OKOTOKS

Self-Driving Shuttle Feasibility Study and Concept Plan

Prepared for
Town of Okotoks

Prepared by
Stantec

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CHAPTER 1

Okotoks Context

Regional Collaboration and Governance

Okotoks, a town of 29,000, is located south of Calgary and is surrounded by Foothills County. The town has regional importance — over 250,000 people from surrounding municipalities (including Foothills, High River, Black Diamond, and Turner Valley) come to Okotoks for many things such as community events, recreation opportunities.[1] The Town values regional governance, planning, and partnerships and has demonstrated this on numerous occasions.

Okotoks was an active member and participant in the former Calgary Regional Partnership (CRP), working together with the municipalities of the region to plan for sustainable growth. Okotoks partnered with the Towns of Black Diamond, Turner Valley, and High River as well as the City of Calgary and the CRP to pilot regional transit service (On-It Regional Transit) in the south sub-region of the Calgary region. This public transit service was discontinued alongside the disolution of the Calgary Regional Partnership in February 2018.The rights to the brand and service were purhcased by Southland Transportation Ltd. who continues to operate private shuttles to Calgary.

A legislated growth management board now exists in the Calgary region. This provides additional opportunities for Okotoks to actively participate in sustainable growth management on a regional level.

Community event after a local Dawgs game
Source: okotoks_dawgs Instagram

Public feedback:
Many residents felt that vehicles used for the On-It public transit system were too large for operations on residential streets.

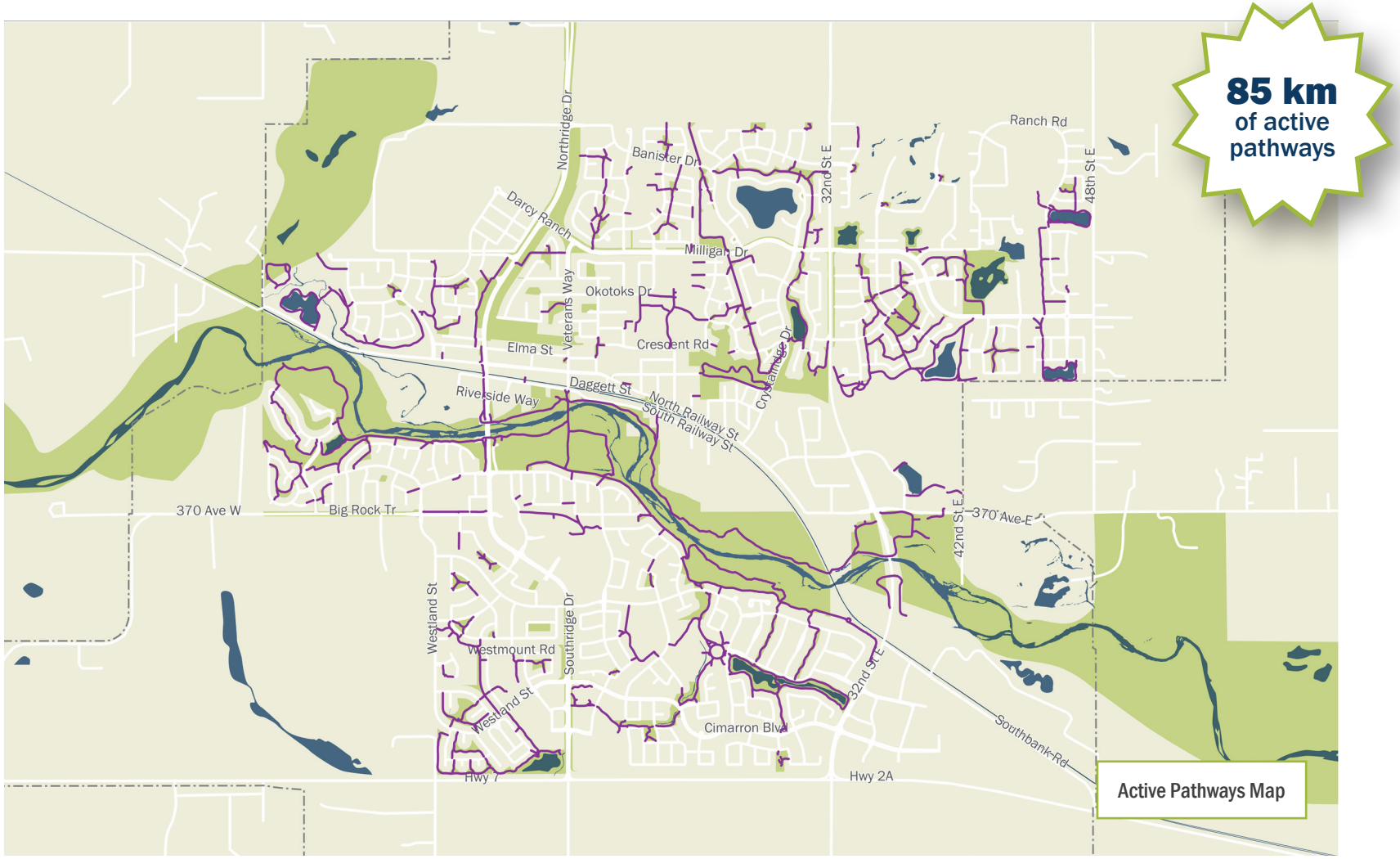
On-It Regional Transit private bus
Source: onitregionaltransit.ca

Active pathways throughout the community

1 Town of Okotoks, *Municipal Development Plan Update* (n.d.) p. 5

Active Pathways

Okotoks has a well-developed system of parks, open spaces, and pathways encompassing 495 hectares and 85 kilometres.[2] A central feature of the active pathway system is the Sheep River Valley. It defines the geography and character of the town.



2 Town of Okotoks, *Parks & Pathways* (2018) retrieved from *https://www.okotoks.ca/parks-recreation/parks-pathways*

Limited Diversity in the Built Environment

The Sheep River Valley defines the geography and character of the town. The built environment is comprised of discrete neighbourhoods and areas with disconnected streets; however, walkability is counterbalanced by the extensive active pathway network. Neighbourhoods are comprised mostly of owner-occupied single-family homes: 77% of homes are single-family and 84% of households own their home.[3] Services and amenities are not contained within residential neighbourhoods, particularly within new residential neighbourhoods. Okotoks had a total of 1,663,749 square feet of commercial floor space in 2013 in the Olde Towne shopping district and along Northridge Drive, Southridge Drive, and Highway 7.[4] Industrial development is located primarily in the Okotoks Business Park and the Southbank Business Park and there is additional undeveloped land near Highways 2 and 2A.

Many residents noted that while the community is very walkable, the addition of another mode of transportation to and from shopping areas or evening activities would be a welcome alternative.

A Wealthier Community of Families

Compared to the rest of Alberta, Okotoks has a higher proportion of families with adults aged 30–45 years old and children aged 0–19 years old, and a lower proportion of those aged 20–29 and 50+. Although these

3 Town of Okotoks, *Municipal Development Plan Update* (n.d.) p. 11

4 Town of Okotoks, O2 Planning + Design, Coriolis Consulting Corp., *Town of Okotoks Growth Study and Financial Assessment* (2014) p. 43

Downtown Okotoks store fronts along Elizabeth Street

A single-family home in the Crystal Shores neighborhood

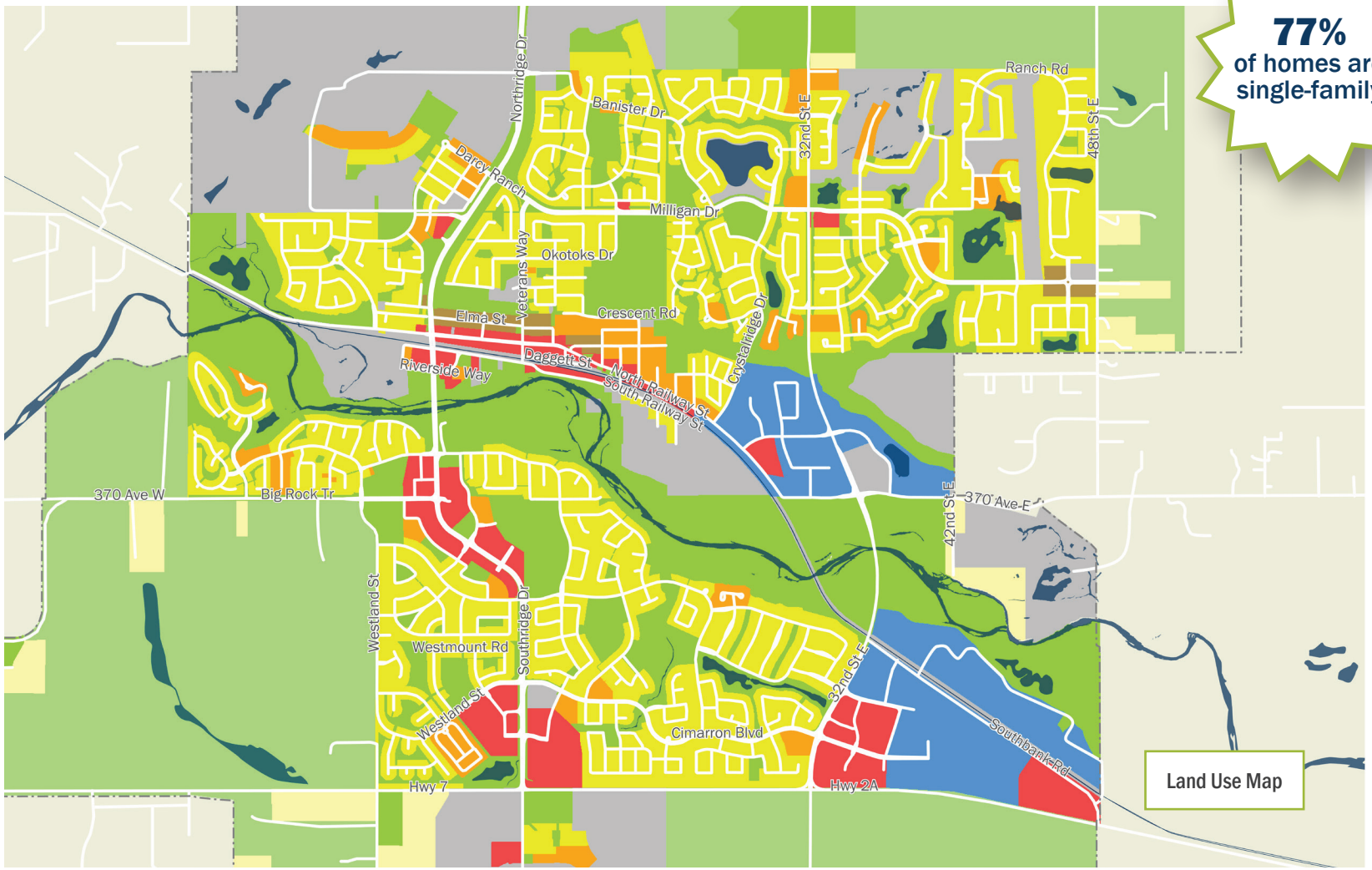
The Okotoks Operations Centre

The Sandstone Lodge senior living community

LEGEND

- Agricultural
- Country Residential
- Single Detached Residential
- Multi-Unit Residential
- Mixed Use
- Commercial
- Industrial
- Parks and Community Facilities
- Other

77%
of homes are single-family



Land Use Map

proportions are not typical of Alberta as a whole, they are in line with other suburban communities with high growth rates.[5] Households in Okotoks earn a median income of $116,163 compared to $93,835 in the rest of Alberta.[6] This demographic trend in Okotoks (majority young families, etc.) is expected to continue in the future.

Increasing the Local Job Market

Many residents travel outside of Okotoks to work (60% of residents commute) and 87% of all working adult residents drive to work or carpool with another driver (3%) (it is assumed that those who walk, take transit, or work from home make up the remaining 10%). Three percent of residents are likely to take transit while 4% are likely to walk and less than 1% are likely to cycle. Fifty-seven percent of children walk or cycle to school.[7]

In 2017, 450 jobs were created and new storefronts and home-based businesses continue to increase every year.[8] The major employment sectors in Okotoks are the service industry, the Town of Okotoks, and education.[9]

Moving forward, the Town has indicated that more commercial and industrial lands will be necessary to support the growing population. Commercial floor space is predicted to grow by about 45,000 square feet per year while industrial floor space is predicted to grow 60,000 square feet per year.[10]

Population Has More Than Doubled Since 2001

The population increased from 12,000 in 2001 to nearly 29,000 in 2016 and is expected to grow by around 900 people per year in the next 60 years.[11] The recent annexation of 1,950 hectares in 2017, enables steady and continued growth.[12] For example, the lands to the northeast and southwest of Okotoks have been identified as high priority residential development areas while commercial areas are recommended to the south of Highway 7 and to the north of Town. The areas south and southeast of Town have been recommended for industrial development.[13]

A Legacy of Innovation

The Town has embraced innovation as a way to achieve the community vision to create a thriving community that is the environmental leader in Alberta. The Town's commitment to innovation is exemplified by projects such as the Downtown Urban Design Master Plan, Environmental Master Plan, Living Soils Filtration Project, and the Drake Landing Solar Community. In addition, the Town is also working toward diversifying the local economy by fostering an innovation sector to attract businesses and industries.

5 Town of Okotoks, O2 Planning + Design, Coriolis Consulting Corp., *Town of Okotoks Growth Study and Financial Assessment* (2014) p. 7

6 Government of Alberta Treasury Board and Finance, 2016 *Census of Canada Incomes* (2017)

7 Town of Okotoks, *Municipal Development Plan Update* (n.d.) p. 41

8 Town of Okotoks, *Municipal Development Plan Update* (n.d.) p. 17

9 Okotoks Economic Development, *Okotoks Economic Development Strategic Plan* (2015) p. 53

10 Town of Okotoks, O2 Planning + Design, Coriolis Consulting Corp., *Town of Okotoks Growth Study and Financial Assessment* (2014) pp. 43-45

11 Town of Okotoks, O2 Planning + Design, Coriolis Consulting Corp., *Town of Okotoks Growth Study and Financial Assessment* (2014) p. 39

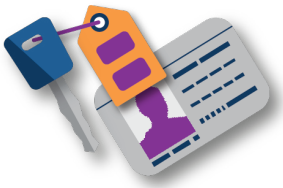
12 Town of Okotoks, *Annexation* (2018) retrieved from *https://www.okotoks.ca/town-services/planning-development/planning/annexation*

13 Town of Okotoks, O2 Planning + Design, Coriolis Consulting Corp., *Town of Okotoks Growth Study and Financial Assessment* (2014) p. 58

Demographics of Okotoks

Highest Age Cohorts

Young Families: Cohorts 0-19 & 30-35 years old



Work Commute

60% of workers commute

Work Commute

90% of commuters drive alone or carpool

School Commute

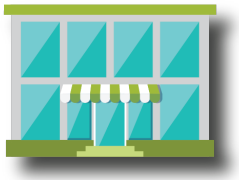
57% of children walk or cycle to school

Median Income

$116,163

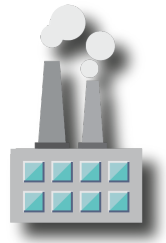
Job Growth

470 jobs created in 2017



Commercial Growth

45,000 sq. ft./ year predicted growth



Industrial Growth

60,000 sq. ft./ year predicted growth

A Recognized Leader in Sustainability

Okotoks demonstrated its leadership in sustainable community development with the establishment of the Drake Landing Solar Community in 2005. The community has won several awards including the 2011 World Energy Globe Award for Sustainability. A reduction of approximately 5 tonnes greenhouse gas emissions per home occur each year in the solar community.[14] In 2015 and 2018, Okotoks received a Sustainable Communities Award from the Federation of Canadian Municipalities in the water category, for its Water Conservation, Efficiency, and Productivity Programs. In the newly adopted Environmental Master Plan and the preceding Sustainability Plan, introducing transit is named as a key action item.

A (R)Evolution is Upon Us

While Canada began on-street testing of highly automated and connected vehicles in 2017, the United States has been testing them since 2009. The first autonomous shuttle bus (or self-driving shuttle) arrived on US soil in 2016, and the rate of adoption nationwide is growing exponentially.

Residents expressed their pride in their community's reputation, and felt that the addition of transit to Okotoks would serve as an environmentally responsible way to move around town.

14 Town of Okotoks, *Municipal Development Plan Update* (n.d.) p. 5

Summary

Innovation, sustainability, and a focus on improving the local economy are central tenants to the design of the local transit system, including how the system is delivered behind the scenes.

The character, density, and design of the community are unlikely to support a fixed-route service with a high enough frequency to be attractive to the choice rider. Instead, an alternative, innovative solution should be considered that delivers the highest quality of service, with a focus on convenience, within given budgetary constraints.

Extending the culture of environmental protection and stewardship means looking to technological advancements to secure environmentally friendly vehicles and supporting networks. Electric and hybrid vehicles are also quiet, which is less disruptive to the neighbourhoods they travel through.

What We Know		
Primarily single family residential (77%) and siloed land use	→	Lower ridership expectations; difficult to serve with fixed-route transit
Employment in services, education, and civic	→	Getting people to work will require long service hours – shift work
60% of workers leave Okotoks	→	Daytime market: personal business, social, medical, and entertainment for young families, retirees, and those who work from home
Residents have established means of getting around Okotoks because there is no transit	→	Choosing transit will be a conscious choice for most (choice riders)
Lots of active paths, but neighbourhood impermeability (fences)	→	Reduce catchment area at stops


BEER SUMMIT

CHAPTER 2

Industry Innovative Strategies

Industry Innovation Strategies

Communities, businesses, and transit agencies are piloting innovative alternative service delivery strategies in lower-density neighbourhoods, often where fixed route transit is not viable. The results of these pilot projects have been encouraging as they have demonstrated improved service quality and customer experience while maintaining or reducing the cost of providing services.

By leveraging app-based technology, real-time ride-matching and optimizing software, and innovative service delivery models, organizations are experimenting with providing demand-responsive service to improve various performance metrics like: trip time, on-time performance, cost, service area and service hours. While this creativity is enabled by technology, it is also driven by an increase in customers' expectations of service due in large part to Transportation Network Companies (TNCs), like Uber and Lyft. These TNCs offer easy-to-use, personalized service with a price point between public transit and taxis. Watching their success and realizing the opportunity, transit agencies, communities and private companies are innovating to capitalize on some of this latent demand and travel market share.

This scan of the industry for the latest innovations in transit solutions provides the Town of Okotoks with an array of tools and lessons learned from real world applications. The following case studies include both Canadian and American examples, and range in context from serving industrial parks, dense central business districts, small towns, lower density and suburban neighbourhoods. They present diverse service profiles, service delivery models, customer support and interface strategies. When available, customer survey results and financials are included.

Beginning with the foundation, this document first highlights the impact of technology on transportation and defines key terms and typical service styles. Then, nine case studies are presented with enough detail to understand the various applications, service styles, outcomes, and lessons learned. Finally, the document concludes with key take-aways and themes extracted from the research.

Transportation is Technology

One of the biggest drivers of change is the development of technology in the transportation and transit space. Before we dive into specific case studies, it is worth spending a moment on where and how technology continues to transform transportation.

The technological impacts are described in four areas: the customer interface, behind the scenes, the vehicles, and customer expectations.

The Customer Interface

- Customers use one central app which easily facilitates mobile fare payment and trip reservation.
- Real time visuals and information about the vehicles' location, type and in some cases, customer satisfaction ratings of the drivers.
- Ability to customize transit to you: pick-up and drop-off locations, time of trip, and sometimes vehicle type.

Behind the Scenes

- Integrated driver app which uses powerful and self-learning algorithms and real-time traffic conditions to create the most efficient shared-passenger trips as possible.
- Real time fleet management software and app, which is often integrated with the customer interface app.
- Advanced data analytics enable quick identification of problems/opportunities to expedite quick responses for continued customer service/improvements/efficiencies.

The Vehicles

» Electric buses are here. They are zero emission, quiet and substantially easier to maintain due to the fraction of moving parts in an electric engine compared to an internal combustion engine. Battery life is the primary constraint but will continually improve over time.

» In addition to traditional shuttle buses, organizations are seeking any vehicle type that meets the needs of the service, from cars, to SUVs, to converted minivans and full-sized vans.

» Connected and autonomous vehicle (CAV) technology is advancing and making its way into larger vehicles, starting with personal cars, trucks and SUVs to shuttle buses and eventually traditional 12m buses. This technology suite, sometimes referred to as automated driving systems (ADS), is designed to be safer and more efficient by removing human error, communicating with infrastructure, customers, and other vehicles.

Customer Expectations

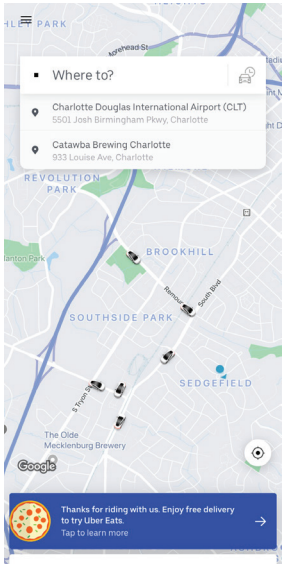
» On-demand, dynamic routing, new mobility services (Uber and Lyft) have dramatically changed customers' expectations.

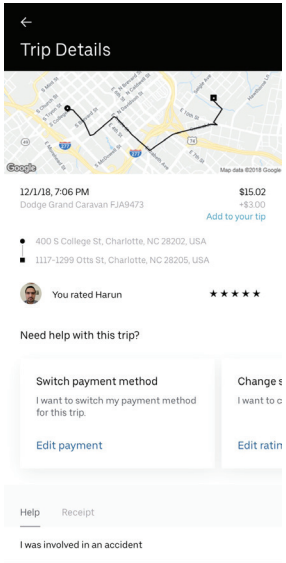
» Access to the atomic clock via cell phones has changed the definition of 'on time' to a demanding one in which customers hold operators accountable to the second.

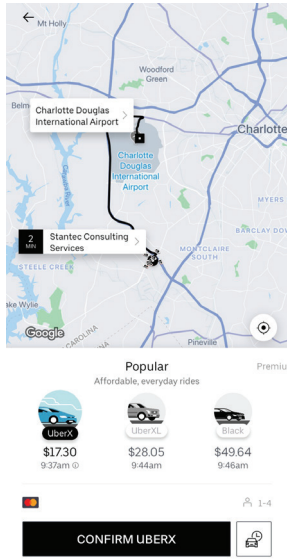
Apps like Uber make reserving rides easy

Apps use tools for tipping, rating, & reporting issues

Apps provide on-demand service & dynamic routing







New Flyer Electric Bus in Manitoba
Source: electrek.com

Automated Connected Electric & Shared

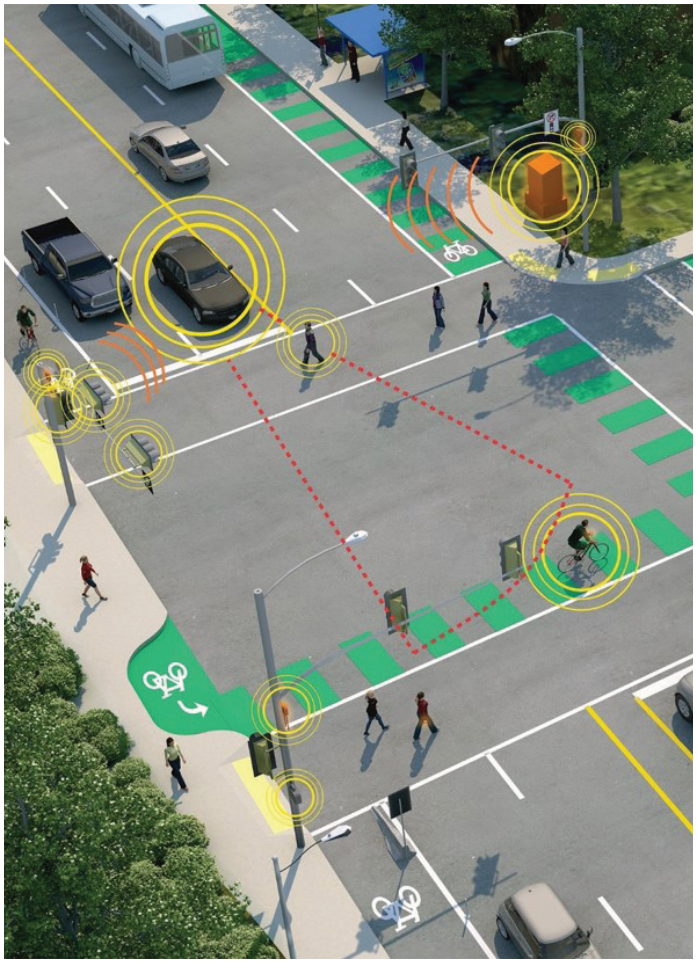
The new mobility technologies and solutions that have emerged in the market over the last 10 years have come in four principal categories: Autonomous, Connected, Electric, and Shared (ACES). While some solutions fall in all four categories, each has potential benefits for the Town of Okotoks to consider when evaluating its overall mobility system.

Automated

Perhaps the most popular in terms of mainstream attention, autonomous vehicles are those that operate independent of the world around them and do not need a driver. Such vehicles depend on a sophisticated set of sensors and computing to construct a digital map of the world around them in real time and move accordingly. Trials and pilots of autonomous vehicles, particularly cars, have been occurring around the world for a number of years with millions of miles of successfully logged trips. Manufacturers include not just the legacy automobile manufacturers (e.g., General Motors, Ford, Volkswagen) but also include other technology-based firms including Google/Waymo, Uber, Lyft, and Apple who are developing fleets of cars, trucks, and even delivery vehicles to operate without a driver. Investment in autonomous technology has now become mainstream with billions of dollars in new investments being announced on a regular basis.

Connected

The ability for a vehicle to speak to other vehicles (Vehicle to Vehicle - V2V), the surrounding infrastructure (Vehicle to Infrastructure - V2I), and to every other potential device (Vehicle to Everything - V2X) is made possible through a series of external devices and communication protocols. Connections provide additional information to the vehicle such as the location of potential accidents ahead, ride hailing by a potential passenger, location/availability of parking spaces, and location/availability of charging stations. At its most basic level, today's mapping applications on phones are examples of how information is communicated through a connected system that pools information from other drivers to improve the experience for everyone. The infrastructure that permits this type of communication travels across the current 4G mobile networks, across local Wi-Fi, as well as with Digital Short-Range Communications (DSRC) devices mounted in the car and along the roadside. At present only, DSRC can provide fast enough communications for a car to react in real time – such as when the vehicle in front of you suddenly stops short. In the future, 5G mobile networks are expected to deliver similar if not faster communication speeds.



A rendering from ACTIVE-AURORA, a network of on-road test beds for Connected Vehicle systems, technologies, applications and services for traffic, transit, goods movement, and active transportation. ACTIVE is based in Edmonton, Alberta, and AURORA is based in Vancouver, British Columbia.

Electric

The electric car has long been a technology that transportation planners have embraced as a way to reduce the negative impacts of air and noise pollution emanated by the internal combustion engine. To date, the limited range (under 190km per full charge) and high cost have limited their general acceptance. That has changed in the past two years as dramatic advances in battery storage have more than doubled the range potential (385-480 kilometres per charge). Further, production technologies are reducing costs such that industry experts recently estimated that the cost of delivering an automobile with an electric engine will be cheaper than a similar model with an internal combustion engine within five years (2023). The limiting factor in widespread adoption of electric vehicles will be the charging network. Tesla and some regional power companies, are leading the way with the construction of a network of super-charging stations across North America, but a more fine-grained network of local charging stations will need to be constructed.

Shared

Shared mobility has historically taken the form of public transit – buses and trains – where many people share a vehicle to travel in similar directions. The great recession gave rise to a sharing economy that leveraged the power of social networking and mapping to rent out a variety of assets including extra bedrooms (AirBNB), office space (WeWork), and available car seats (Uber/Lyft). For vehicle trips, drivers share trips with a passenger through the use of a user-friendly app that rates both driver and passenger and simplifies the payment system.

This network has now extended to the shared use of other mobility services including bicycles (both docked and dockless) and electric scooters. Additionally, manufacturers and service providers have been developing new vehicle technologies known as micro-transit or driverless shuttles to provide short distance connectivity – typically less than 5km in length – in business districts, office and college campuses, and in high tourist areas.

Electric car charging station; Source: greencarreports.com

Limebike's dockless bikes and electric scooters; Source: businessinsider.com

What Do We Mean by Self-Driving Shuttles?

At this point in time, self-driving technology is making rapid advancements and is being tested around the world in diverse conditions including public streets, private office parks, and university campuses. These electric shuttles carry between 8–16 people and typically operate at a top speed of 40kph. They are ideally suited for first/last kilometre solutions on quiet, lower-speed roads and can operate in mixed-traffic. However, they can operate more efficiently within a dedicated right of way, similar to bus rapid transit. Given their low speeds and somewhat limited carrying capacity, they are not particularly suited for long distance trips nor higher speed roads or highways.

Safety is paramount. Most of the vehicles have 3–4 redundant braking mechanisms in case one fails, including braking if the engine fails or loses power. Emergency stop buttons inside the vehicle and a direct telecom connection to a central command hub are also common. In addition, it's important to note that because these are low speed vehicles, any accidents that occur would typically only cause minimum damage or minor injuries.

Most shared autonomous vehicles (SAV) on the market today have a tight turning radius (4–4.5m), and some operate in both directions, eliminating the need to turn around. They can work seamlessly with a mobile phone-based app, can be called on-demand, and monitored in real-time. Most are wheelchair accessible and are working to offer more accessibility features in compliance with Canadians with Disabilities Act (CDA) regulations.

The aesthetic of the shuttles varies depending on the manufacturer, but the dimensions are generally 5m x 2m x 2.7m, which is smaller than community buses. These electric vehicles can typically operate between 3–10 hours on a single charge—depending on operational environment and deployment strategy—and recharge via induction or by physically plugging them in. Given the rapid advances in battery technology, this range is being extended with each new version. Supportive infrastructure, such as a secure storage site, intersection treatments, Intelligent Transportation System (ITS) infrastructure, and transit priority treatment is generally less intensive than traditional transit, but this can vary greatly depending on local desires and conditions. In addition, if placemaking and permanency are important, installations would include fixed-point stations with interactive signage and fully dedicated lane(s).

Shuttle Details

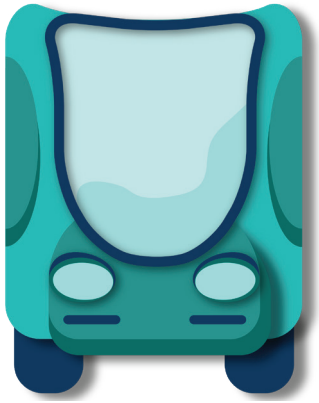
Example Manufacturers & Self-Driving Shuttles

Easy Mile EZ10

Local Motors Olli

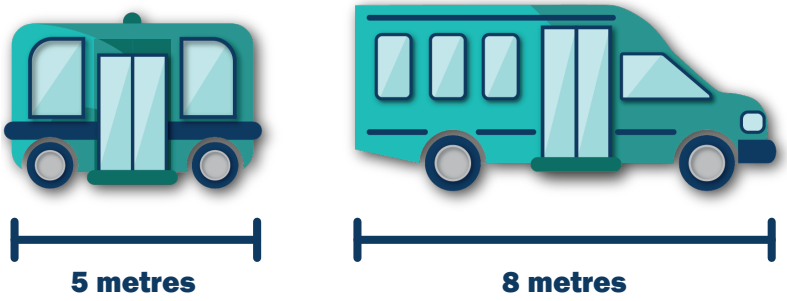
Navya Arma

Self-Driving Shuttle Specifics



- Typical size: 5m x 2m x 2.7m
- Top speed: 40kph
- Maximum capacity: 8-16 people
- Amount of time on a single battery charge: 3-10 hours

Self-Driving Shuttle & Standard Bus Comparison



Notable Features:

- Tight enough turning radius (4-4.5m) to drive on existing streets
- Operates in both directions, eliminates the need to turn around
- Works with a mobile app for on-demand calls and real time monitoring
- Wheelchair accessible and working to offer more accessibility features and compliance with Canadians with Disabilities Act (CDA) regulations
- Redundant breaking mechanisms
- Emergency stop button on-board
- Direct telecom connection to central command hub for passengers

How Does the Technology Work?

Autonomous driving technology uses a combination of redundant sensor systems to ensure the precise location of the vehicle and its ability to accurately identify and negotiate objects.

Most of the sensing technology is fully integrated into the vehicle — hence its ability to operate autonomously. However, before the vehicles are deployed for public use, a high-definition, three-dimensional map is created of the corridor and stored in one of the vehicle's computers to use as a frame of reference. This map forms the foundation from which the vehicle can detect differences in its operational domain (dog on the sidewalk, person crossing the road). It also acts as a security measure, ensuring the vehicle cannot be operated outside of its designated alignment.

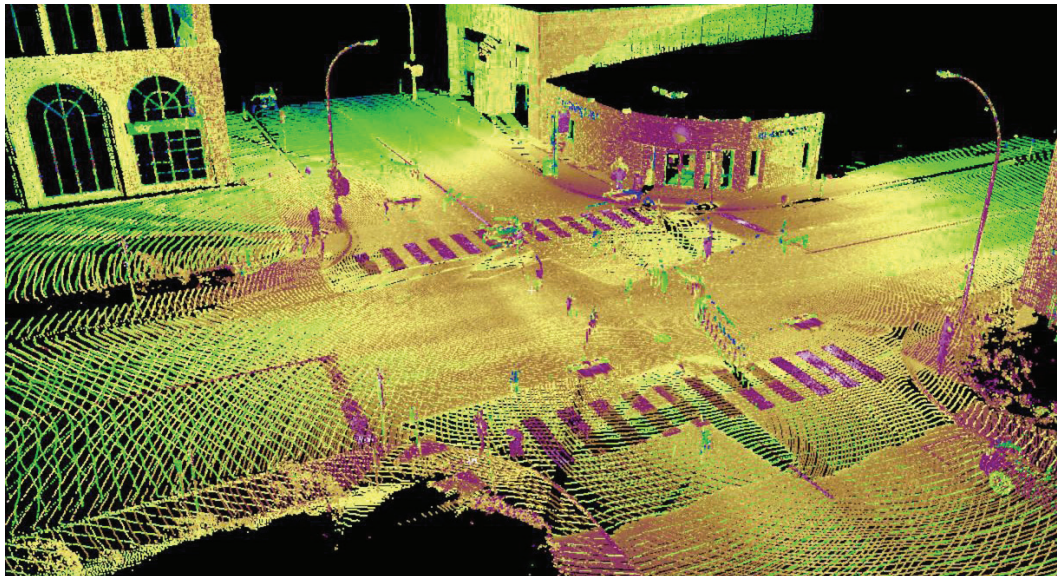
Autonomous driving technology uses a combination of redundant sensor systems to ensure the precise location of the vehicle and its ability to accurately identify and negotiate objects.

LIDAR (Light Detection and Ranging). The vehicles typically have both 360-degree and 180-degree LIDAR sensors. LIDAR continuously emits millions of laser beams (light) per second which bounce off the surrounding environment and return to the sensor. The time it takes to return to the sensor indicates the distance and type of object.

LIDAR creates a continuous picture of the vehicle's surroundings, and identifies the vehicle's position relative to these surroundings within an accuracy of about one inch in a range as great as 61 metres. LIDAR creates a robust, three-dimensional map of the surrounding area, enabling the vehicle to know ahead of time when the lane curves to the left or when there is a stoplight coming up in a half-mile. LIDAR can also detect and track obstacles in motion, in addition to the static environment.

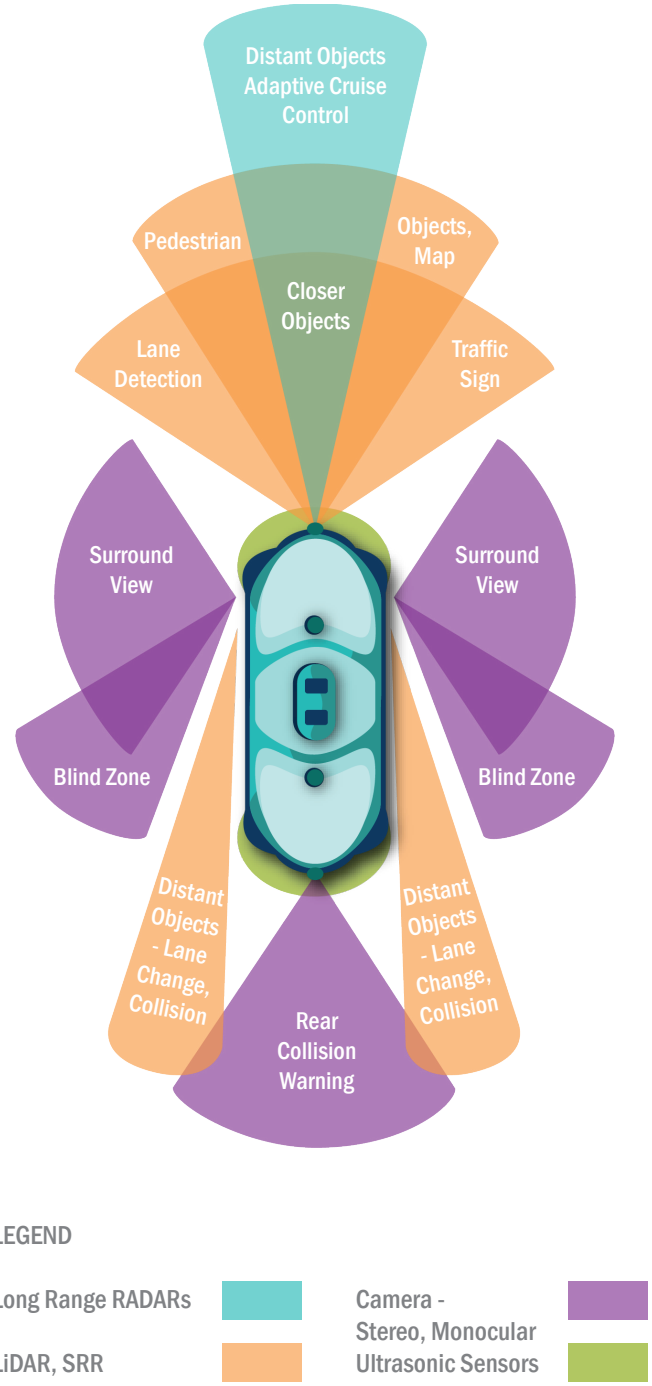
RADAR (Radio Detection and Ranging). These sensors are located in the front and back of the vehicles to help monitor traffic with a range of a few centimetres to 30 metres.

RADAR uses radio (or electromagnetic) waves to determine the range, angle and relative velocity of objects. RADAR systems are upgrading from 24 GHz to the 77 GHz frequency band, which improves both the accuracy and resolution by more than 20 times. This means that objects next to one another can now be distinguished as unique if they are 2.5cm apart instead of the nearly 1 metre tolerances of the 24 GHz systems. The size of the antenna required for a 77 GHz band is one ninth the size of a 24 GHz band, increasing the space available on the vehicle for other things.



Example of 3D mapping technology creating an accurate model of the environment along a route from which the shuttle can detect differences | Kelowna, Canada

Diagram explaining the locations of each sensor system described below and the different factors within the shuttle's surroundings



Ultrasonic sensors. Similar to RADAR and LIDAR, these sensors use sound waves to detect objects and their location. Ultrasonic sensors are most effective at low speeds.

Cameras. Cameras are used to help detect traffic signals and signs since they are uniquely able to detect colors and fonts. They are another layer of technology used to ensure safe operations by providing redundancies in case of failure. Using mono and stereo cameras in combination with RADAR systems, they determine the precise evaluation of speed and distance. The cameras must have a very high dynamic range of more than 130 decibels in order to create a clear image in challenging lighting environments (direct sun). These digital cameras can create a 360-degree view of the vehicle's surroundings, not too dissimilar from the cameras used by Google to create their Street View imagery.

GNSS (Global Navigation Satellite System). Each vehicle uses a GNSS, usually Global Positioning System (GPS), to relay the vehicle's precise location to the remote supervisor and act as an input for localization processing.

Inertial Navigation System (INS). INS is comprised of a set of position sensors (accelerometer, gyroscope, magnetometer) to calculate the vehicle's location, speed, and direction without the use of satellite communication.

Sensor Fusion. The process in which a central computer fuses the information from all sensors using powerful processors to identify objects, and then make decisions based on that information using rules governed by a risk assessment, safety standards, and local traffic law.

Communication – DSRC, 4G/5G, LTE, Wi-Fi. Various radio communications technologies may be employed for different purposes, including vehicle-to-infrastructure communications, emergency communications, and navigation.

CHAPTER 3

Self-Driving Shuttle Strategies for Okotoks

Introduction

Autonomous vehicles are being tested worldwide on public roads since late 2015. Self-driving shuttles are one of the vehicle types that are more readily being deployed because they are designed to be low speed (travelling at speeds < 40 kph). Travelling at lower speeds reduces the risk and severity of accidents and comes with different regulations for the design, testing and operations of the vehicles. These shuttles hold the promise of providing a more attractive, cost effective solution for first/last kilometre trips.

Okotoks is interested in being an early adopter of self-driving shuttles because:

- It is only a matter of time before they are the new standard and are widely adopted; therefore, getting to know the technology sooner rather than later will help Okotoks better prepare for the autonomous future.
- Removing the operator from the vehicle will realize substantial cost savings to transit operations.
- Most self-driving shuttles are 100% electric, helping to contribute to a healthier, more sustainable Okotoks.
- It will continue the Town's legacy of being innovative by harnessing the power of technology to transform municipal services.
- The town's size, lower traffic volumes and speeds make it an ideal candidate for the technology.

Looking to the not so distant future, Okotoks began the process to become one of Canada's testing grounds for autonomous vehicles by evaluating potential routes and creating a concept plan.

Self-Driving Shuttle Route Alternatives

The entire urbanized area of Okotoks was included in the scope of the study. The team refined all routing options to the top six, options A - F, which are described in no particular order on the following pages.

The criteria used to create the alternatives included:

- Meaningful destinations: does the route connect desirable destinations in addition to residential areas?
- Route length: while some options exceed this standard, routes aimed to remain under 3km one-way.
- Bidirectional: all options should be bi-directional for customer convenience.
- Traffic volumes and speed: preference is given to roads with low traffic volumes, and posted speeds below 50 km/hr.
- Town's priorities: does the route meet the top three priorities of the Town: contribute to a healthy lifestyle, improve mobility across the river, and enhance economic vitality in the town centre?

The routes were then evaluated against criteria that reflects the values and priorities of Okotoks and the technical requirements of the technology. The preferred shuttle route is described in the subsequent chapter and lays the foundation for advancing the project towards implementation.

Route A – Recreation Centre to Library

Route A connects the Okotoks Recreation Centre to Okotoks Public Library, traveling along Veterans Way and Milligan Drive, operating in mixed traffic as well as on active transportation pathways. This option also provides connections to Sandstone Lodge, Rotary Performing Arts Centre, and the town centre. Three alignments were developed to navigate between the western multi-use path on Veterans Way and the Okotoks Recreation Centre.

Alignments

Okotoks Recreation Centre to Veterans Way Alternatives

1. **Milligan Drive:** Milligan Drive is a four lane road with a boulevard separating travel lanes. Higher traffic volumes result in the recommendation to physically separate the automated shuttle lane from regular traffic. Removing one lane will have an impact on average traffic speed, especially during peak hours when school drop off and pick up occurs. Milligan Drive has free flowing traffic, whereas Veterans Way has a stop sign at the intersection. Shuttle priority through intersection upgrades should be considered.

2. **Okotoks Drive:** This residential street typically has lower traffic volumes, except during school drop off and pick up hours when traffic increases dramatically. Parallel parking is permitted and used on both sides of the street, while alleys behind the homes reduce the number of driveways along Okotoks Drive. While the shuttle could operate in mixed traffic, striping on the road would be required to more clearly delineate travel lanes. Navigating variable parallel parking is a challenge for the technology at this point in time. It is recommended to create a dedicated or shared lane for the automated shuttle either along the centre or along the southern side of the street. This will reduce parallel parking to one side of the street only.

3. **Wilson Street active path combination:** This option has the lowest vehicle volumes and potential interruption to traffic, but it also has the most impact to active modes. This option requires infrastructure investment in two locations: pavement connecting Veterans Way and the alley in-between Centre Street and Okotoks Drive and pavement connecting Wilson Street to the bus loop which connects to the active paths. Conflict with school buses and active path users must be mitigated.

Veterans Way

Potential alignment options include a dedicated lane on road, mixed traffic operation, and operating on either the eastern or western active path. To accommodate a dedicated lane in one of the travel lanes, the bike path will need to be removed or shared with the shuttle and lane widths will be at their minimum.

Optional Extension: The Heartland

An optional terminus at the southern end of the route is to extend service to The Heartland, a retirement residence, adding 0.6km of route. The extension also enables access to Southridge Drive businesses and services.

LEGEND

ROUTES

- Proposed Route
- Proposed Route Alternative
- Optional Route Extension

FRAMEWORK

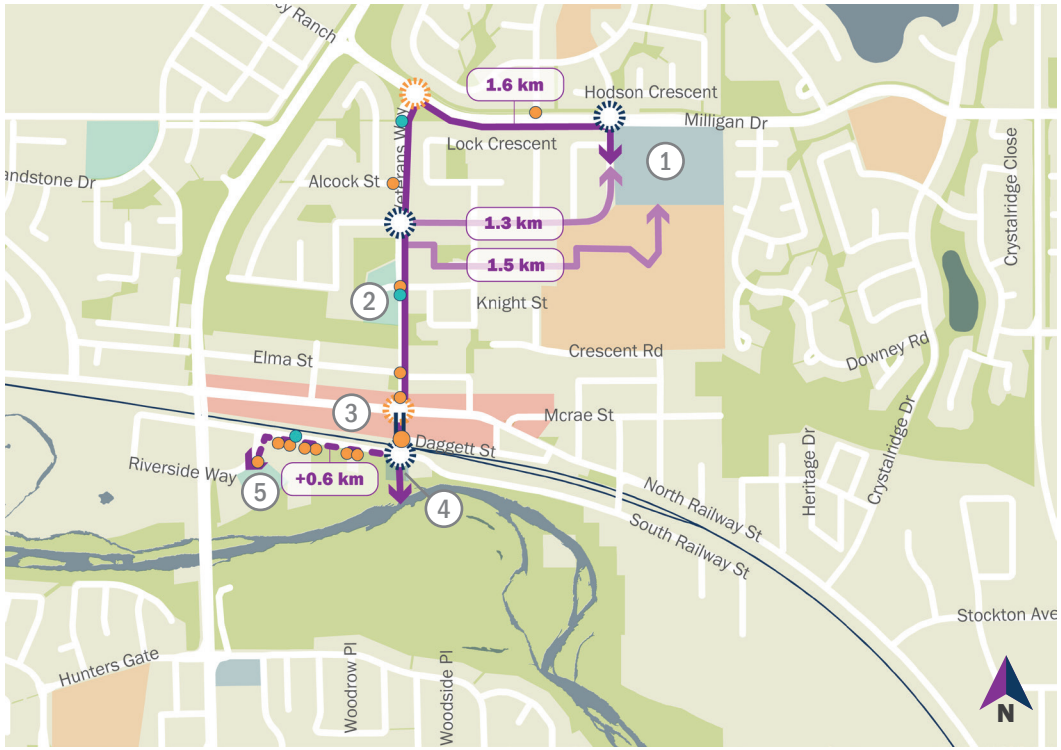
- Signalized Intersection
- All-Way Stop Intersection
- Unsignalized/Semi-Signalized Intersection (i.e. one or two-way stops) or Driveway
- Unsignalized/Semi-Signalized Intersection or Driveway (3+ in a row, usually single-family driveways)
- Additional Pedestrian Crossing
- On-Street Parking

BASE MAP

- Green Space
- Waterbodies
- Roads
- Rail

DESTINATIONS

- Civic
- Schools
- Commercial Centres
- Senior Living



Route A's preferred option along Milligan Drive and Veterans Way serves these major destinations: 1) Okotoks Recreation Centre, 2) Sandstone Lodge, 3) the town centre, and 4) Okotoks Public Library. It also provides better access across the river. The optional extension to the south and west serves 5) The Heartland and Southridge Drive.

Population and Community Characteristics

- Serves the most people by size and in terms of density of all route alternatives.
- Provides connections to destinations for all ages, including schools, library, recreation centre and senior housing.
- Operates in a highly-visible location and connects to Okotoks' town centre.
- Promotes the use of community facilities, such as the library and recreation centre.
- Supports active transportation and physical activity through connections to pedestrian bridge and river pathways.

Physical Infrastructure Characteristics

- Priority should be given to making operations simple when considering all alignment options for the entire length of the route. Varied surfaces and lane configurations create complex operations (combination of physical separation, shared lane with traffic, and shared active transportation path).
- Requires signalization or priority treatment at the intersection at Milligan Drive and Veterans Way (Milligan Drive alignment only), Elizabeth Street and Veterans Way, the railroad crossing and South Railway Street.
- Add cautionary signage at unsignalized driveways, and cautionary or High-Intensity Activated Crosswalk Beacon (HAWK) signal at all-way stop intersection at Okotoks Drive and Veterans Way.
- Involves crossing an active railway corridor and a signalized intersection at Elizabeth Street along Veterans Way.

LEGEND

Yes ✓ No –

Route Quick Facts

Route distance

1.6 km

Travel time (estimated)

5-6 minutes

Frequency with one vehicle

12 minutes

Estimated population (within 400 metre radius)

3,200 people

Access Priorities

Does this route give access to 6th+ grade schools?

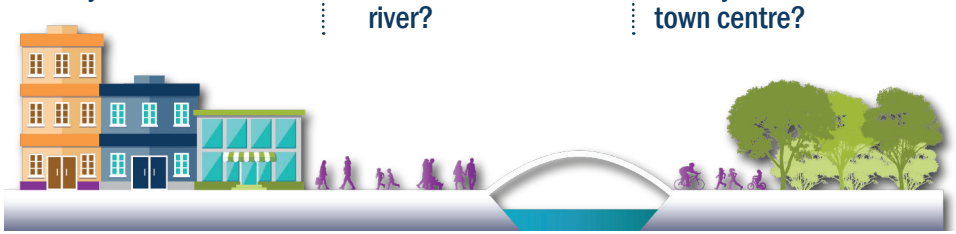
Does this route give access to senior housing?

Town Priorities

Does this route contribute to a healthy lifestyle? ✓

Does this route improve mobility across the river? ✓

Does this route enhance the economic vitality in the town centre? ✓



Route B – North Railway

Route B connects key destinations in Okotoks' town centre, including Okotoks Municipal Centre, Okotoks Public Library, local businesses, a cinema, Seaman Stadium and Okotoks Operations and Environmental Education Centre. The route operates along two roads between Highway 2A and 32nd Street. An alternative route is also considered along Heritage Pathway.

Alignments

Daggett and North Railway Streets

This low-traffic street would allow for operation of a shuttle in mixed traffic, but would deliver passengers to the backs of buildings instead of to active frontages on main streets such as Elizabeth Street or McRae Street. Efforts could be made to improve or create entrances to businesses from Daggett Street, which would increase visibility and accessibility to downtown destinations. To this end, Daggett acts as the alley for the businesses featuring delivery and garbage trucks which may park in the right of way of the shuttle. Both perpendicular and parallel parking are on both sides of the street.

This corridor introduces new connections to key destinations such as Okotoks Cinemas, Okotoks Operations Centre, and Seaman Stadium. However, this long stretch includes many driveways, cross streets controlled by stop signs, and pedestrian crossings. Traffic along North Railway Street is free flowing without requiring stops between Daggett Street and 32nd Avenue. Even though the posted speed is 40 km/hr, actual speeds tend to be higher. The shuttle could operate in mixed traffic, or there is plenty of right of way to create a dedicated lane for shuttle operations.

Heritage Parkway Alternative

This option provides a completely segregated alternative for connecting Okotoks Public Library to Okotoks

Route B serves these major destinations: 1) the town centre, 2) Okotoks Operations Centre, and 3) Seaman Stadium. This route has major complications on the north side of N Railroad Street due to multiple unsignalized driveways or semi-signalized with stop signs on the connecting side streets. (See page 74 for base map legend)

LEGEND

ROUTES
- Proposed Route
- Proposed Route Alternative
- Optional Route Extension

FRAMEWORK
- Signalized Intersection
- All-Way Stop Intersection
- Unsignalized/Semi-Signalized Intersection (i.e. one or two-way stops) or Driveway
- Unsignalized/Semi-Signalized Intersection or Driveway (3+ in a row, usually single-family driveways)
- Additional Pedestrian Crossing
- On-Street Parking

Operations Centre and Seaman Stadium along Heritage Parkway. This 2.8km active pathway option provides a safer route than the Daggett Street and North Railway Street option by removing points of conflict; it is entirely separated from traffic. However, accommodations for active path users must be considered and space made for people and bikes safely and easily pass the shuttle. The pathway may need to be reinforced and widened.

Population and Community Characteristics

- Connects civic buildings and downtown commercial centre along the back of buildings on Daggett Street.
- Relatively low population density and population size within 400m.
- Does not directly serve schools or seniors residences.
- Service along North Railway Street supports development and businesses along the corridor.
- The Heritage Parkway Alternative limits the destinations served.

Physical Infrastructure Characteristics

- Challenging operations due to numerous driveways and on-street parking on Daggett Street and North Railway Street.
- Upgrades required to the intersection of Veterans Way and Daggett Street and Daggett Street and North Railway Street to permit the shuttle to safely cross currently uncontrolled cross traffic.
- Consideration should be given to creating a segregated path along North Railway Street.
- Longer route length compared to other options increases travel time and subsequently reduces the service frequency that is possible with one vehicle.

LEGEND

Yes No

Route Quick Facts

Route distance

2.7 km

Travel time (estimated)

8-10 minutes

Frequency with one vehicle

20 minutes

Estimated population (within 400 metre radius)

2,500 people

Access Priorities

Does this route give access to 6th+ grade schools?

Does this route give access to senior housing?

Town Priorities

Does this route contribute to a healthy lifestyle?

Does this route improve mobility across the river?

Does this route enhance the economic vitality in the town centre?

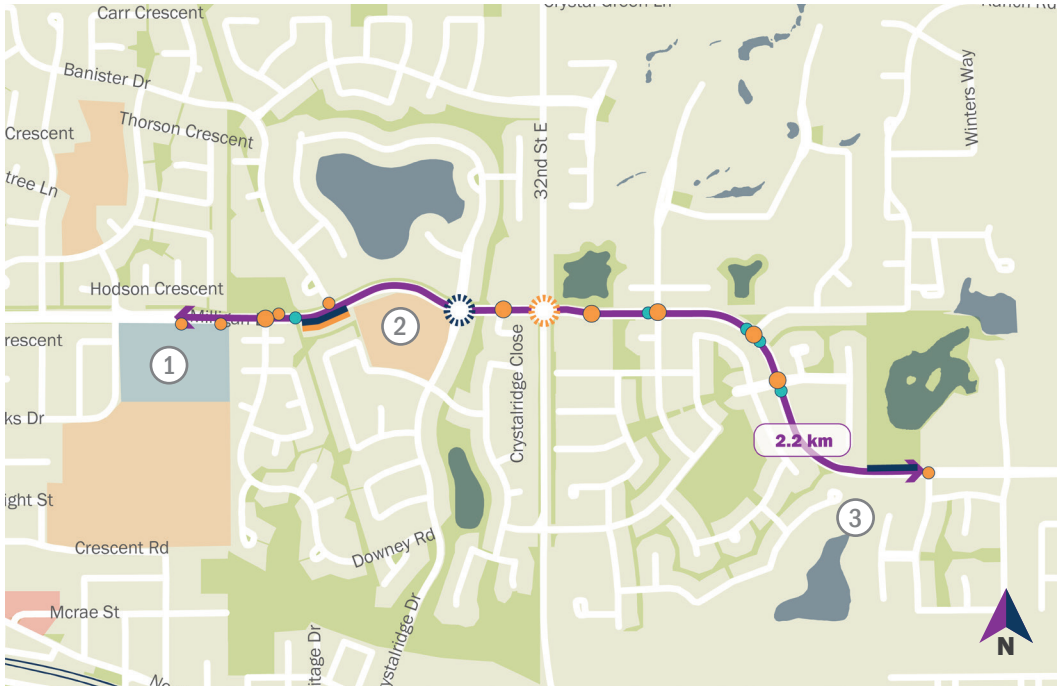
Route C – Milligan Drive

Route C operates exclusively along Milligan Drive, providing connections between Okotoks Recreation Centre, Dr. Morris Gibson School, and residential neighbourhoods of Crystal Ridge and Drake Landing. In addition to Okotoks Recreation Centre, riders have opportunities to visit other recreational and open spaces such as Halstead Park and Drake Landing Soccer Fields. Although Dr. Morris Gibson School is the only school located along Milligan Drive, Good Shepherd School, École Percy Pegler, and École Okotoks Junior High School are all located within 400-500m of the shuttle route.

Alignments

Milligan Drive

Milligan Drive is a four lane boulevard for the entire length of the route with no on-street parking. There are a few driveways, one signalized intersection at 32nd Street and one four–way stop at Crystal Ridge Drive. This corridor has one of the highest traffic volumes of all options, so if operating in mixed-traffic, signage and street painting should be considered to communicate that a low speed shuttle is operating.



Route C serves these major destinations: 1) Okotoks Recreation Centre, 2) Dr. Morris Gibson School, and 3) the Drake Landing neighbourhood. (See page 74 for base map legend)

LEGEND

ROUTES
- Proposed Route
- Proposed Route Alternative
- Optional Route Extension

FRAMEWORK
- Signalized Intersection
- All-Way Stop Intersection
- Unsignalized/Semi-Signalized Intersection (i.e. one or two-way stops) or Driveway
- Unsignalized/Semi-Signalized Intersection or Driveway (3+ in a row, usually single-family driveways)
- Additional Pedestrian Crossing
- On-Street Parking

Population and Community Characteristics

- Provides access to the greatest population size within 400 m compared to all other options.
- Connects residential, educational, and recreational land uses, particularly benefiting families, children, and youth.
- Does not provide connections to commercial destinations or Okotoks Town Centre.
- Does not link to a major destination or activity centre at the east end of the route.

Physical Infrastructure Characteristics

- Four lane street (two lanes in each direction) provides the opportunity to designate space in the right-of-way for a segregated shuttle lane, if desired.
- Major intersection at Milligan Drive and 32nd Street requires priority treatment and connectivity for the shuttle.

LEGEND

Yes

No

Route Quick Facts

Route distance

2.2 km

Travel time (estimated)

7-8 minutes

Frequency with one vehicle

16 minutes

Estimated population (within 400 metre radius)

6,000 people

Access Priorities

Does this route give access to 6th+ grade schools?

Does this route give access to senior housing?

Town Priorities

Does this route contribute to a healthy lifestyle?

Does this route improve mobility across the river?

Does this route enhance the economic vitality in the town centre?

Route D – 32nd Street

Route D operates along 32nd Street connecting Seaman Stadium and Okotoks Operations Centre with either the Recreation Centre or Holy Trinity Academy. Option one utilizes the active path network through the Crystal Ridge neighbourhood, while option two utilizes Milligan Drive to access the Recreation Centre.

Alignments

North Destination Alternatives

1. **Crystal Ridge Active Path to Recreation Centre:** This option removes the vehicle from traffic, creating increased safety. However, the path may need to be reinforced and widened to accommodate the shuttle and active path users. The transition from 32nd Street to the active path must occur at either Milligan Drive or Crystal Shores Road, and should be signalized appropriately for safe navigation.
2. **Milligan Drive to Recreation Centre:** As discussed in the option above, Milligan Drive is a four lane boulevard with higher traffic volumes. The shuttle could operate in mixed traffic or in it's own dedicated path, which would restrict general traffic flow.
3. **32nd Street to Holy Trinity Academy:** Travel lanes reduce from four to two north of Crystal Ridge Drive and posted speeds remain at 50 km/hr, however actual speeds may be higher. Mixed traffic operation is likely necessary, and special consideration given for terminus at Holy Trinity Academy. The 1 km distance north of Milligan Drive only features one potential stop before arriving at Holy Trinity. Considerations should be given to provide service that compliments school bell and activity times.

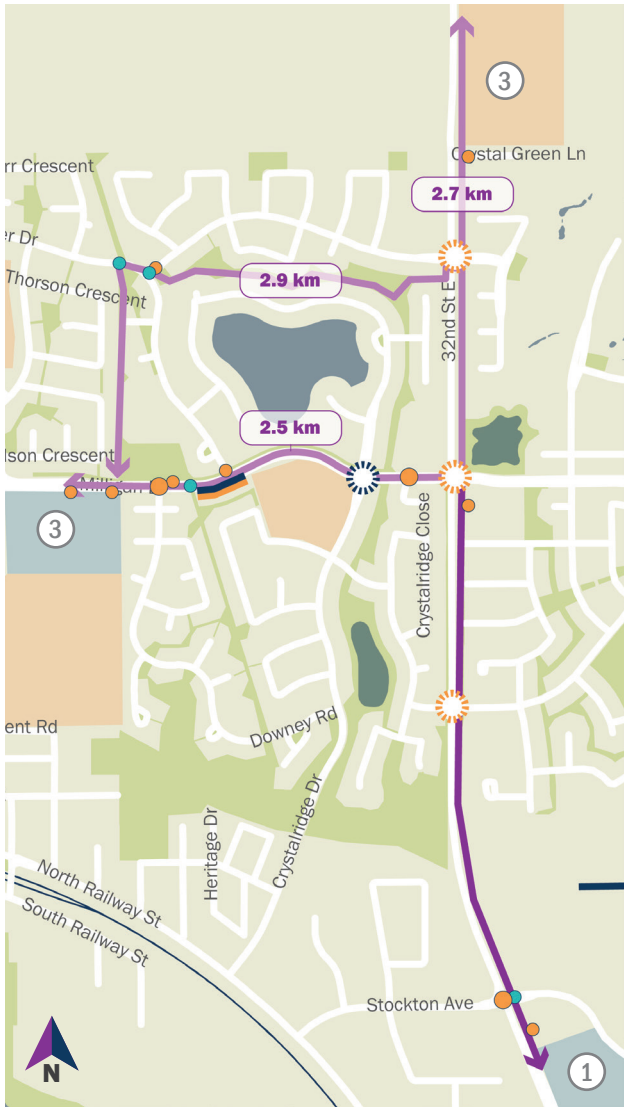
LEGEND

ROUTES

- Proposed Route
- Proposed Route Alternative
- Optional Route Extension

FRAMEWORK

- Signalized Intersection
- All-Way Stop Intersection
- Unsignalized/Semi-Signalized Intersection (i.e. one or two-way stops) or Driveway
- Unsignalized/Semi-Signalized Intersection or Driveway (3+ in a row, usually single-family driveways)
- Additional Pedestrian Crossing
- On-Street Parking



Route D has the potential to connect 1) the Seaman Stadium to another major destination in town, depending on which alternative is chosen: park and ride from 2) Holy Trinity Academy or 3) Okotoks Recreation Centre, through the Crystal Shores neighbourhood or along Milligan Drive. (See page 74 for base map legend)

32nd Street

32nd Street has very high traffic volumes, and is not suitable for on-street operations. It has a wide right-of-way, purposely constructed for future capacity expansion. The alignment along 32nd Street follows the active pathway along one side of the road (which may need to be reinforced and widened). Special signage and treatment will be required at intersections with the introduction of a motorized vehicle along a traditionally non-motorized path. Access to 32nd Street is limited to the intersections, with fencing prohibiting pedestrian access along the duration of the corridor.

Population and Community Characteristics

- Limited access to the residential neighbourhoods along 32nd Street because of continuous fencing.
- Connects Seaman Stadium, the Okotoks Operations Centre, the Recreation Centre and schools.
- Does not provide connections to commercial destinations or Okotoks Town Centre.
- No direct service to senior housing or 55+ residences.

Physical Infrastructure Characteristics

- Two lane road with left hand turn lanes at intersections.
- Two signalized intersections at Milligan Drive and Crystal Shores Road.
- The active path along 32nd Street may require widening and reinforcement for shuttle operation.
- Special consideration should be given to all street crossings from the active path.

LEGEND

Yes No

Route Quick Facts

Route distance	Travel time (estimated)	Frequency with one vehicle	Estimated population (within 400 metre radius)
2.7 km	**8-10 minutes**	**20 minutes**	**5,300 people**

Access Priorities

Does this route give access to 6th+ grade schools?

Does this route give access to senior housing?

Town Priorities

Does this route contribute to a healthy lifestyle?

Does this route improve mobility across the river?

Does this route enhance the economic vitality in the town centre?

Route E – Library to Arena

Route E travels along Sheep River Pathway, Woodhaven Drive, and Woodgate Road, connecting Okotoks Public Library to Foothills Composite High School. This option also brings passengers to Southridge Emergency Services, Pason Centennial Arena, Foothills Centennial Centre, Centennial Village, and other commercial land uses including Safeway, Staples, Ford, McDonald's, and A&W. The shuttle would operate along an active transportation path for approximately half of the route and would travel on the street network for the remaining segments. The two alignment options include traveling south along Sheep River Pathway from the new bridge (Library connection) to Woodgate Road or Woodbend Way.

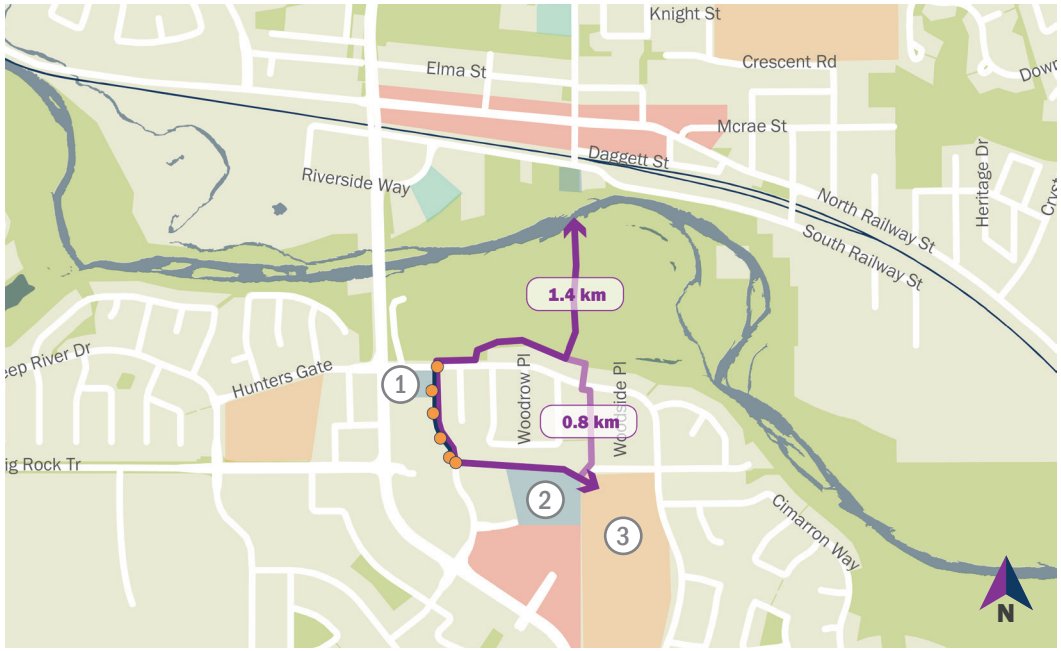
Alignments

Woodgate Road

To ensure a safe transition from the active path to the street at Woodhaven Drive and Woodgate Road, the intersection will need to be upgraded to a three– or four–way stop with special signage for human drivers to look for the shuttle entering from the active path.

Woodbend Way Alternative

Woodbend Way, while more direct, is not recommended because it has more than 24 driveways in one block length with parking on both sides. To accommodate a dedicated shuttle lane, parking on one side would need to be eliminated (at least). The shuttle could operate in mixed traffic for this one block length, but it is less desirable than Woodgate Road because of the driveways and pedestrian crossings. Woodgate Road also grants easier access to the commercial, retail and services district to the west, adjacent to Southgate Road.



Route E's preferred option along Woodgate Road serves these major destinations: 1) Southridge Emergency Services, 2) Pason Centennial Arena, and 3) Foothills Composite High School, as well as provides better access across the river. (See page 74 for base map legend)

LEGEND

ROUTES
- Proposed Route
- Proposed Route Alternative
- Optional Route Extension

FRAMEWORK
- Signalized Intersection
- All-Way Stop Intersection
- Unsignalized/Semi-Signalized Intersection (i.e. one or two-way stops) or Driveway
- Unsignalized/Semi-Signalized Intersection or Driveway (3+ in a row, usually single-family driveways)
- Additional Pedestrian Crossing
- On-Street Parking

Population and Community Characteristics

- Promotes a healthy lifestyle by increasing access to Pason and the Sheep River active pathway network for physical activity, and educational opportunities at the Public Library and High School.
- Provides additional river crossing, which is arguably one of Okotoks' greatest transportation challenges.
- Connects residents in the south to the town centre while eliminating the need to find parking.

Physical Infrastructure Characteristics

- Spends less time on public roads in comparison to other route options.
- Only six potential conflict points with vehicle and active mode users, including potential conflict at Hunters Gate with vehicles coming from Southridge Drive.
- No signalized intersections and no driveways on the east side of Woodhaven Drive, and only one intersection requires further review and potential upgrades.

LEGEND

Yes

No

Route Quick Facts

Route distance

1.4 km

Travel time (estimated)

4-5 minutes

Frequency with one vehicle

10 minutes

Estimated population (within 400 metre radius)

1,800 people

Access Priorities

Does this route give access to 6th+ grade schools?

Does this route give access to senior housing?

Town Priorities

Does this route contribute to a healthy lifestyle?

Does this route improve mobility across the river?

Does this route enhance the economic vitality in the town centre?

Route F – South Okotoks

Route F operates from Cornerstone Centre and Westmount Centre to Southbank Centre along Cimarron Blvd. Shopping opportunities on this route include the Walmart Supercentre, Canadian Tire, Winners, Home Depot, Costco, clothing stores, restaurants, fast food establishments, and other commercial destinations. Healthcare centres and various clinics are also located on this route including Pinnacle Medical Centres; Okotoks Health and Wellness Centre; physiotherapy, chiropractic, and massage clinics; dentist and orthodontist offices; and a naturopathic centre. This route alternative would require a designated lane to be created on Cimarron Blvd for the shuttle to operate, or it would require use of the active transportation path (Cimarron Parkway).

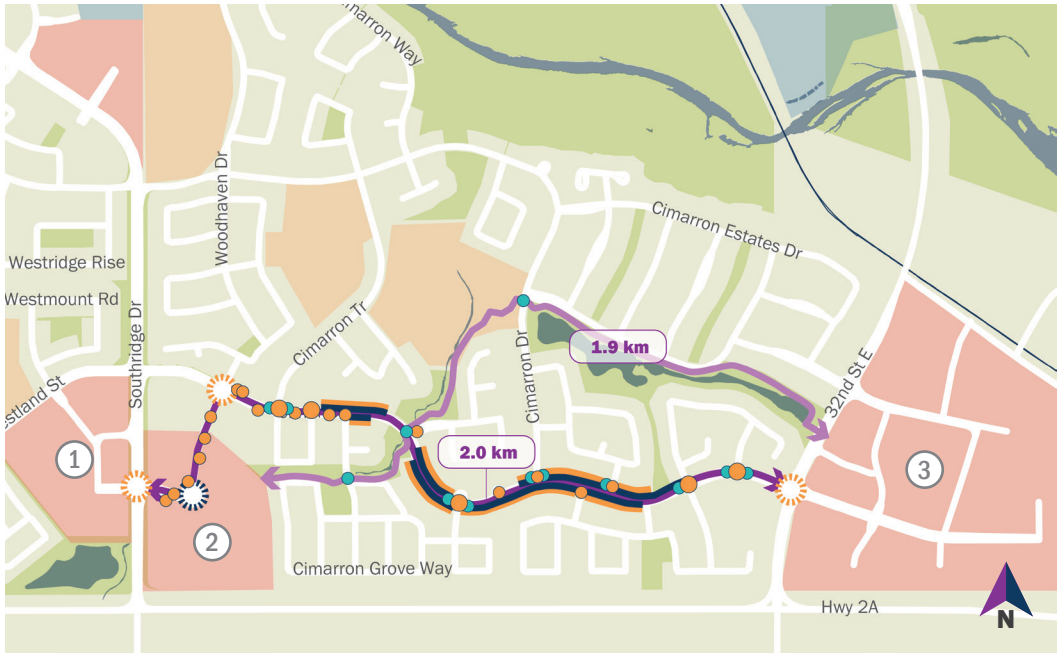
Alignments

Cimarron Blvd

This 2 km route requires the shuttle to travel along Cimarron Blvd between shopping centres. While this option provides higher visibility compared to the Cimarron Parkway option, there are over 100 driveways that would act as potential conflict points.

Cimarron Parkway Alternative

Similar in length to the option along Cimarron Blvd (1.9km), this option requires the use of an active transportation connection to travel between shopping centres. In addition, it also provides access to St. Mary's School. While this option has fewer conflict points and driveways, the shuttle's visibility would be low and would therefore require greater efforts to promote the service. The presence of the shuttle on the active connection may also reduce the amount of pedestrians and cyclists who use this pathway to the west, adjacent to Southgate Road.



Route F connects the three major shopping centres in the southern part of town: 1) Westmount, 2) Cornerstone, and 3) Southbank. This route has major complications along Cimarron Blvd due to multiple private driveways for single-family homes. (See page 74 for base map legend)

LEGEND

ROUTES
- Proposed Route
- Proposed Route Alternative
- Optional Route Extension

FRAMEWORK
- Signalized Intersection
- All-Way Stop Intersection
- Unsignalized/Semi-Signalized Intersection (i.e. one or two-way stops) or Driveway
- Unsignalized/Semi-Signalized Intersection or Driveway (3+ in a row, usually single-family driveways)
- Additional Pedestrian Crossing
- On-Street Parking

Population and Community Characteristics

- Provides connection to numerous commercial and service destinations, and connects to major activity centres at both ends of the route.
- Reaches a relatively large population within 400m of the route.
- Preferred option (Cimarron Boulevard) does not provide access to grade 6+ schools or senior housing.

Physical Infrastructure Characteristics

- Preferred option (Cimarron Boulevard) must navigate over 100 driveways and unsignalized intersections.
- A separate lane will be required for the shuttle to operate in its own right-of-way.

LEGEND

Yes

No

Route Quick Facts

Route distance

2.0 km

Travel time (estimated)

6-7 minutes

Frequency with one vehicle

14 minutes

Estimated population (within 400 metre radius)

5,400 people

Access Priorities

Does this route give access to 6th+ grade schools?

Does this route give access to senior housing?

Town Priorities

Does this route contribute to a healthy lifestyle?

Does this route improve mobility across the river?

Does this route enhance the economic vitality in the town centre?

Comparative Analysis

	Route A	Route B	Route C	Route D	Route E	Route F
Route Distance	1.6 km	2.7 km	2.2 km	2.7 km	1.4 km	2.0 km
Travel Time (est)	5-6 mins	8-10 mins	7-8 mins	8-10 mins	4-5 mins	6-7 mins
Frequency with 1 vehicle	12 mins	20 mins	16 mins	20 mins	10 mins	14 mins
Estimated population (within 400-metre radius)	3,200 people	2,500 people	6,000 people	5,300 people	1,800 people	5,400 people
Does this route give access to 6th+ grade schools?	✓	--	--	✓	✓	--
Does this route give access to senior housing?	✓	--	✓	--	✓	--
Does it contribute to a healthy Okotoks?	✓	--	--	--	✓	--
Does it help improve mobility across the river?	✓	--	✓	--	✓	--
Does it contribute to the economic vitality of town centre?	✓	✓	--	--	✓	--

LEGEND

Yes ✓ No --

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CHAPTER 4

Preferred Self-Driving Shuttle Alternative

Preferred Self-Driving Shuttle Alternative

Routes A and E

The analysis table to the far right compares all potential routes against a series of five criteria which reflect Okotoks' values and priorities. Routes A and E are the most suitable, and when combined, create a logical, seamless route that creates a new connection across the Sheep River. Serving hundreds of students, the downtown and other business/commercial areas, the short route accomplishes a lot.

Service Profile

Individually, each route can be operated with one vehicle in service and maintain a headway that is attractive to users (10–15 minutes). Operating routes A and E together should be done with two vehicles to maintain that same level of service. The vehicles typically operate at a top speed of 20 km/hr.

Shuttle stops for passengers to be picked up and dropped off will be predetermined and will likely include (from north to south):

- Recreation Centre (A)
- Veterans Way and Okotoks Drive/Centre Court (A)
- Veterans Way and Elma Street/Elizabeth Street (A)
- Okotoks Library (A)
- Woodhaven Drive and Woodgate Road (E)
- Woodgate Road and the active pathway (E)
- Pason Arenas (E)
- Foothills Composite High School (if path extends) (E)

The preferred self-driving shuttle alternative is a combination of Routes A and E. These best serve the priorities of the community in a logical and safe route.

Infrastructure Considerations

Route A

Alignment

While alignment requires further analysis, the simplest option is for the shuttle to operate in mixed traffic along Veterans Way and either mixed traffic or in a protected lane along Milligan Drive. The shuttle would follow the exact same pattern and rules that all other road users use. A comprehensive education program including signage and painting will help inform all users of the low speed shuttle operation.

Volume and Speed

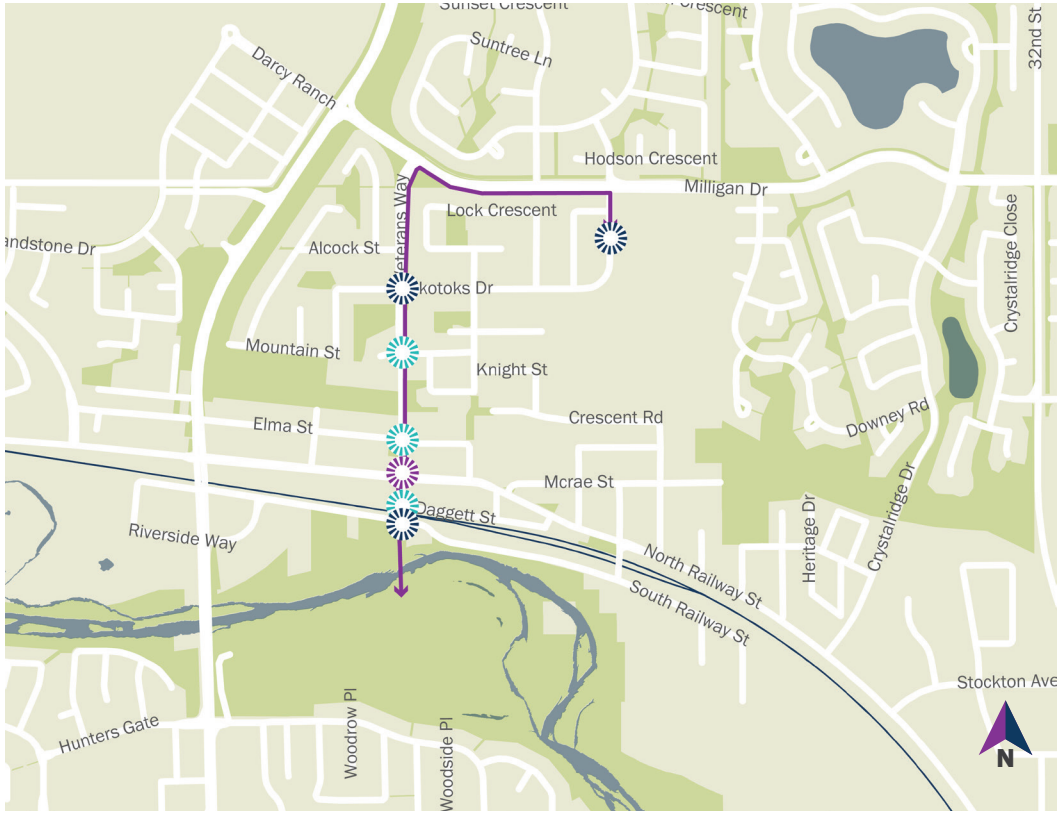
While traffic volume and speed on Veterans Way are amendable to a self-driving shuttle, volume and speed are considerably higher on Milligan Drive. Considerations should be made to protect all road users by either slowing traffic or creating a protected lane for the shuttle, or both. Signage and pavement markings will aid in alerting road users of the shuttle's low speed operation.

Intersections

All signalized intersections should be connected (V2I) to the shuttle to ensure safe operation through the intersections, including the railroad crossing. Additional enhancements to the Veterans Way and Milligan Drive intersection may be warranted.

LEGEND

- Transit Priority Signalized Intersection
- All-way Stop Intersection (add cautionary signage and HAWK signal)
- Unsignalized Driveway (add cautionary signage)



The proposed intersection enhancements along Route A are shown above.

Route E

Alignment

This route includes the use of two active pathways and one bridge, in addition to the road network. Moving from north to south, the vehicle transverses the new bridge across the Sheep River, continues along the active pathway system, Woodhaven Drive, Woodgate Road, and finally it follows the active pathway that connects Pason Arena and the high school. The bridge crossing may be enhanced with connected technology warning users of the shuttle approaching and giving the shuttle right-of-way. A similar system could be used for emergency response vehicles. While detailed analysis is required, operation in mixed traffic is recommended. Alternatively, there is likely enough right-of-way to create a dedicated path along the eastern side of Woodgate Road. The two active pathway portions of the route should be signed and enhanced by adding laybys for active users to step into and wait for the vehicle to pass.

Volume and Speed

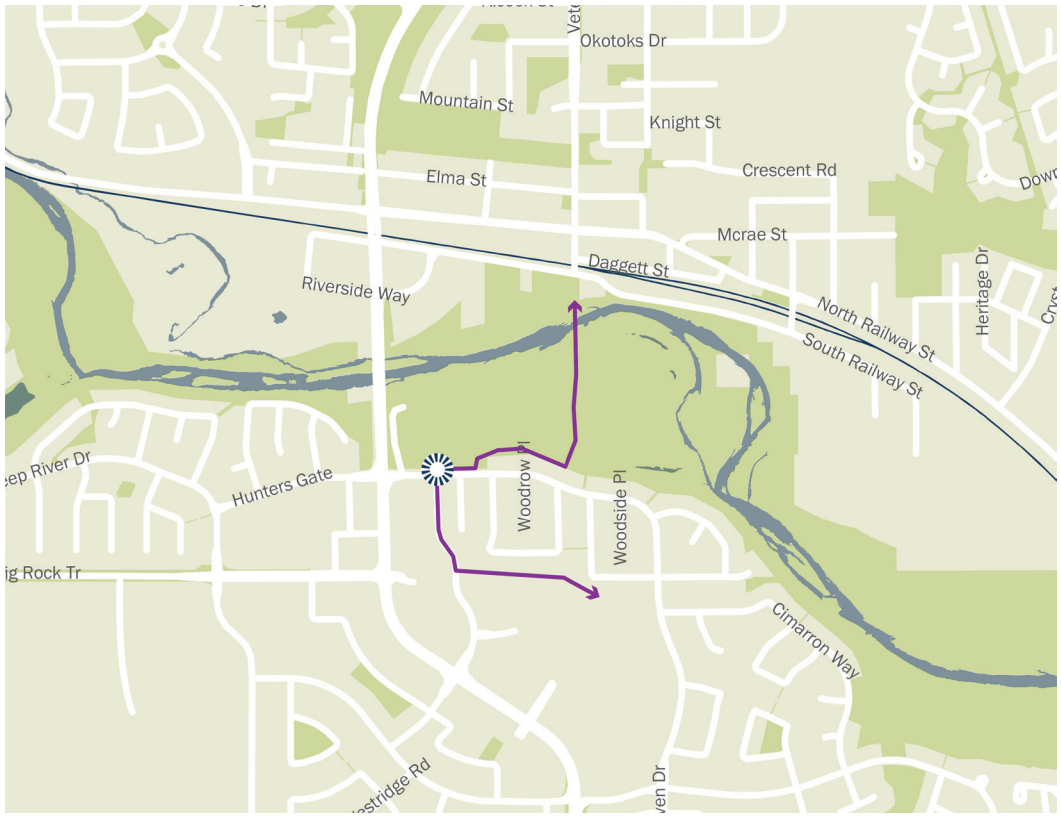
The volume and speed of traffic on Woodhaven Drive and Woodgate Road are low and slow and conducive to shuttle operation.

Intersections

There are no signalized intersections along route E, and considering the low volume of traffic, only signage and painting may be required. However, enhancements like using connected vehicle technology to turn on lights when the vehicle approaches the intersection will only add value.

LEGEND

All-way Stop Intersection (add cautionary signage and HAWK signal)



The proposed intersection enhancements along Route E are shown above.

Cost Estimate

High-level cost estimates and considerations are included here to inform the discussion for implementing this new technology. Costing categories are similar to traditional transit systems, however the details vary.

Initially, when testing begins, the service will be more expensive than traditional transit because the vehicles will require an on-board attendant to be present at all times. The anticipated cost savings are realized when the vehicles operate autonomously, without a human onboard. The cost of the operator accounts for 60-80% in most transit agencies. The higher cost of the vehicles and associated expenses will reduce this savings by approximately 10-30%, still creating a significant annual operating cost savings.

Start-Up Costs

Start-up costs include vehicle shipping, site commissioning, route mapping and programming, staff training, and other items. Costs vary dramatically, and sometimes are included in the monthly lease fee, while they tend to be additional if the vehicle(s) is purchased outright.

Capital

Each shuttle can be purchased or leased. Purchase price ranges from $280,000 - $400,000. Leasing monthly fees vary dramatically depending on the terms of the lease. A 3-year lease will have lower monthly fees than a 1-year lease. Costs can range from $10,000/month to $20,000/month. Infrastructure cost estimates are not included in this concept plan.

Operating

Excluding the vehicle capital cost and monthly lease fee, operating costs are primarily composed of wages for the onboard attendant. Additional expenses include the software licensing fee for the shuttle, insurance, maintenance, remote monitoring and supervision, and others.

Start-Up Costs
- Vehicle shipping
- Site commissioning
- Route mapping and programming
- Staff training
- Other ancillary items

Capital
- Shuttle purchase or lease

Operating
- Wages for onboard attendant
- Software licensing fee for shuttle
- Insurance
- Maintenance
- Remote monitoring and supervision
- Potentially other costs

CHAPTER 5
Moving Forward

Okotoks Self-Driving Shuttle

The output of this concept plan and feasibility study is a preferred route that has been determined to be feasible for the technology at this time. The remaining steps required before opening day are not cumbersome, and the design and engineering work can be completed relatively quickly. The components that may require the most time include stakeholder engagement and regulatory approvals. To date, there has not been a deployment on public roads in Western Canada; however, the first public road deployment occurred in summer 2018 in Candiac, Quebec, and many others are in the works. Being the first often requires more time and extra due-dilligence. The major milestones to complete prior to deployment are summarized below.

Detailed Route Design

The detailed design phase should answer all questions, create solutions for a safe route and describe the operating plan and environment so that the Town is prepared to advance to procurement.

Block by block, stop by stop and intersection by intersection analysis is required to evaluate safety, risks, barriers, potential conflicts and alignment. In addition:

- Each termini and all stops require detailing.
- Infrastructure and Intelligent Transportation System (ITS) modifications need to be evaluated.
- Site selection for secure vehicle storage and charging is required.
- Regulatory compliance is required.
- Cost estimates must be developed for the deployment and operation of the service.

Stakeholder Engagement

Transportation authority is a shared responsibility between the federal, provincial and territorial governments; therefore, stakeholder engagement must occur on all three levels: federal, provincial, and local. With special consideration to the newness of the technology, engaging the entire community, with a focus on residents and businesses along the preferred route is important.

Federal Government

The *Federal Motor Vehicle Safety Act* (MVSA) establishes safety regulations for the importation and manufacturing of vehicles, and the shipment of vehicles across provincial/territorial boundaries.

Provincial Government

The Province determines which vehicles are allowed on public roads through licensing, registration, and insurance, as well as the laws and regulations for the safe operation of vehicles on public roads. Therefore, the Province is ultimately responsible for approving and overseeing testing of highly-automated vehicles.

Municipal Government

The Town of Okotoks ensures that local infrastructure can support the vehicles, enforces by-laws, implements public transit, and coordinates with local safety officers and emergency response personnel.

Funding Plan

To support the testing of highly autonomous vehicles in Alberta, a coordinated funding plan will identify all stakeholders, avenues of funding, and the final funding distribution between all parties.

Okotoks is also a recipient of GreenTRIP funds, some of which may be allocated to the capital costs associated with the piloting and testing of self-driving shuttles.

Procurement

Procurement will vary depending on the specific needs of the Town, but may include: the vehicle(s), operations, design and engineering, software, marketing and public relations, and program management.

Deployment

In this case, deployment includes the 2-3 months preceding opening day when the vehicles arrive, route mapping and site commissioning occur, vehicle and site testing, staff training, and the marketing and education campaign ramps up.

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