March 18, 2024

Calgary School Transit: Optimization Analysis

DSMM - Maple Mapping

PREPARED BY:

Auradee Castro (c0866821)

Bhumika Rajendra Babu (c0867081)

Lakshmi Kumari (c0867090)

Maricris Resma (c0872252)

TABLE OF CONTENTS

I. Project Overview

This project aims to improve public transportation for Calgary students and their families by optimizing public transporation routes and stops around school locations. By making commutes more reliable and convenient, we can ease the burden on parents and ensure students have dependable daily travel options. Ultimately, this project seeks to create a more supportive and accessible transportation system that aligns with the educational needs of the community.

To achieve this, Maple Mapping team is tasked to focus on providing data to transportation authorities. By establishing connections between school locations, routes and stops, and analyzing this data, the team would identify patterns and trends for improved student commutes. This analysis will serve as a foundation for future route optimization algorithms, which will be developed after gaining a comprehensive understanding of current network patterns and trends.

II. Data Requirements

Leveraging Calgary's open data portal[1], the team acquired information on the city's public transportation system, including details on various combination of transit routes and stops, and other associated features. *Figure 1* shows Calgary transit route network with color-coded designation.

- **Route Category:** Classification of transit routes (e.g. Express, Regular, LRT, School)
- **Stop Name:** Descriptive title for each stop
- **Route Short Name:** Identifier for each transit route
- **Route Long Name:** Descriptive title for each transit route
- **Creation/Modification Date (UTC):** Date the record was downloaded from the site
- **Global ID**: Unique identifier assigned for each data record
- **Multi Line String:** Geospatial data representing multiple transit routes

These datasets are crucial for optimizing Calgary's public transit routes, especially regarding student access to schools. It would fuel route mapping, spatial analysis, and optimization tools to enhance efficiency and connectivity for students who rely on public transportation. To gain deeper insights, the team integrated

[1] Calgary Transit Routes: https://data.calgary.ca/Transportation-Transit/Calgary-Transit-Routes/hpnd-riq4/

the comprehensive list of Calgary community schools[2] – 456 schools in total, containing only records for Elementary, Junior and Senior Highschool – from the open data portal into the analysis. This data includes the type of schools and the postal codes.

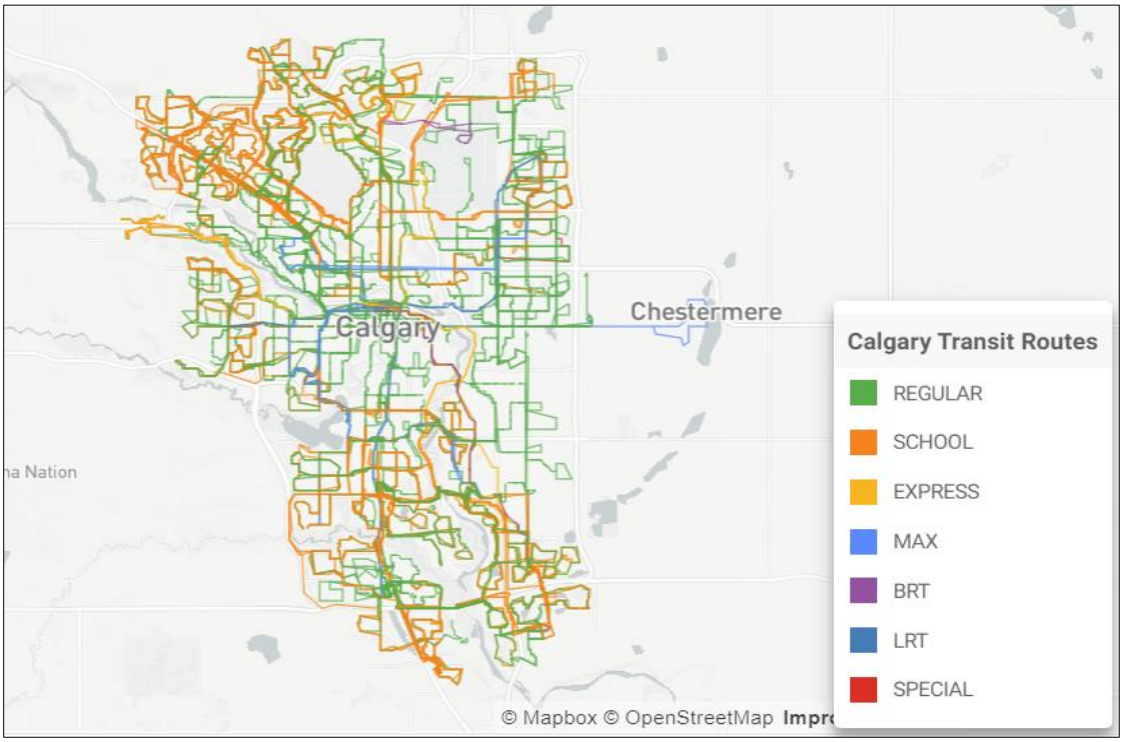

Figure 1 Calgary Transit Route Network

III. Data Cleaning and Processing

The analysis relies on high-quality data. To achieve this, the team performed data cleaning, a vital step that transforms raw data into a usable format. This process ensures the data is accurate, reliable, and ready for insightful analysis. Data cleaning involves identifying and correcting errors, inconsistencies, and missing values within the dataset.

- **Handling missing or duplicate records**: Identified and handled the missing and duplicate records in the dataset to maintain data integrity and ensure the accuracy of analysis.

[2] Calgary Schools: https://data.calgary.ca/Services-and-Amenities/School-Locations-map/qgmn-sudk

- **Dropping unnecessary records:** Schools that are marked as “Unknown” were dropped from the records and excluded from the analysis.
- **Feature removal**: Listed below are the columns that were dropped from the dataset as they weren’t relevant for the analysis.
    - *Calgary Transit Dataset:* Creation Date, Modification Date, Global ID, Multi Line String
    - *Calgary School Dataset:* City, Province, Data Source
- **Added new features**: To create insightful maps that pinpoint schools and transit stops, the team enriched the dataset with latitude and longitude data for both locations. This allows us to visually analyze transportation connections relevant to students.

IV. DATA ANALYSIS

Following data cleaning and processing, the team developed a visualization tool to extract key insights about Calgary's schools and transit system as shown in *Figure 2*. This tool is crucial for building optimization algorithms that will ultimately improve student transportation in the city. Visit this link to view the full report.

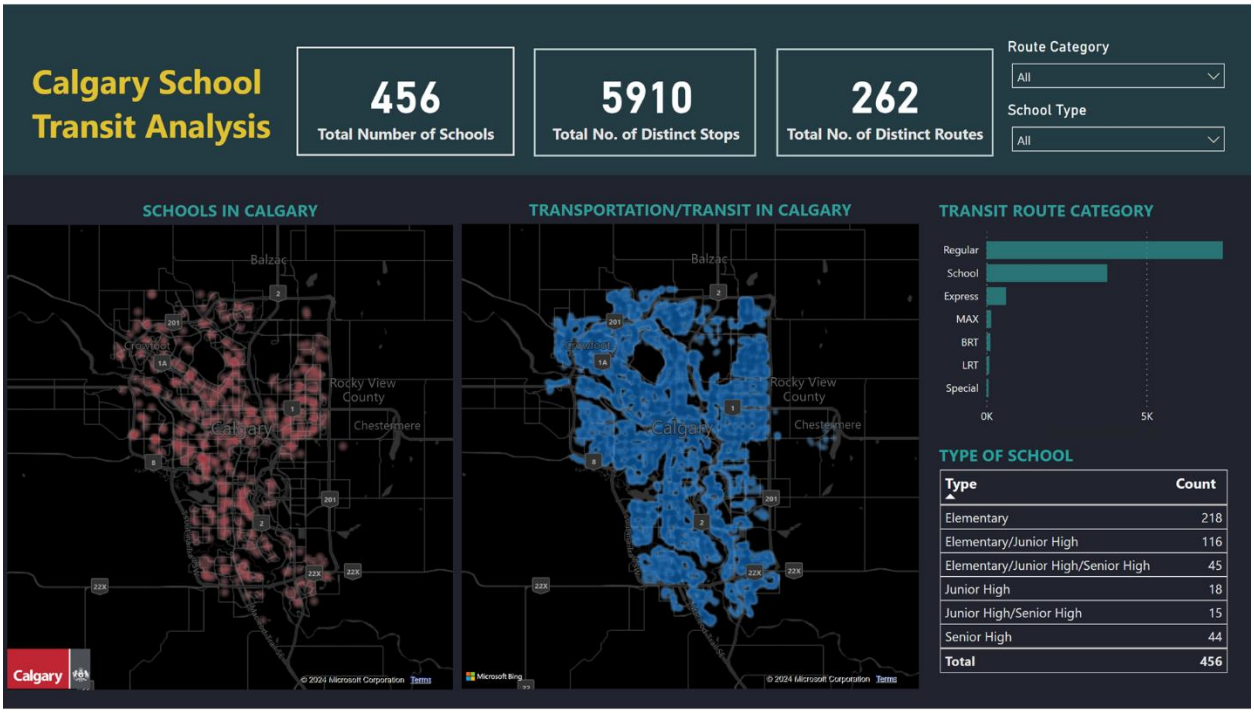

Figure 2 Calgary School Transit Analysis using Power BI

Data Distribution Analysis

- **Calgary Schools:** Our analysis revealed there are a total of 456 community schools in Calgary (excluding “Unknown” entries). Notably, 80% cater to elementary students.
- **Calgary Transit System:** The report shows that Calgary's transit network consists of:
    - *262 Distinct Routes:* Providing various travel options throughout the city.
    - *5,910 Distinct Stops:* Offering access points for riders across Calgary.

  The chart further details the distribution of transit route categories. As you can see, *Regular* routes, servicing a total of 7,387 stops, are the most prevalent. *School-Specific* routes, with 3,778 records, come in second, while *Express*, *MAX*, *BRT (Bus Rail Transfer)*, *LRT* and *Special* routes are significantly less frequent.

Key Findings Based on Route Category Analysis

To maximize the impact on student transportation within Calgary's public transit network, this analysis will focus on three key route categories: Regular, School, and LRT (Light Rail Transit). Other routes, such as Express, MAX, BRT and Special routes, are primarily used by employees and workers for commutes to business districts and industrial areas. While these categories are important for the overall network, they are not the primary focus of this student-centric optimization effort.

Regular Routes

These routes form the backbone of Calgary's public transit system, serving a wide range of destinations across the city and making them a reliable option for daily commutes, leisure and trips. As illustrated in *Figure 3*, the extensive network of Regular routes provides comprehensive coverage across city’s diverse neighborhoods, serving the majority of schools at various levels, offering a convenient transportation option for students of all ages.

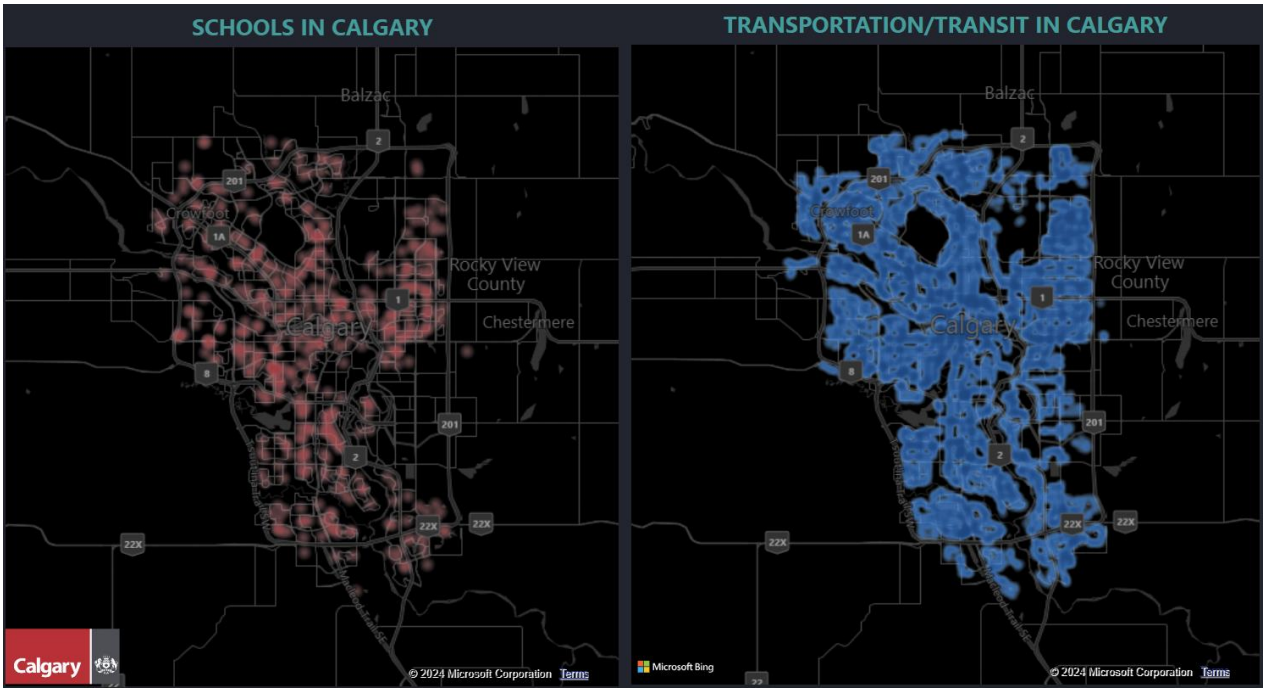

Figure 3 Regular Transit Network in Calgary

School Routes

These routes are specifically designed to serve schools, offering a direct connection for students. This is particularly important because Calgary's schools are predominantly elementary (80%). Optimizing routes for this category holds significant value as elementary school children are often more reliant on public transportation due to their age and limited ability to travel independently. Analyzing *School* routes specifically (*Figure 4*) reveals a potential gap in coverage, particularly in mid-Calgary areas. This could be due to several factors, such as:

- *New housing developments:* Rapidly growing areas might not yet have established school routes.
- *School size and location:* Smaller schools or schools located away from existing routes might require dedicated routes or route adjustments.
- *Inefficient route design:* Existing school routes might not be optimized for maximizing student pick-up and drop-off efficiency.

This finding suggests the need for further investigation by transportation authorities in Calgary to identify areas for improvement in school route accessibility. Potential solutions could include:

- *Targeted route expansions:* Adding new routes or extending existing ones to serve currently underserved areas.
- *Route consolidation and adjustments:* Optimizing existing routes to improve efficiency and coverage, potentially reducing redundancy and travel time for students.
- *Collaboration with school boards:* Working with school boards to identify priority areas for route adjustments and ensure routes align with school schedules and student needs.

By taking a data-driven approach to school route optimization, Calgary can ensure that all students, particularly those in elementary grades, have safe, reliable and efficient access to public transportation.

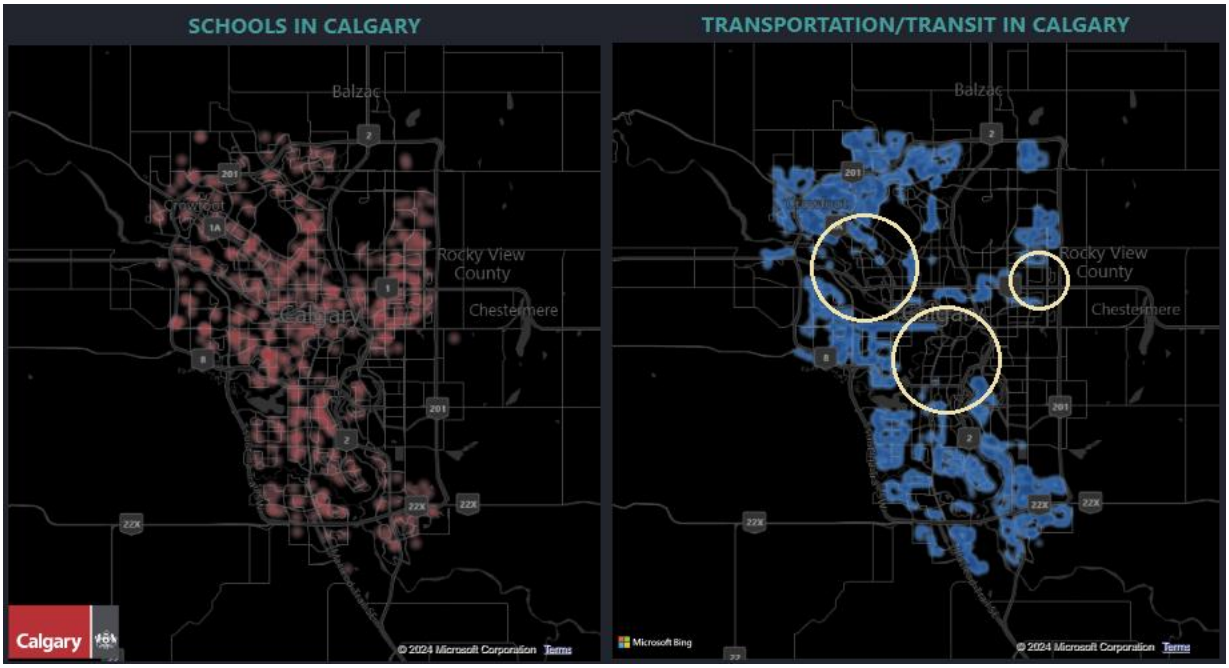

Figure 4 School Transit Network in Calgary

Light Rail Transit (LRT)

Calgary's current LRT system consists of two lines: the Red Line running north-south and the Blue Line running east-west. The intersection point, where these lines meet downtown, can become congested during peak ridership times. The upcoming Green Line expansion[3], starting construction in 2024, is a positive step towards improving overall network coverage. However, the current design focuses on a

[3] Green Line (LRT): https://www.calgary.ca/green-line.html

north-south route potentially paralleling existing bus routes in the mid-city area. This could lead to redundancy and missed opportunities for improved accessibility in other parts of the city.

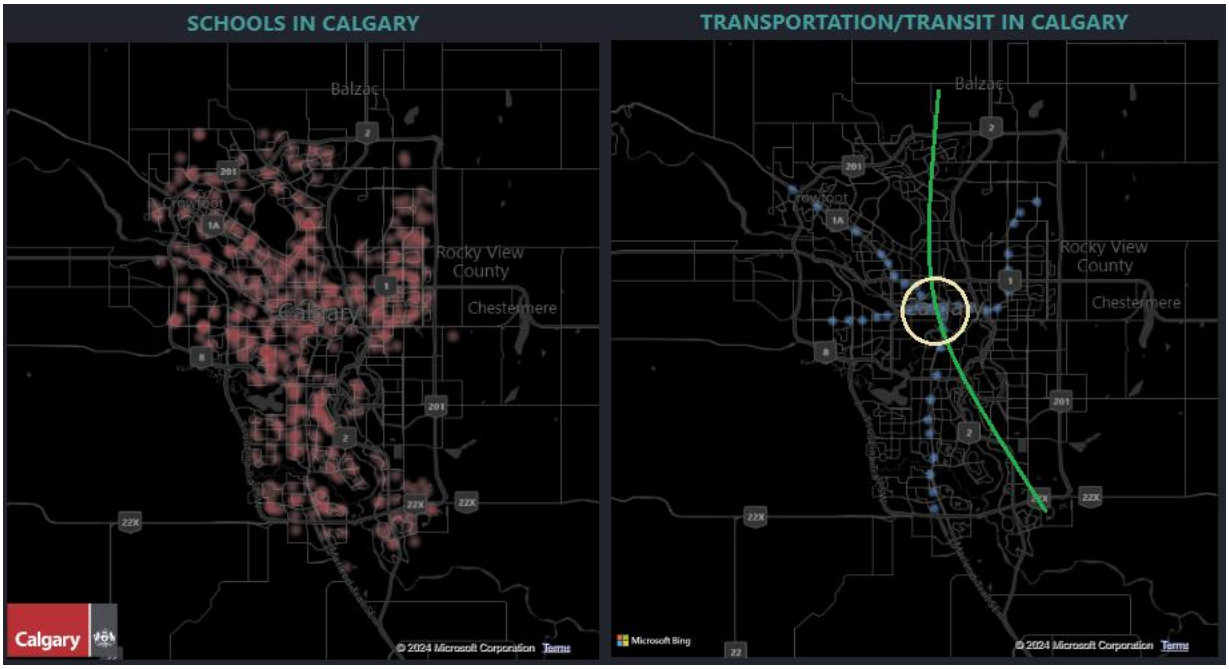

Figure 5 Light Rail Transit (LRT) Network in Calgary

Here are some suggestions to consider for optimizing the Green Line with student needs in mind:

- *Strategic route planning:* Explore the possibility of shifting a portion of the Green Line's mid-city route to cover underserved areas with high student populations. This could involve analyzing ridership data and school locations to identify optimal alignments.
- *Improved connectivity:* Ensure proper integration between LRT stations and other forms of public transportation, such as buses. This could involve implementing a feeder bus system that efficiently connects students from neighborhoods to nearby LRT stations.
- *Enhanced station infrastructure:* Consider improvements at LRT station exits to facilitate easier student commutes. This could include dedicated lanes for connecting buses, improved signage for walking and cycling routes to nearby schools, and potentially installing secure bike storage facilities.

Calgary's LRT network offers a fast and reliable transportation option for students. By analyzing the proximity of schools to LRT stations, this could potentially reduce reliance on buses in specific areas, particularly during peak hours, leading to a more efficient and less crowded overall transit network.

V. Conclusion

This analysis of Calgary's public transit network and its role in student commutes has revealed valuable insights and opportunities for improvement. By implementing the key recommendations outlined in this report, Calgary can create a more accessible, efficient, and student-centered transportation system. Engaging stakeholders, optimizing existing resources, and embracing innovative technologies are crucial steps on this journey.

The following recommendations further emphasize a student-centric approach to optimizing Calgary's public transit system:

- **Conduct Surveys or Gather Feedback:** To better understand the needs and preferences of students and parents, which can inform more nuanced adjustments to routes and schedules.
- **Review and Adjust Based on Capacity and Demand:** For routes serving the most frequently mentioned schools, assess whether the current capacity meets demand and adjust as necessary.
- **Explore New Technologies for Route Optimization:** Utilize GIS software and route optimization algorithms to explore alternative routing scenarios that could offer improvements in efficiency and service quality.

The benefits extend beyond improved student experiences. A well-optimized student transportation system can alleviate traffic congestion, reduce reliance on private vehicles, and contribute to a more sustainable urban environment. This data-driven approach fosters continued collaboration between transportation authorities, school boards, and the community, ensuring all students have safe, reliable, and efficient access to public transportation.