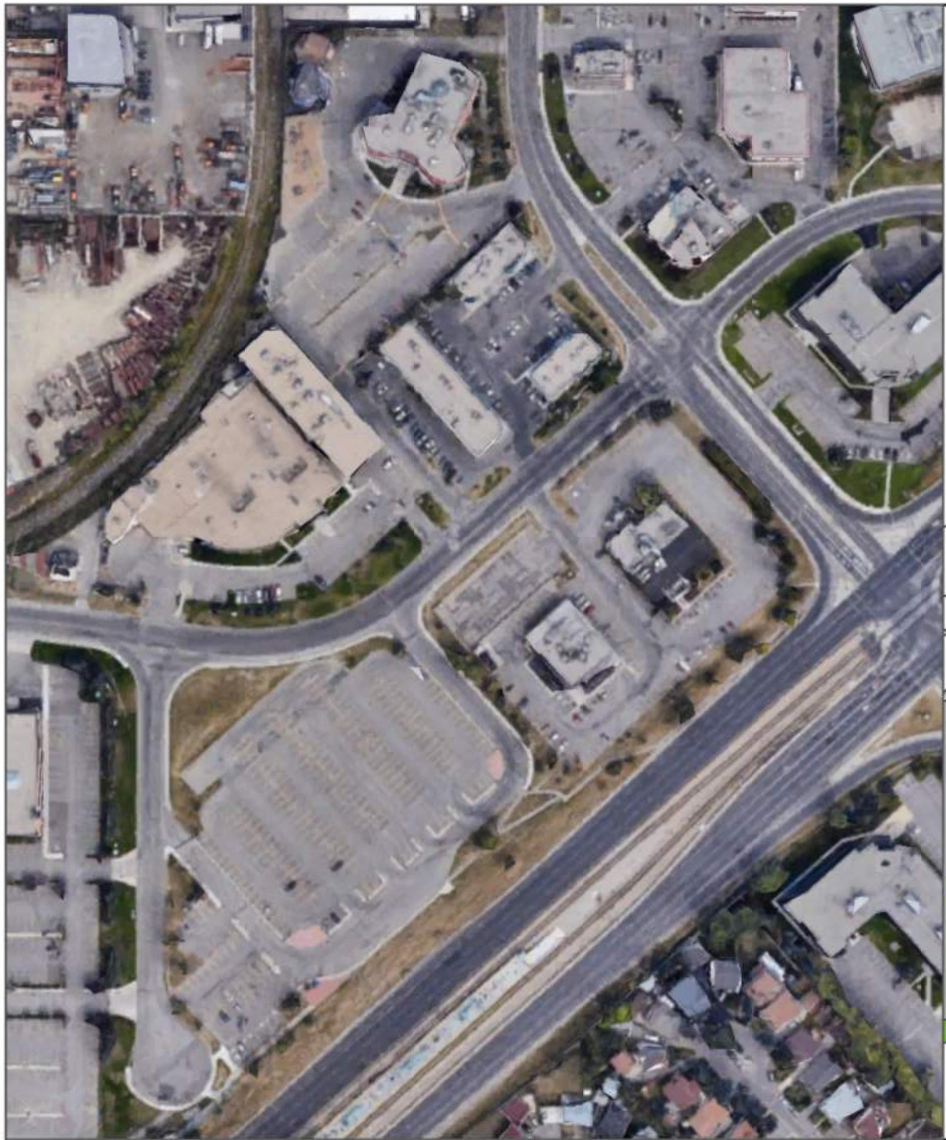
REVISIONS

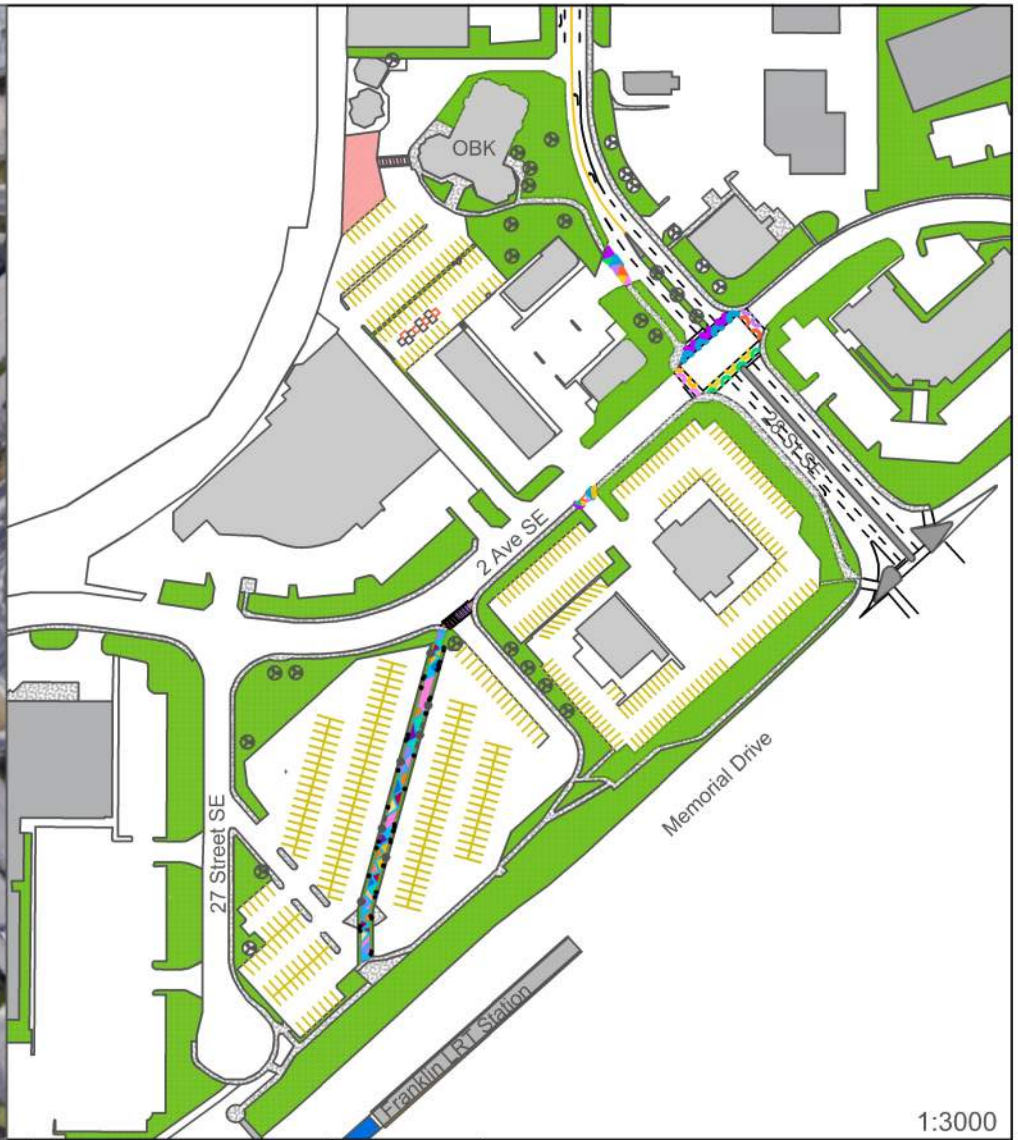
NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
3	80% DESIGN	2022/03/22	I.R.
2	50% DESIGN	2022/03/11	I.R.
1	30% DESIGN	2022/02/04	I.R.
0	CONCEPTUAL DESIGN	2022/02/01	I.R.

DRAWN BY: B. KING
DESIGNED BY: B. KING
CHECKED BY: I. ROMAN

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS
ECOLE LA MOSAIQUE
MARTINDALE GATE / MARTINDALE BLVD DIVERSION
PLAN VIEW (1:500)

Appendix D – Meridian Final Design Package





LEGEND

- CONCRETE SIDEWALK
- PLAYGROUND
- GREEN SPACE
- BUILDING
- TREE

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/15	A.A.
0	50% DESIGN	2022/03/10	A.A.

N

DRAWN BY
A. Ambrogiano

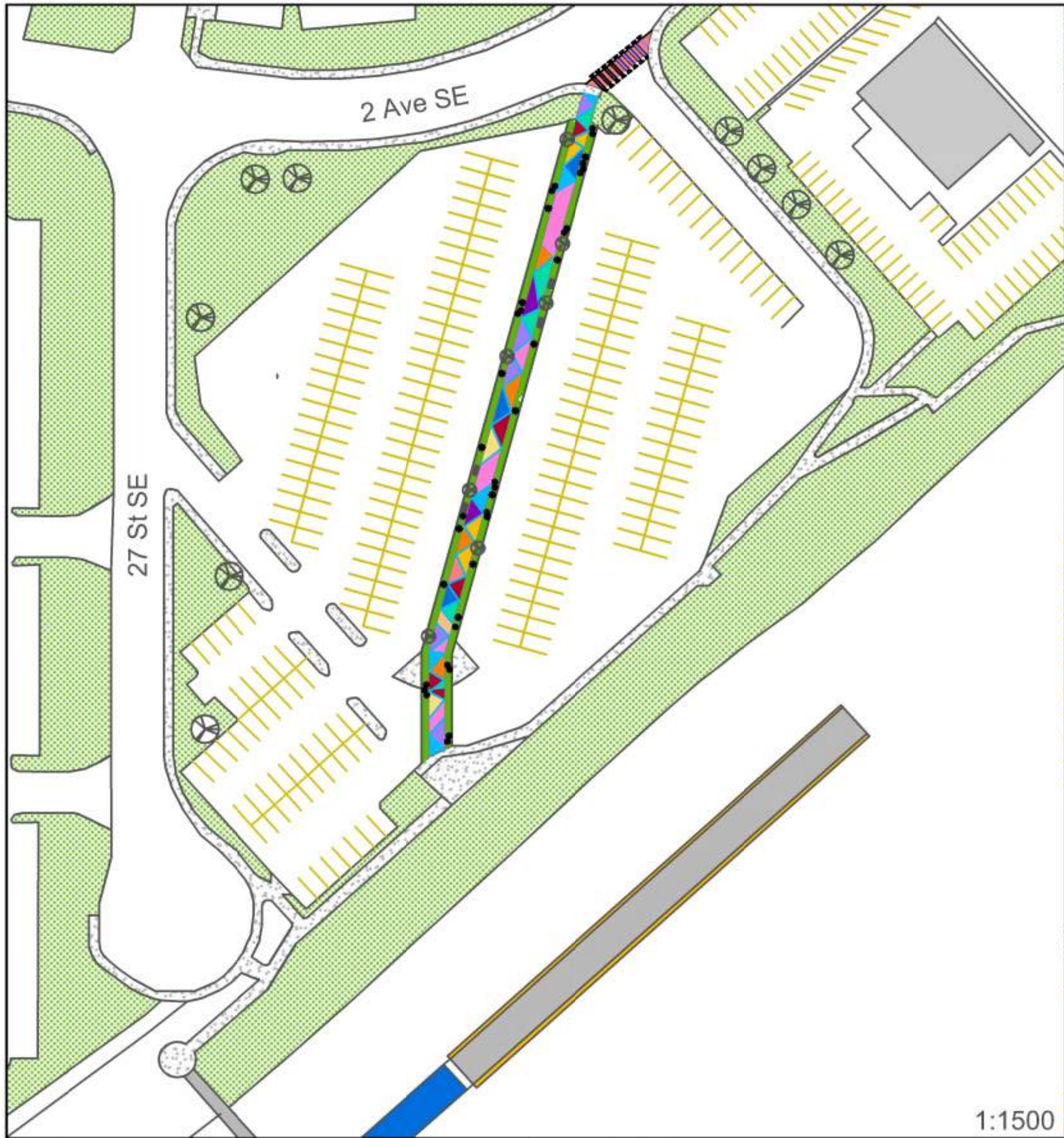
DESIGNED BY
A. Zambrano

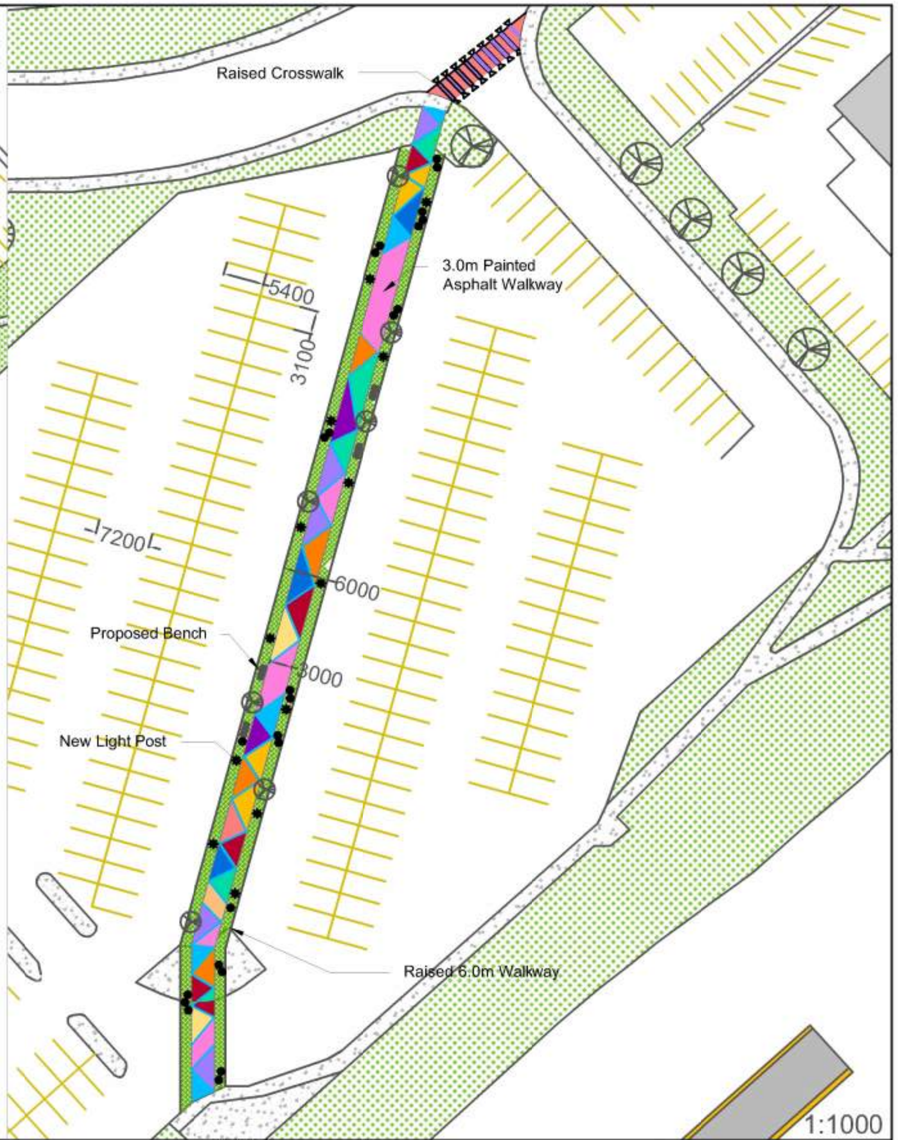
CHECKED BY
A. Zambrano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Proposed Site Layout





LEGEND

- CONCRETE SIDEWALK
- GREEN SPACE
- TREE
- LIGHT
- BUILDING
- VEGETATION

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/15	A.A.
0	50% DESIGN	2022/02/14	A.A.

N

DRAWN BY
A. Ambrogiano

DESIGNED BY
A. Zambrano

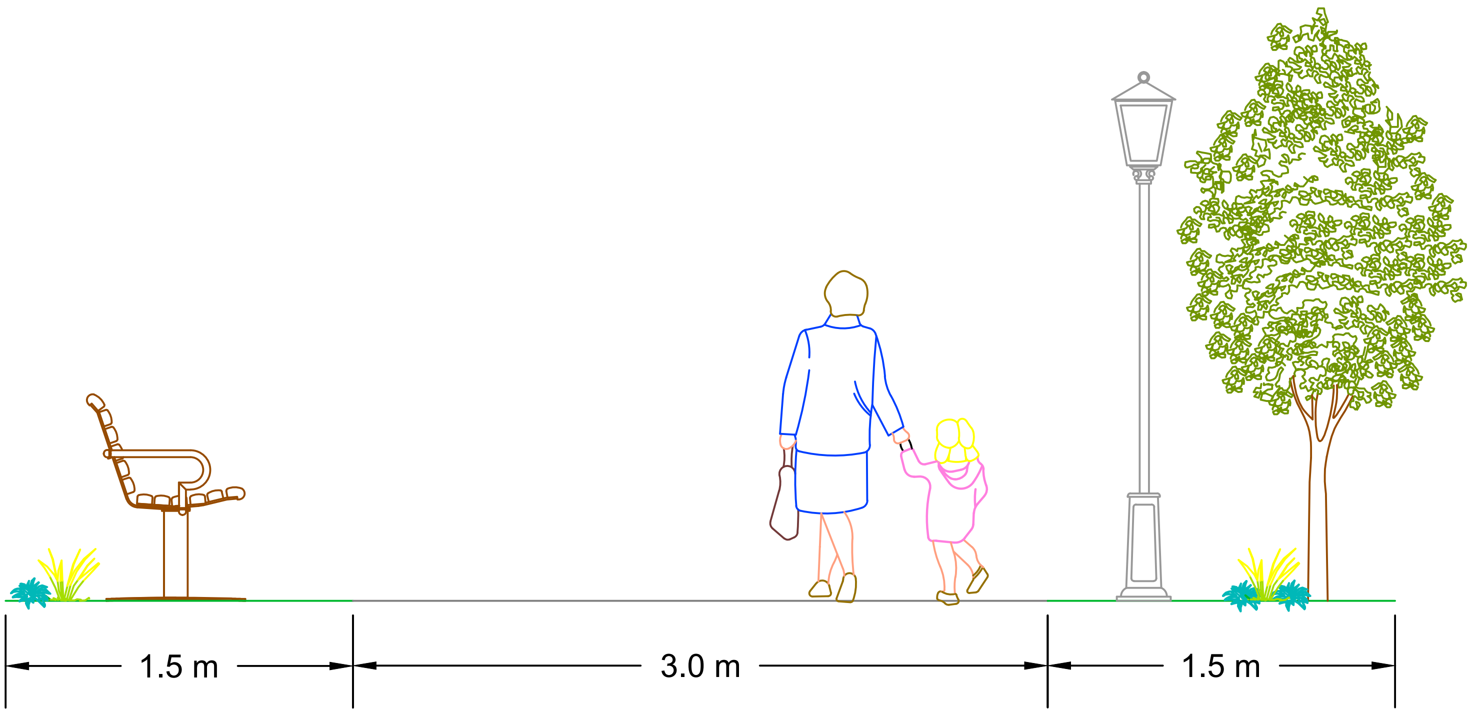
CHECKED BY
A. Zambrano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Franklin Station Park & Ride

Franklin Station Park & Ride Catwalk Crosswalk



Karl Foerester Reed Grass

Blue Oat Grass

Fescue Grass

NOT FOR CONSTRUCTION

LEGEND

REVISIONS

NO.	Franklin Station Park & Ride Catwalk Cross-Section	DATE (2022/03/17)	A.Z.

DRAWN BY
A. Zambrano

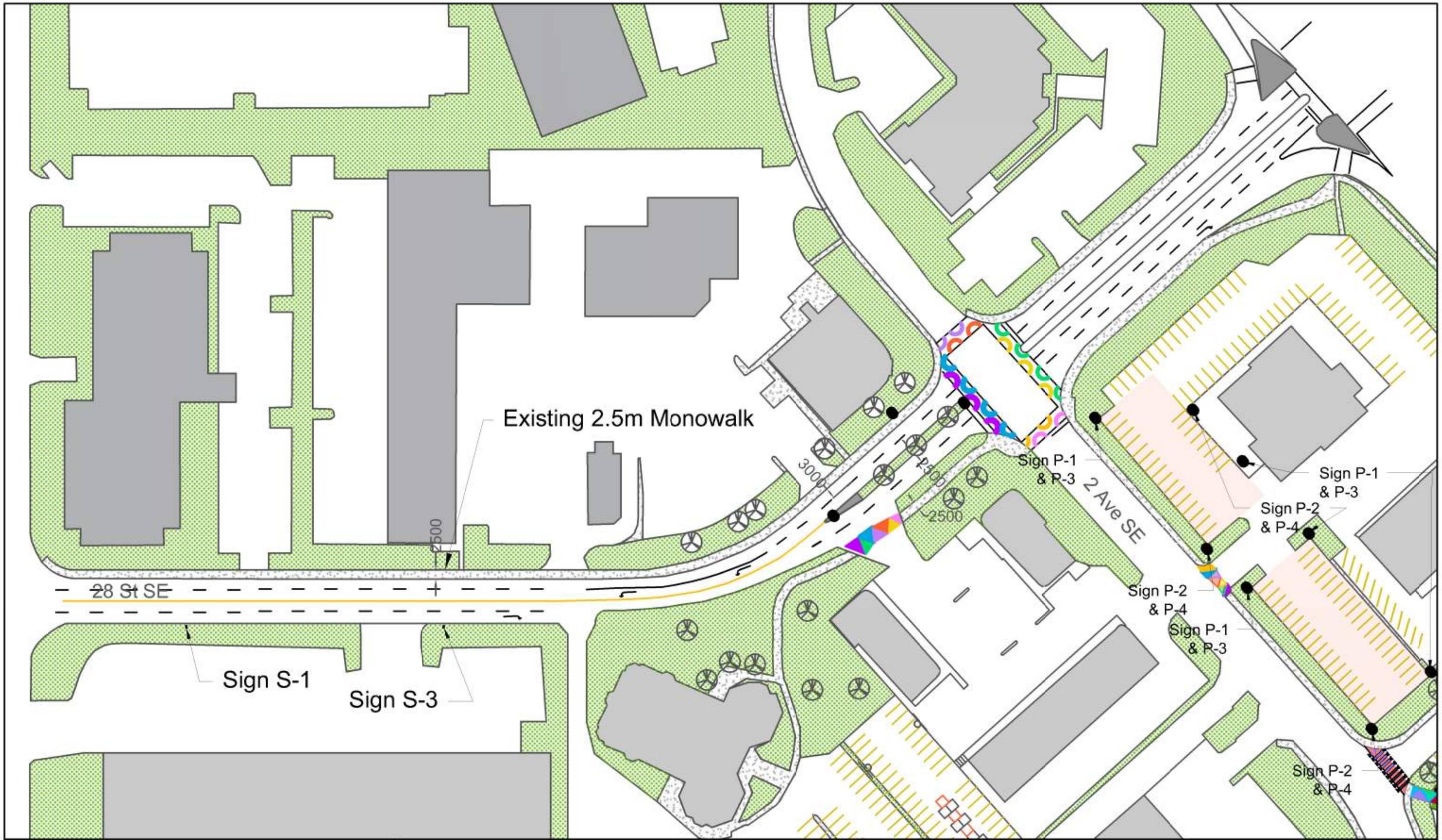
DESIGNED BY
A.Zambrano

CHECKED BY
A.Ambrogiano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Franklin Station Park & Ride Catwalk



LEGEND

- CONCRETE SIDEWALK
- GREEN SPACE
- TREE
- SHARED PICK-UP/DROP-OFF SPACE
- BUILDING

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/15	A.A.
0	50% DESIGN	2022/02/14	A.A.

1:1500 N

DRAWN BY A. Ambrogiano

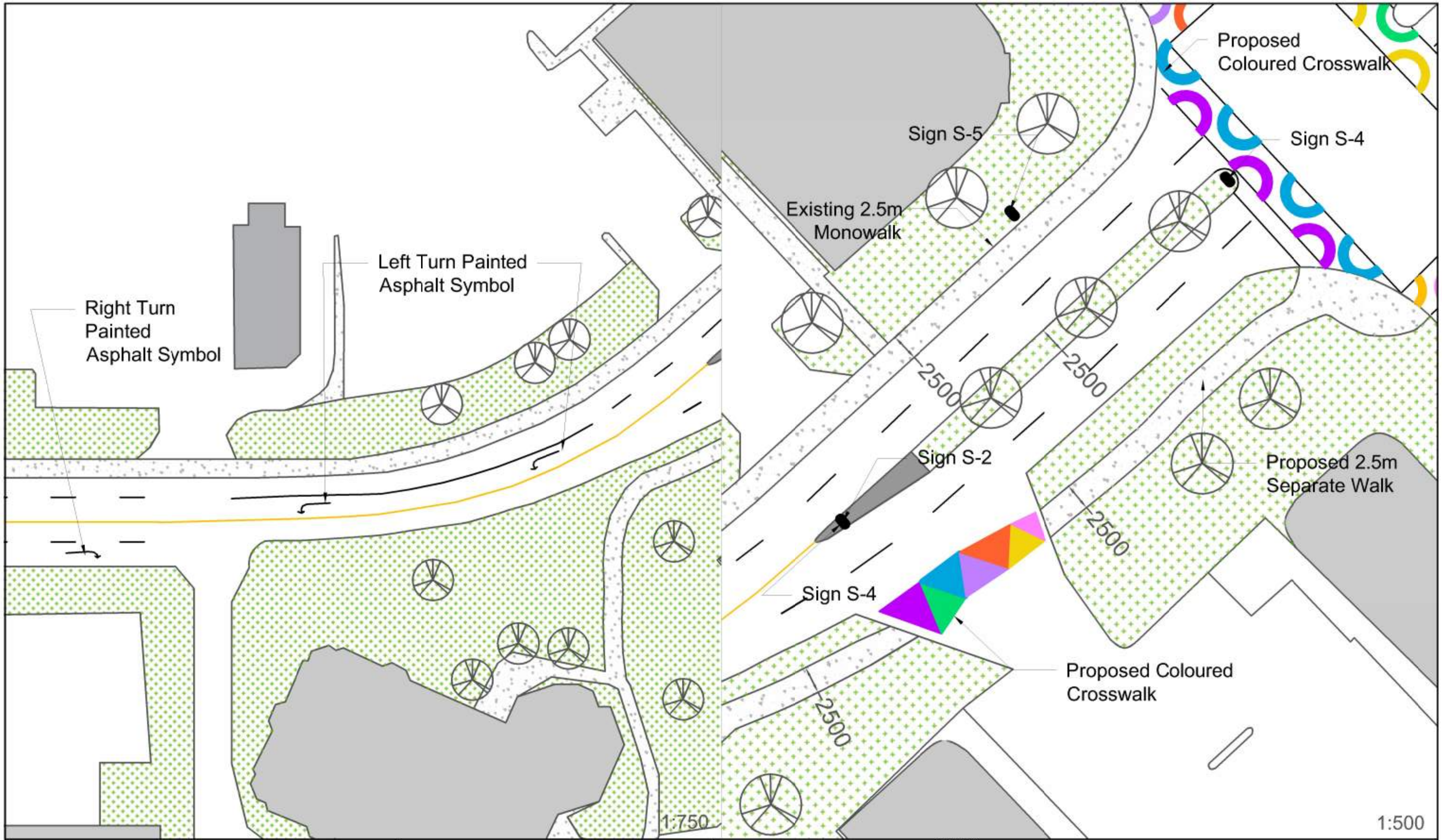
DESIGNED BY A. Zambrano

CHECKED BY A. Zambrano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Proposed 28 Street SE



LEGEND

- CONCRETE SIDEWALK
- GREEN SPACE
- TREE
- SHARED PICK-UP/DROP-OFF SPACE
- BUILDING

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/22	A.A.
0	50% DESIGN	2022/02/14	A.A.

DRAWN BY
A. Ambrogiano

DESIGNED BY
A. Zambrano

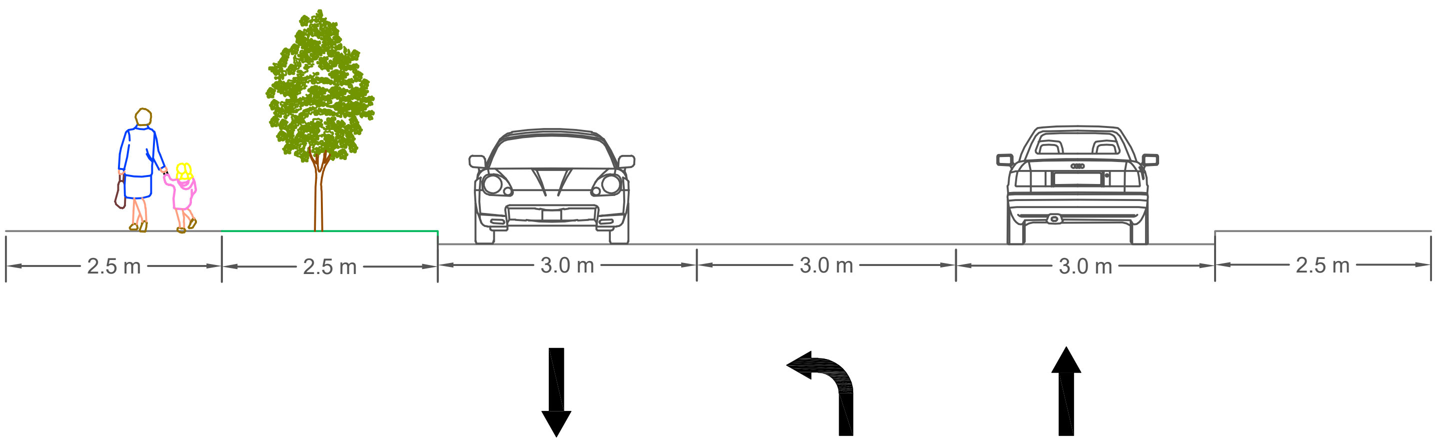
CHECKED BY
A. Zambrano

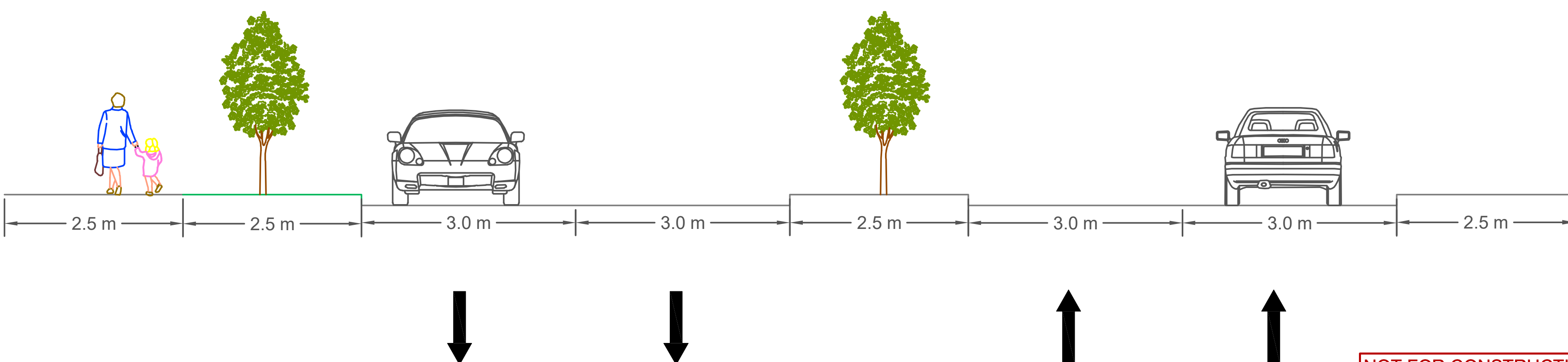
ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY
FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Proposed 28 Street SE - Enlarged

28th Street Cross Section





NOT FOR CONSTRUCTION

LEGEND

REVISIONS

NO.	28th Street Separate Walk & Road Cross Section	DATE (2022/03/17)	A.Z.

DRAWN BY
A.Zambrano

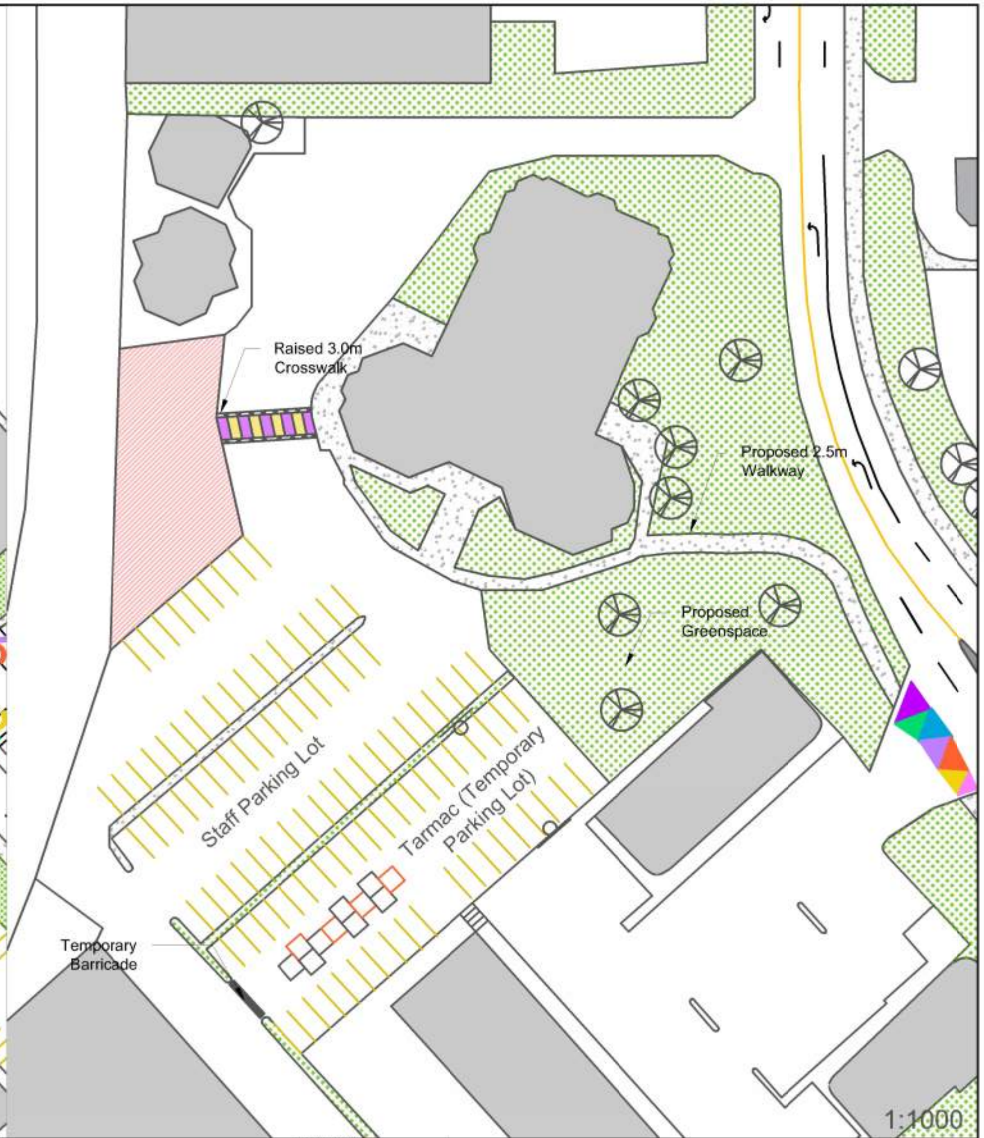
DESIGNED BY
A.Ambrogiano

CHECKED BY
A.Ambrogiano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

28th Street Separate Walk & Road



LEGEND

- CONCRETE SIDEWALK
- PLAYGROUND
- GREEN SPACE
- TREE
- BUILDING

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/15	A.A.
0	50% DESIGN	2022/02/14	A.A.

N

DRAWN BY
A. Ambrogiano

DESIGNED BY
A. Zambrano

CHECKED BY
A. Zambrano

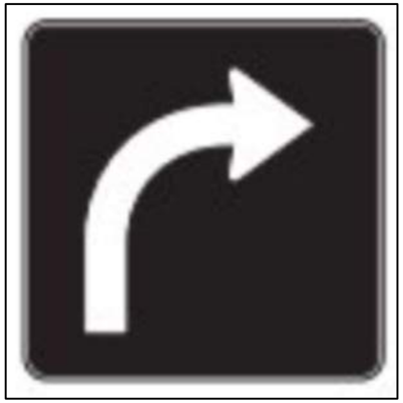
ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Proposed OBK Parking Lot

S-1

S-2



S-3

S-4

S-5

LEGEND

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/22	A.A.
0	50% DESIGN	2022/02/14	A.A.

DRAWN BY
A. Ambrogiano

DESIGNED BY
A. Zambrano

CHECKED BY
A. Zambrano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Proposed Street Signage

P-1

P-2

P-3

P-4

LEGEND

REVISIONS

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	ISSUER
1	FINAL DESIGN	2022/03/22	A.A.
0	50% DESIGN	2022/02/14	A.A.

DRAWN BY
A. Ambrogiano

DESIGNED BY
A. Zambrano

CHECKED BY
A. Zambrano

ENCI 570 T2
ACTIVE TRANSPORTATION SAFETY FOR SCHOOL ACCESS

OMAR BIN AL-KHATTAB

Proposed Parking Lot Signage

Appendix E – Preliminary Construction Cost Estimates

COST ESTIMATE - DESIGN OPTION 1

Project Name:	Active Transportation Safety for School Access	Prepared By:	Emilio Rodriguez and Rachel Ryu
Date:	April 12, 2022	Community:	Beltline

Item No.	Description	Quantity	Unit	Unit Price	Total Price
1.0	**GENERAL**				
1.01	Mobilization and Demobilization	1	L.S.	$ 4,300.00	$ 4,300.00
1.02	Site Survey	1	L.S.	$ 500.00	$ 500.00
1.03	Temporary Fencing / Barricades	40	l.m.	$ 30.00	$ 1,200.00
1.04	Staff Parking Closure	1	L.S.	$ 500.00	$ 500.00
1.05	School and Residential Street Parking Closure	1	L.S.	$ 1,000.00	$ 1,000.00
1.06	Erosion and Sediment Control (ESC)	1	L.S.	$ 794.25	$ 794.25
1.07	Utility Coordination	1	L.S.	$ 1,300.00	$ 1,300.00
1.08	Traffic Control and Accommodation	1	L.S.	$ 4,500.00	$ 4,500.00
				SUBTOTAL	**$ 14,094.25**
2.0	**ROADWAY / STREET INFRASTRUCTURE**				
	Removals				
2.01	Removal and disposal of sidewalk	934.417	s.m.	$ 25.39	$ 23,724.85
2.02	Removal and disposal of concrete curb and gutter	470	l.m.	$ 31.27	$ 14,696.90
2.03	Mill and overlay asphalt pavement for sidewalk	934.417	s.m.	$ 3.73	$ 3,485.38
2.04	Remove school zone signs	3	ea	$ 196.13	$ 588.39
	Earthworks				
2.05	Topsoil stripping / Removal of turf	135.71976	c.m.	$ 3.76	$ 510.31
2.06	Subgrade preparation	1233.816	s.m.	$ 1.97	$ 2,430.62
2.07	Granular Base Course	124.39	ton	$ 30.77	$ 3,827.48
	Shared Street Upgrades				
2.08	Asphalt concrete pavement on shared street sidewalks/roadways	62.19	ton	$ 473.31	$ 29,435.15
2.09	Supply and lay sand and gravel (on 13th avenue and 11th street)	181.44	ton	$ 36.65	$ 6,649.78
2.10	Supply and install bricks (on 13th avenue and 11th street)	54000	ea	$ 0.97	$ 52,380.00
2.11	Supply and install "mixed use street" sign	4	ea	$ 581.56	$ 2,326.24
2.12	Supply and install shared street speed limit sign	4	ea	$ 581.56	$ 2,326.24
2.13	Supply and install paint works (bike lane, crosswalk, midblock barrier, lane divider)	494	l.m.	$ 6.53	$ 3,225.82
2.14	Supply and install *no parking / limited parking* signs	2	ea	$ 791.57	$ 1,583.14
				SUBTOTAL	**$ 147,190.28**
3.0	**10th Street Upgrades**				
3.01	Additional Street Lights for Mixed Use Road along 10th Street & 11th Street (install as needed)	10	ea	$ 677.13	$ 6,771.30
				SUBTOTAL	**$ 6,771.30**
				TOTAL DIRECT COST	**$ 168,055.83**
				CONTINGENCY (20%)	***$ 33,611.17***
				ENGINEERING AND CONSTRUCTION (15%)	***$ 25,208.37***
				TOTAL COST	**$ 226,875.37**

COST ESTIMATE - DESIGN OPTION 1 - MIDBLOCK BARRIER

Project Name:	Active Transportation Safety for School Access	Prepared By:	Rachel Ryu
Date:	April 9, 2022	Community:	Martindale

Item No.	Description	Quantity	Unit	Unit Price	Total Price
1.0	**GENERAL**				
1.01	Mobilization and Demobilization	1	L.S.	$ 4,300.00	$ 4,300.00
1.02	Site Survey	1	L.S.	$ 500.00	$ 500.00
1.03	Temporary Fencing / Barricades	20	l.m.	$ 30.00	$ 600.00
1.04	Staff Parking Closure	1	L.S.	$ 500.00	$ 500.00
1.05	School and Residential Street Parking Closure	1	L.S.	$ 1,000.00	$ 1,000.00
1.06	Erosion and Sediment Control (ESC)	1	L.S.	$ 794.25	$ 794.25
1.07	Utility Coordination	1	L.S.	$ 1,300.00	$ 1,300.00
1.08	Traffic Control and Accommodation	1	L.S.	$ 4,500.00	$ 4,500.00
				SUBTOTAL	**$ 13,494.25**
2.0	**ROADWAY / STREET INFRASTRUCTURE**				
	Removals				
2.01	Removal and disposal of monolith sidewalk, concrete curb and gutter	25	l.m.	$ 243.57	$ 6,089.25
2.02	Mill and overlay asphalt pavement	314.16	s.m.	$ 3.73	$ 1,171.81
	Earthworks				
2.03	Topsoil stripping	71.5	c.m.	$ 3.76	$ 268.84
2.04	Common excavation	195	c.m.	$ 145.00	$ 28,275.00
2.05	Subgrade preparation	112.5	s.m.	$ 1.97	$ 221.63
2.06	Granular Base Course	65.52	ton	$ 30.77	$ 2,016.05
	Mid Block Barrier				
2.07	Supply and install monolithic sidewalk, curb and gutter	60	l.m.	$ 243.57	$ 14,614.20
2.08	Supply and install "bus/bike only" sign	2	ea	$ 581.56	$ 1,163.12
2.09	Supply and install of plastic bollard barrier	70	ea	$ 49.95	$ 3,496.50
2.10	Supply and install cul-de-sac sign / dead end sign	2	ea	$ 581.56	$ 1,163.12
2.11	Supply and install concrete midblock barrier	20	c.m.	$ 780.37	$ 15,607.40
2.12	Supply and install paint works (bike lane, crosswalk, midblock barrier, lane divider)	500	l.m.	$ 6.53	$ 3,265.00
2.13	Supply and install speed bumps	4	ea	$ 1,000.00	$ 4,000.00
2.14	Supply and install *no parking / limited parking* signs	2	ea	$ 791.57	$ 1,583.14
2.15	Supply and install new bus bench	1	ea	$ 1,000.00	$ 1,000.00
2.16	Supply and install wheel chair ramps by the midblock barrier	2	ea	$ 300.00	$ 600.00
				SUBTOTAL	**$ 84,535.06**
3.0	**MARTINDALE BLVD - MARTINDALE GATE DIVERSION**				
3.01	Remove and reinstall sidewalk as multiuse pathway	45	l.m.	$ 146.32	$ 6,584.40
3.02	Supply and install paint works (guide line, crosswalks, driveway entrance)	1	L.S.	$ 2,864.98	$ 2,864.98
3.03	Supply and install concrete diversion (for driveway style entrance)	20	c.m.	$ 780.37	$ 15,607.40
3.04	Close right turn to Martindale Boulevard (i.e., extended landscaping)	300	s.m.	$ 11.00	$ 3,300.00
				SUBTOTAL	**$ 28,356.78**
				TOTAL DIRECT COST	**$ 126,386.09**
				CONTINGENCY (20%)	***$ 25,277.22***
				ENGINEERING AND CONSTRUCTION (15%)	***$ 18,957.91***
				TOTAL COST	**$ 170,621.22**

COST ESTIMATE - Design Option Combo: Alteration of 28th Street and Park&Ride Walkway

Project Name: Active Transportation Safety for School Access
Date: March 27, 2022
Prepared By: Arianna Ambrogiano
Community: Meridian

Item No.	Description	Quantity	Unit	Unit Price	Total Cost
1.0	**GENERAL**				
1.1	Mobilization and Demobilization	1	LS	$ 22,740.00	$ 22,740.00
1.2	Site Survey	1	LS	$ 3,000.00	$ 3,000.00
1.3	Erosion and Sediment Control (ESC)	1	LS	$ 2,500.00	$ 2,500.00
1.4	Utility Coordination	1	LS	$ 1,300.00	$ 1,300.00
15.0	Traffic Control and Accommodation	1	LS	$ 5,000.00	$ 5,000.00
				SUBTOTAL	**$ 34,540.00**
2.0	**ROADWAY / STREET INFRASTRUCTURE**				
2.1	**Park & Ride Walkway Construction**				
	Removals				
2.1.1	Sawcutting of existing asphalt pavement	260	LM	$ 10.07	$ 2,618.20
2.1.2	Removal of existing asphalt pavement	88	M3	$ 46.14	$ 4,060.32
2.1.3	Removal of concrete medians in parking lot	50	M2	$ 26.18	$ 1,309.00
	Asphalt and Concrete Works				
2.1.4	Subgrade preparation and compaction	800	M2	$ 1.32	$ 1,056.00
2.1.5	Supply and install asphalt pathway	400	M2	$ 90.00	$ 36,000.00
2.1.6	Supply and install concrete curb wall	260	LM	$ 76.30	$ 19,838.00
2.1.7	Supply and install raised crosswalk	1	EA	$ 1,500.00	$ 1,500.00
2.1.8	Provision of paintwork for pathway	1	LS	$ 3,000.00	$ 3,000.00
	Lighting				
2.1.9	Electrical Conduit	300	LM	$ 31.14	$ 9,342.00
2.2.10	Provision and installation of streetlights (as needed)	15	EA	$ 4,700.43	$ 70,506.45
	Landscaping				
2.1.11	Supply and install topsoil	400	M2	$ 81.96	$ 32,784.00
2.1.12	Supply and install fescue grass	400	M2	$ 2.50	$ 1,000.00
2.1.13	Supply and install oat grass	12	EA	$ 250.00	$ 3,000.00
2.1.13	Supply and install reed grass	12	EA	$ 250.00	$ 3,000.00
2.1.14	Supply and install trees	7	EA	$ 1,000.00	$ 7,000.00
	Miscellaneous				
2.1.15	Supply and install benches	4	EA	$ 2,000.00	$ 8,000.00
2.1.16	Remove and replace parking lot stalls	1	LS	$ 2,500.00	$ 2,500.00
				PARK & RIDE WALKWAY SUBTOTAL	**$ 206,513.97**
2.2	**28th Street Alterations**				
	Removals				
2.2.1	Sawcutting of existing asphalt pavement	50	LM	$ 10.07	$ 503.50
2.2.2	Removal of existing asphalt pavement	416	M3	$ 46.14	$ 19,194.24
2.2.3	Removal and disposal of concrete curb and gutter	100	LM	$ 33.13	$ 3,313.00
2.2.4	Removal and disposal of concrete median	220	M2	$ 26.18	$ 5,759.60
2.2.5	Removal and salvage signs	2	EA	$ 133.36	$ 266.72
	Asphalt and Concrete Works				
2.2.6	Subgrade preparation and compaction	2600	M2	$ 1.32	$ 3,432.00
2.2.7	Supply and install asphalt pavement	1240	M2	$ 35.96	$ 44,585.44
2.2.8	Supply and install concrete curb and gutter	200	LM	$ 125.34	$ 25,068.00
2.2.9	Supply and install concrete median	20	M2	$ 84.50	$ 1,690.00
2.2.10	Supply and install concrete separate walk	240	M2	$ 184.75	$ 44,340.00
2.2.11	Provision of paintwork for crosswalks	1	LS	$ 3,000.00	$ 3,000.00
	Signage				
2.2.12	Supply and install street signs	5	EA	$ 422.00	$ 2,110.00
	Landscaping				
2.2.13	Supply and place topsoil	800	M2	$ 81.96	$ 65,568.00
2.2.14	Hydroseeding	800	M2	$ 2.00	$ 1,600.00
2.2.15	Supply and install trees	7	EA	$ 1,000.00	$ 7,000.00
	Line Painting				
2.2.16	Supply and place road markings	1	LS	$ 1,300.00	$ 1,300.00
2.2.17	Supply and place painted pavement message - turn arrow	3	EA	$ 123.33	$ 369.99
				28TH STREET ALTERATIONS SUBTOTAL	**$ 229,100.49**
2.3	**OBK Parking Lot**				
	Miscellaneous				
2.3.1	Supply and place temporary barrier	1	LS	$ 1,500.00	$ 1,500.00
2.3.2	Supply and install raised crosswalk	1	EA	$ 1,500.00	$ 1,500.00
2.3.3	Provision of paintwork for tarmac	1	LS	$ 1,000.00	$ 1,000.00
				OBK PARKING LOT SUBTOTAL	**$ 4,000.00**
2.4	**Shared Use Parking Lot**				
	Signage				
2.4.1	Supply and install signs	8	EA	$ 422.00	$ 3,376.00
				SHARED USE PARKING LOT SUBTOTAL	**$ 3,376.00**
				TOTAL DIRECT COST	**$ 477,530.46**
				CONTINGENCY (20%)	$ 95,506.09
				ENGINEERING AND CONSTRUCTION (15%)	$ 71,629.57
				TOTAL COST	**$ 644,666.12**

Appendix F – Martindale Proposed Implementation Timeline

Proposed Implementation Timeline - École La Mosaïque

Task Number	Task Name	Start Date	Finish Date	Duration in Days
1	Martindale Blvd.			
1.1	Site preparation			
1.1.1	Site survey	7/4/2022	7/6/2022	3
1.1.2	Road and parking lot closure	7/7/2022	7/7/2022	1
1.1.3	Installation of fence surrounding site perimeter	7/12/2022	7/12/2022	1
1.1.4	Site mobilization	7/8/2022	7/11/2022	2
1.1.5	Erosion and sediment control measures	7/6/2022	7/6/2022	1
1.1.6	Utility coordination	7/13/2022	7/14/2022	2
1.1.7	Traffic control and accomodation	7/8/2022	7/8/2022	1
1.2	Removals			
1.2.1	Removal and disposal of monolith sidewalk, concrete curb and gutter	7/18/2022	7/20/2022	3
1.2.2	Asphalt pavement removal	7/15/2022	7/15/2022	1
1.3	Earthworks			
1.3.1	Topsoil stripping	7/23/2022	7/25/2022	3
1.3.2	On-site common excavation	7/21/2022	7/29/2022	7
1.3.3	Subgrade preparation	8/1/2022	8/1/2022	1
1.3.4	Surface preparation - granular base course	8/2/2022	8/8/2022	5
1.4	Mid block barrier construction			
1.4.1	Supply and install monolithic sidewalk, curb and gutter	8/9/2022	8/17/2022	7
1.4.2	Supply and install "bus/bike only" sign	9/2/2022	9/2/2022	1
1.4.3	Supply and install of plastic bollard barrier	8/29/2022	9/2/2022	5
1.4.4	Supply and install cul-de-sac sign / dead end sign	9/2/2022	9/2/2022	1
1.4.5	Supply and install concrete midblock barrier	8/18/2022	8/26/2022	7
1.4.6	Supply and install paint works (bike lane, crosswalk, midblock barrier, lane divi	9/7/2022	9/8/2022	2
1.4.7	Supply and install speed bumps	9/5/2022	9/6/2022	2
1.4.8	Supply and install no parking / limited parking signs	9/2/2022	9/2/2022	1
1.4.9	Supply and install new bus bench	9/9/2022	9/9/2022	1
1.4.10	Supply and install wheel chair ramps by the midblock barrier	9/9/2022	9/9/2022	1
1.5	Demobil.			
1.5.1	Site demobilization	9/8/2022	9/9/2022	2
2	Intersection of Martindale Blvd. and Martindale Gate			
2.1	Site preparation			
2.1.1	Site survey	9/12/2022	9/12/2022	1
2.1.2	Installation of fence surrounding site perimeter	9/16/2022	9/16/2022	1
2.1.3	Site mobilization	9/14/2022	9/15/2022	2
2.1.4	Erosion and sediment control measures	9/13/2022	9/13/2022	1
2.1.5	Utility coordination	9/19/2022	9/20/2022	2
2.1.6	Traffic control and accomodation	9/14/2022	9/14/2022	1
2.2	Removals			
2.2.1	Removal and disposal of sidewalk	9/22/2022	9/23/2022	2
2.2.2	Asphalt pavement removal	9/21/2022	9/21/2022	1
2.3	Earthworks			
2.3.1	Topsoil stripping	9/28/2022	9/28/2022	1
2.3.2	On-site common excavation	9/26/2022	9/28/2022	3
2.3.3	Subgrade preparation	9/29/2022	9/29/2022	1
2.3.4	Surface preparation - granular base course	9/30/2022	9/3/2022	2
2.4	Intersection treatment construction			
2.4.1	Reinstall sidewalk as multiuse pathway	10/4/2022	10/5/2022	2
2.4.2	Supply and install paint works (guide line, crosswalks, driveway entrance)	10/11/2022	10/11/2022	1
2.4.3	Supply and install concrete diversion (for driveway style entrance)	10/4/2022	10/10/2022	5
2.4.4	Installation of trees and grass (landscaping)	10/12/2022	10/14/2022	3
2.5	Demobil.			
2.5.1	Site demobilization	10/13/2022	10/14/2022	2