E-Micromobility
Risk Assessment

The Woodlands, TX

THE WOODLANDS TOWNSHIP

Completed
May 2025

Introduction

The popularity and access to electric micromobility devices has been rapidly growing across the nation. As use of these devices increases within The Woodlands, their impact on the safety of our pathways has been a growing concern. This ***E-Micromobility Risk Assessment*** has been commissioned by The Woodlands Township to study the potential safety risks of these devices to our pathways. While the study identifies common risks and potential solutions to mitigate these impacts, the primary use of this report is for research and analysis purposes.

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Executive Summary

Overview

The E-Micromobility Risk Assessment is was commissioned by The Woodlands to evaluate the safety risks and potential solutions electric micromobility device (EMD) usage on township pathways. This assessment addresses the growing concerns related to the safety to pedestrians, bicyclists, and EMD users along the pathway. The report includes:

Defining Micromobility: Seven common forms of micromobility are defined and reviewed to identify the devices' unique risks to the users and others. EMDs vary widely, with e-scooters and e-bikes having lower speeds and including more safety features, while emerging devices like e-unicycles and e-minibikes have higher speeds and fewer industry standards.

Regulatory Landscape: Local, state, and national regulations vary by entity, with The Woodlands currently prohibiting motorized vehicles on pathways, except for mobility devices necessary for the physically disabled.

Safety Risks: Common risks include collisions, falls, and battery-related incidents. Factors influencing these risks include device speed, vehicle mass, surface conditions, visibility, and user distractions.

Pathway Analysis: The Woodlands boasts 220 miles of pathways, with bicycle and pedestrian crash hotspots identified near major intersections. The pathways are primarily eight-foot-wide concrete paths, with some natural trails in the George Mitchell Nature Preserve.

Safety Solutions: Potential solutions include promoting helmet use, educating riders on safe practices, implementing speed limits, enhancing infrastructure, and establishing clear regulations for EMD usage.

Policy Options

The assessment underscores the need for proactive measures to promote the safety of all pathway users. As EMD usage continues to grow, ongoing policy and design updates will be needed to adapt to the evolving mobility landscape. There are two identified policy options and associated next steps for how the Township may proceed:

Option 1: Allow Certain EMDs on Pathways:

- Amend Township Order No. 019-09 to clarify which EMDs are allowed on the pathways.
- Create a Safety Education Coordinator position to monitor safety trends and inform residents on pathway and roadway safety.
- Amend Township Order No. 019-09 to establish system-wide speed limits to the pathways network and specific speed limits to high risk areas.

Option 2: Prohibit EMDs on Pathways:

- Create a Safety Education Coordinator position to educate residents on safety for EMD users on the roadway and their restriction on Township pathways.
- Provide education in schools and to parents about the restriction of EMD use on Township pathways.
- Expand the Town Center Ranger volunteer program to monitor EMD use on pathways.

Background

The Woodlands, Texas, has been a national leader in intentionally providing residents access to multi-use pathways that are safe and connected to prominent community destinations. Like many successful trails networks, the pathways in The Woodlands are more than just a recreation facility, providing a convenient commuting option for residents going to work or school. While initially designed for people to walk and bike along, the pathways have recently become corridors for residents to use their electric micromobility devices (EMD), such as electric bicycles or electric scooters.

The use of electric bikes, electric scooters, and other EMDs has been rising in the past decade. With the introduction of shared micromobility from companies like Lime and Bird, riding scooters and bikes for transportation has become a common occurrence in urban areas. In 2023, over 157 million shared micromobility trips were take in the US and Canada.[1] While shared micromobility is common in many communities, The Woodlands currently does not have any third-party operators in the area. EMD use is exclusively on personal devices owned by the individual.

The increased use of EMDs on The Woodland's pathways, particularly among younger residents, has raised concerns over the safety of all users, including pedestrians, traditional bicyclists, and the EMD users themselves. The higher speeds and heavier weight of these devices compared to their non-electric counterparts presents the risk of more severe crashes when they do occur. By reviewing existing and emerging EMD devices; local, state, and national regulations; common risks associated with EMD use; and solutions to improve safety, The Woodlands will be better positioned to provide safe facilities for township residents.

Bicycle, scooter, and EMD parking at Creekside Park Junior High.

Multi-use pathway in The Woodland Township.

Bicycle, scooter, and EMD parking at Creekview Elementary School.

Defining E-Micromobility

Electric micromobility devices (EMD) are any small, low-speed, electric-powered transportation device, including electric-assist bicycles (e-bikes), electric scooters (e-scooters), and other small, lightweight, wheeled electric-powered conveyances.[2] These devices are smaller and lighter than cars or trucks and have the flexibility to be used in a variety of spaces. This form of mobility is ideal for short trips, often one to two miles in length.

There are many of forms of EMDs in use today, some that are well established and have defined industry standards (e.g., e-bikes, e-cargo bikes) and others that are still emerging and rapidly evolving (e.g., e-skateboards, e-unicycles, e-scooters). In addition to EMDs, there are forms of micromobility that solely rely on human exertion to move (e.g., kick-scooters, bicycles, skateboards, etc). These forms of micromobility are generally considered safer than their motorized counterparts.[3]

While e-scooters and e-bikes are the most common EMDs and the primary focus of this study, this report will also review five other common e-micromobility devices seen in The Woodlands today. This include e-skateboards, e-unicycles, seated e-scooters, e-minibikes, and electric golf carts. A full description of each device, including common specifications and associated risks, are detailed on pages three through nine.

E-Micromobility Devices

E-Skateboard

Skateboards with an electric motor that allow riders to travel without manual pushing. (reference page three)

E-Unicycle

Single-wheeled, self-balancing personal transportation devices powered by an electric motor. (reference page four)

E-Scooter

Two-wheeled vehicles powered by an electric motor, designed for users to stand while riding. (reference page five)

E-Bike

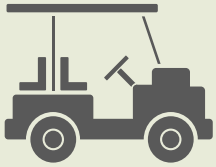
Bicycles equipped with an electric motor to assist with pedaling, making it easier to ride uphill or over long distances. (reference page six)

Seated E-Scooter

Two-wheeled vehicles powered by an electric motor, designed for users to sit while riding. (reference page seven)

E-Minibike

A compact small, two-wheeled electric motorbike designed for both kids and adults. (reference page eight)



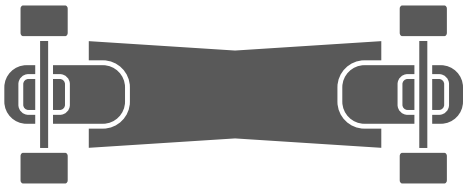
Electric Golf Cart

A small, four-wheeled vehicle typically used to transport golfers and their equipment. (reference page nine)

E-Skateboards

Electric skateboards (e-skateboards) are skateboards with an electric motor, allowing riders to travel without manual pushing. They are controlled using a handheld remote or by weight shifting, making them popular for commuting and recreation. Key features include a rechargeable battery-powered motor, a durable deck, terrain-adaptable wheels, and regenerative brakes.

They come in different riding styles, including commuter-friendly models, off-road variants with all-terrain wheels, and high-performance boards for speed enthusiasts. Many models feature customizable settings that allow riders to adjust acceleration, braking sensitivity, and speed limits to match their skill level.



The first motor-powered skateboard was created in 1975 using a gas engine.[8]

Category	Description	Notes
Speed[4]	32+ mph	While certain models may go over 32 mph, most models have a max speed of 26 mph.
Weight[5]	10 to 30 lbs	May vary by board size and battery type.
Width[6]	7.5 to 8.5 in	Varies by deck design and wheel placement. Can go up to 14 in for certain models.
Noise	Low	Primary noise factors are speed and surface material.
Power/ Battery Type	Lithium-ion	Power output varies from 250 to 3,000 W depending on motor configuration. Lithium-ion batteries may catch fire.
Common Safety Features	Braking system, traction tape, battery management system	Will vary by manufacturer, with some models including regenerative braking, LED lights, and shock-absorbing wheels.

mph - miles per hour
lbs - pounds
in - inches
W - watts
LED - light emitting diode

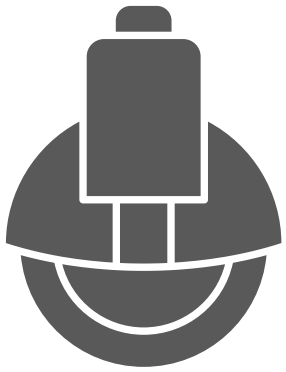
Common Risks

Risks associated with e-skateboards are primary related to speed of the device. High speeds may cause the user to "wobble," creating an unstable condition, causing the user fall or crash. The most common injuries are head injuries and fractures or sprains, usually occurring to the arms or wrists as riders try to break their fall using their hands.[7]

E-Unicycles

Electric unicycles (e-unicycles) are single-wheeled, self-balancing personal transportation devices powered by an electric motor. They use gyroscopes and accelerometers to maintain balance, with foot platforms for the rider to stand on and control the unicycle. E-unicycles are lightweight, portable, and popular for their maneuverability and unique riding experience.

E-unicycles have experienced significant growth in recent years. This is driven in party by their adaptability in urban settings, eco-friendly power source, and compact design. Because of their relativity new introduction, there are few rules and regulations pertaining to e-unicycles in jurisdictions across the US. [9]



Some e-unicycles models have built-in bluetooth speakers and colorful LED lights that flash in sync with the music. [14]

Category	Description	Notes
Speed[10]	12 to 45+ mph	There are electric unicycles with max speeds over 80 mph, but few consumer products are available at this speed.
Weight[11]	20 to 77+ lbs	Electric unicycles vary in size and weight, with some over 100 lbs.
Width[12]	5 to 14 in	May vary based by manufacturer.
Noise	Low/Mild	Primary noise factors are speed and surface material.
Power/ Battery Type[13]	Lithium-ion, nickel-metal hydride	450 to 12,500 W. Lithium-ion batteries may catch fire.
Common Safety Features	Headlights, taillights, and built-in gyroscopes for stability	Will vary by manufacturer.

mph - miles per hour
lbs - pounds
in - inches
W - watts

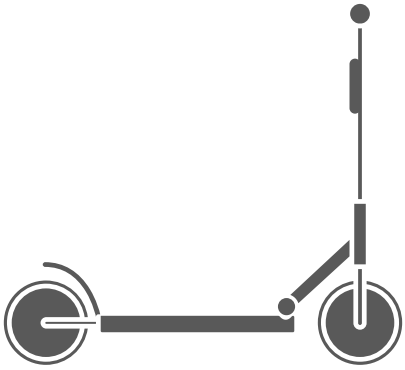
Common Risks

Crashes are common with e-unicycles, particularly in the early phase of learning to ride. While the devices are self-balancing, there is still a higher risk of falling compared to other personal transportation devices. Speed is also a concern, as they can reach higher speeds than other EMDs. They are sensitive to surface material, surface conditions, and other terrain, all which may cause the user to fall. Head injuries, fractures, and sprains are common after a fall.

E-Scooters

Electric scooters (e-scooters) are two-wheeled vehicles powered by an electric motor, designed for short-distance travel in urban areas. They are commonly used for commuting, running errands, or leisure rides. Key features include a rechargeable battery-powered motor, handlebars with controls, a standing deck, small wheels for smooth surfaces, and various types of brakes.

E-scooters are one of the fastest growing forms of micromobility around the world. Companies offering bike and scooter sharing quickly shifted their preference to scooters over bikes due to their popularity and ease of use. In 2017, companies such as Lime and Bird began deploying shared scooters in cities around the county. The introduction of e-scooters to these areas has prompted many individuals to purchase their own for personal use.



The first e-scooter, known as the Autoped, was manufactured in 1915 in Long Island, New York.[19]

Category	Description	Notes
Speed[15]	8 to 18+ mph	Speeds are typically regulated for e-scooters managed by companies such as Lime and Bird.
Weight[16]	23 to 55 lbs	Heavier models have larger batteries and more powerful motors.
Width	1.5 to 2 ft	Will vary by manufacturer.
Noise	Low	Primary noise factors are speed and surface material.
Power/ Battery Type[17]	Lithium-ion	Motor power rangers from 250 to 1,000 W, with higher wattage providing higher speed and quicker acceleration. Lithium-ion batteries may catch fire.
Common Safety Features	Braking system, traction control, lights, reflectors	Will vary by manufacturer. Some models include dual brakes for better stopping power.

mph-miles per hour
lbs-pounds
ft-feet
W-watts

Common Risks

E-scooter's primary risks are related to stability and collisions. Small wheels and high speeds can make riders vulnerable to falls, especially on rough terrain or when braking suddenly. Collisions with cars, pedestrians, or other obstacles are common in urban areas. Without proper safety gear, riders are at higher risk for head injuries, fractures, and sprains. Additionally, lithium-ion batteries can overheat or catch fire if damaged or poorly manufactured.[18]

E-Bike

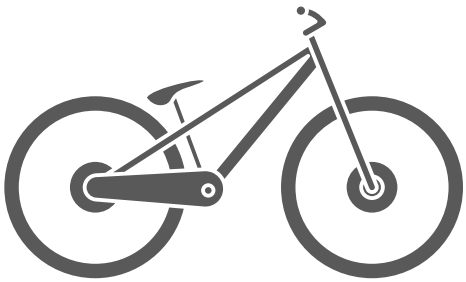
Electric bikes (e-bikes) are bicycles equipped with an electric motor to assist with pedaling, making it easier to ride uphill or over long distances. They feature a rechargeable battery, which powers the motor, and can be used in various modes, from full electric to pedal-assist. E-bikes are popular for commuting, recreational riding, and reducing the physical effort required for bicycling.

Texas state statute categorizes E-bikes by three classes:

Class 1: E-bikes provide pedal assistance up to a speed of 20 mph and do not have a hand actuated throttle;

Class 2: E-bikes are equipped with a hand actuated throttle that propels the device without pedaling (up to 20 mph); and

Class 3: E-bikes provides pedal assistance up to 28 mph, must have a speedometer, and do not have a hand actuated throttle.



The first e-bike was patented by American inventor Ogden Bolton Jr. in 1895, and has seen a massive boom on popularity in the past two decades. [25]

Category	Description	Notes
Speed[20]	14 to 28 mph	Electric assist will stop at 20 to 28 mph, but the user may go faster.
Weight[21]	30 to 85+ lbs	Will vary by manufacturer. E-cargo bikes will be heavier.
Width[22]	2 to 3 ft	Will vary by handlebar length. E-cargo bike may be wider.
Noise	Low	Will vary by tire width/type, speed, and surface material.
Power/ Battery Type[23]	Lithium-ion	252 to 998 W (Texas allows for 750 W max). Lithium-ion batteries may catch fire.
Common Safety Features	Front and rear lights, reflector, disc brakes	Will vary by manufacturer.

mph - miles per hour
lbs - pounds
ft - feet
W - Watt
LED - light emitting diode

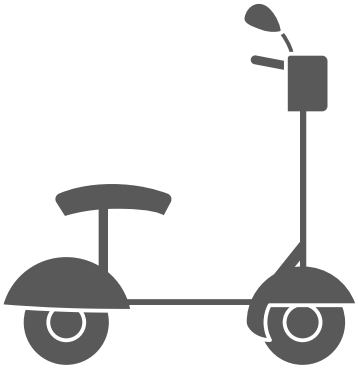
Common Risks

E-bikes can pose safety risks depending on their speed, battery power, and rider experience. Higher-speed models (Class 3) increase the risk of crashes, especially in traffic or when sharing roads with larger vehicles. Throttle-powered e-bikes (Class 2) may lead to loss of control if not handled properly. Heavier models can be harder to maneuver, making sudden stops or turns more difficult. Battery-related issues, such as overheating or fire hazards, can occur if the bike is overcharged or the battery is damaged.[24]

Seated E-Scooter

Seated e-scooters are two-wheeled vehicles powered by an electric motor, ideal for urban commuting and short-distance travel. Similar to electric scooters, they feature electric propulsion and rechargeable batteries. However, they also offer seating, often with storage options. Seated e-scooters are popular for their ease of use, low maintenance costs, and environmental benefits.

There are models of seated e-scooters that are higher speed and can be a street-legal substitute for motorcycles. These varieties (also known as electric mopeds) require insurance, licensing, and registration due to their higher speeds and motor power.[32] This makes them slightly less accessible than other EMDs.



Seated e-scooters are popular in several European countries, including the Netherlands, Germany, Turkey, and France.[37]

Category	Description	Notes
Speed[33]	15 to 55 mph	Seated scooters have similar speeds limitations as standing scooters. Higher powered scooters and mopeds are common.
Weight[34]	50 to 150 lbs	Varies based on battery capacity and frame material.
Width[35]	2 to 3 ft	Varies by manufacturer and style.
Noise	Low	Primary noise factors are speed and surface material.
Power/ Battery Type	Lithium-ion	Typically 350 to 500 W. Lithium-ion batteries may catch fire.
Common Safety Features	Lights, turn signals, disc breaks, mirrors, anti-theft systems	Will vary by manufacturer.

mph - miles per hour
lbs - pounds
ft - feet
W - Watts

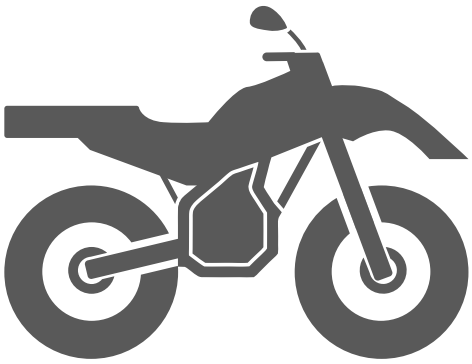
Common Risks

Seated e-scooters share risks similar to traditional mopeds and e-bikes, including crashes due to high speeds and urban traffic. Riders are vulnerable to collisions with larger vehicles, especially at intersections. Poor road conditions, wet surfaces, or sudden braking can lead to loss of control. Additionally, the quiet nature of electric motors may make them less noticeable to pedestrians and drivers, increasing the risk of collisions.[36]

E-Minibikes

Electric minibikes (e-minibikes) are small, two-wheeled electric vehicles designed for both kids and adults. They feature a compact design, rechargeable battery-powered motor, and are suitable for short commutes, recreational rides (on- and off-road). E-minibikes are popular for their convenience, "fun factor," and ease of use.

E-minibikes, when compared to e-bikes, are smaller, lighter, and generally more affordable. Additionally, some models have the capability to fold, which makes them convenient for taking on public transit or fitting into cars. This portability is a significant advantage for those who need a compact and versatile mode of transportation.[38] Varieties with 250cc engines require insurance, licensing, and registration due to their higher speeds and motor power.[39]



Popular e-minibike manufacturers include Rad Power Bikes and Buzz Centris, both known for their powerful motors and versatile designs. [43]

Category	Description	Notes
Speed[40]	10 to 40 mph	Varies by model and motor power.
Weight[41]	40 to 100 lbs	Models will vary based on intended users (children/adult)
Width[42]	20 to 30 in	May vary by frame size and tire size.
Noise	Low/Mild	Primary noise factors are speed and surface material.
Power/ Battery Type	Lead-acid or lithium-ion	Ranges between 25 to 1,000 W. Lithium-ion batteries may catch fire.
Common Safety Features	Disc brakes, LED headlights, speed limiters	Will vary by manufacturer.

mph - miles per hour
lbs - pounds
in - inches
W - watts
LED - light emitting diode

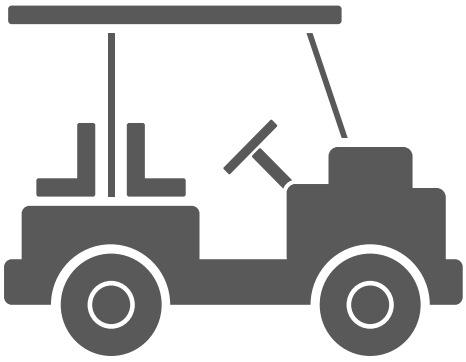
Common Risks

E-minibikes pose safety risks depending on their power and intended use. Lower-powered models for kids may lead to falls due to unstable handling, while mid-range models can be hazardous at higher speeds. High-performance models designed for adults carry greater risks of crashes, particularly on rough terrain or in traffic. Battery-related issues, such as overheating or overcharging, are more common in cheaper lead-acid models.

Golf Cart (Electric)

Electric golf carts are small, battery-powered vehicles. While initially designed for transporting golfers and their equipment around a golf course, they are often used for mobility around neighborhoods and other short distances. They feature quiet electric motors, comfortable seating, and storage space. Electric golf carts are popular for their convenience, ease of use, and eco-friendly operation.

They are capable of carrying multiple passengers and larger loads, making them a versatile option for various transportation needs. Their robust design and extended range further enhance their practicality for everyday use. While not typically considered an EMD, electric golf carts are common in The Woodlands and are being reviewed based on their potential to be used on township pathways.



Electric golf carts are favored for their quiet operation, while gas-powered carts tend to have more power and speed.[48]

Category	Description	Notes
Speed[44]	12 to 35 mph	Some models may be modified to go faster.
Weight[45]	500 to 1,100 lbs	Varies by models and battery type.
Width	4 to 5 ft	-
Noise	Low	Electric motors produces minimal noise.
Power/ Battery Type[46]	Lead-acid or lithium-ion	Most use 36-48 V battery systems, ranging from 3 to 5 kW. Lithium-ion batteries may catch fire.
Common Safety Features	Seat belts, headlights, turn signals, braking system	Will vary by manufacturer.

mph-miles per hour
lbs-pounds
in-inches
V-volt
kW-kilowatts

Common Risks

E-golf carts pose safety risks due to their low visibility and relatively slow speed, making them vulnerable in mixed-traffic environments. Their open design provides little protection in a collision, increasing the risk of injury. Sharp turns at higher speeds can lead to tipping, especially on uneven terrain or when carrying multiple passengers. Battery-related issues, such as overheating or fire hazards, can occur if not properly maintained.[47]

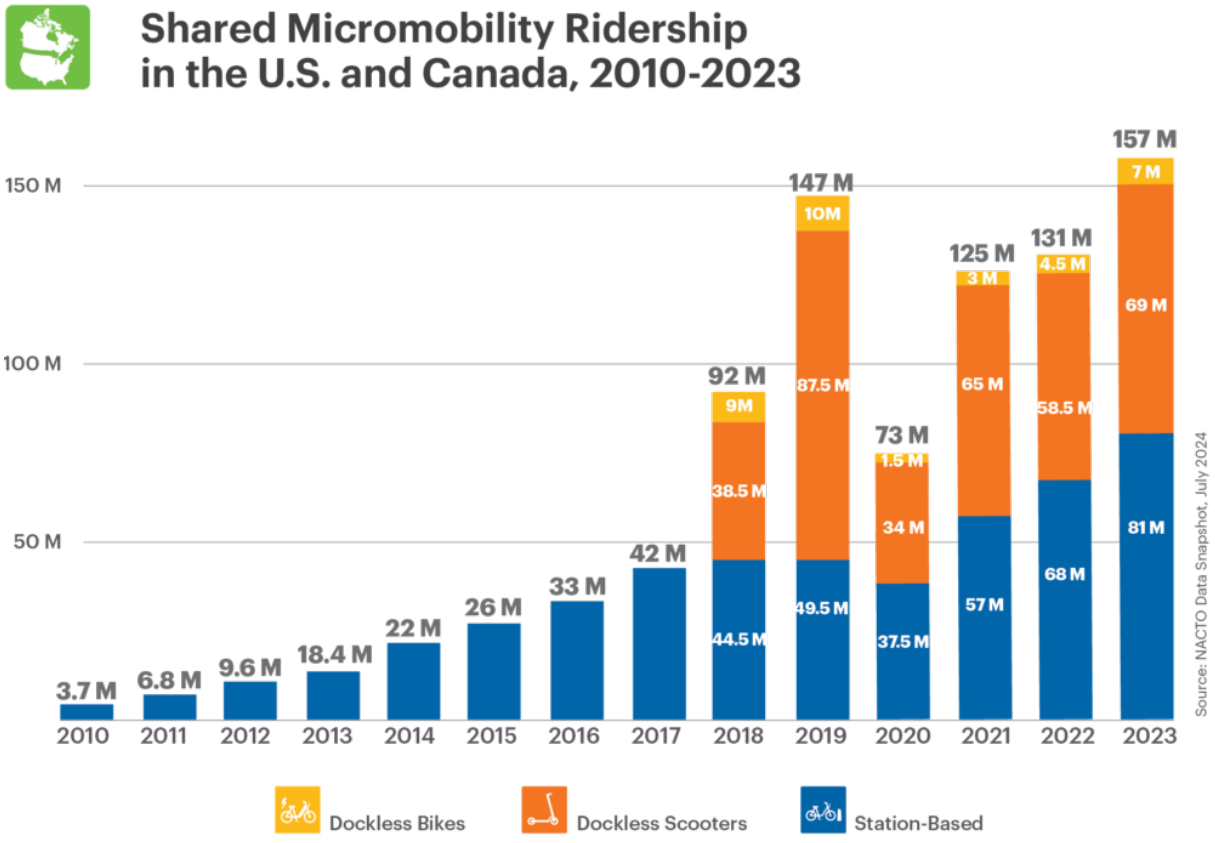
EMD Growth and Popularity

The adoption of electric micromobility has grown significantly over the past decade.[49] Advancements in battery life, affordability, and device durability have generated more interest from individual consumers. The global micromobility market is projected to continue expanding, with an estimated growth from $4.1 billion in sales in 2023 to $9.4 billion by 2030.[50]

Electric vs Gas

Electric-powered devices are considered more appropriate for trail and pathway when compared to gas-powered devices. This is due to their zero emissions and lower noise levels, which minimizes disturbances to other users and wildlife.

While little research has been conducted on personally owned EMDs, research into the growth of shared micromobility can provide insights into the growth of micromobility in general. Information from the National Association of City Transportation Officials (NACTO) indicates the the use of shared micromobility is still increasing in the US and Canada, going from 131 million trips in 2022 to over 157 million trips in 2023, a 20 percent increase.[51]



Regulations and Standards

Local, state and federal laws and regulations are important tools to create a safe environment for people using electric micromobility devices (EMDs) and those they interact with. This section reviews existing regulations as they relate to EMD use in The Woodlands.

The Woodlands

Code of Conduct and Covenants

The Woodlands Township Order 019-09 prohibits the use of motorized vehicles on all Township owned pathways, except for devices necessary for the physically disabled. This regulation includes e-bikes, e-scooters, and other EMDs.[52] While the State of Texas allows e-bike use on state and municipal owned trails, The Woodland's unique status as a township exempts it from this ruling.[53]

Article V, Section 5.01 of the Woodland's Covenants states that every owner, including children, shall have the right to enjoy all community facilities. Safety of these users has been central to the past ruling of prohibiting motor vehicles on Township pathways.

The Woodlands Township Parks and Recreation Patron Code of Conduct guides what is appropriate for users on the pathways and in the parks system, including safety. The Code prohibits activities which place users or others at risk of injury, property damages, or infringe on the rights of other patrons or staff.

Pedestrian and Bicycle Master Plan

The Woodlands adopted the current Pedestrian and Bicycle Master Plan in 2016. This document provides guidance on the inclusion of EMDs on Township pathways, specifically suggesting the Township allow e-skateboards, e-unicycles, and Class 1 and Class 2 e-bikes access to the pathways network.

Chapter 7 of the Master Plan presents recommended programs and policies geared toward creating a safe active mobility environment, including: implementing a bike share program, improved safety training, and enforcement of rules on the pathways through a partnership with the Montgomery County Sheriff's Office.

The Master Plan also provides a sample bicycle and pedestrian ordinance (see Appendix A) which gives guidance for bicycle traffic regulations; use of sidewalks; access from alleys, driveways, or buildings; parking; riding restrictions; and helmet use over property owned by The Woodlands Township (not the roadway). The recommendations contained within the model ordinance were not adopted as of 2025.

State of Texas

Chapter 551 of the Texas Transportation Code contains sections that regulate the operation of e-bikes and operation of bicycles, mopeds, golf carts, and other low-powered vehicles. Most classes of e-bikes are treated by the code as equivalent to standard bicycles, with the exception of Class 3 e-bikes which have additional regulations. Applicable provisions of Chapter 551 also regulate the rights and duties of a person operating an EMD.

Key provisions include:

- Electric bicycles must stop or cease to function when the operator stops pedaling or when the brakes are applied.
- People may operate EMDs while crossing a street or when no sidewalk is available.
- Electric scooters are only to be operated where speed limits are 35 MPH or less - counties may prohibit this operation.
- Mini motorbikes are not authorized on publicly owned streets, sidewalks, or paths for bicycles.
- Parents may not knowingly permit children to violate these rules.[54]

Chapter 664 of the Texas Transportation Code defines the three classes of e-bikes and requires clear labeling of the bicycle by class, top assisted speed, and the motor wattage. Any Class 3 e-bike is required to have a speedometer. There are no age requirements for Class 1 and Class 2 e-bikes, however someone must be 15 years of age or older to operate a Class 3 e-bike.[55] E-bikes can have a maximum power of 750 watts and the assisted power speed cannot exceed 28 MPH. [56]

The Texas Parks and Wildlife Department applies the same rules of regular bicycles to e-bikes, but does not allow e-bicycles on park trails.[57]

Chapter 551 of the Texas Transportation Code allows golf carts to be operated in master planned communities or on roadways with a posted speed limit less than 35 MPH. They must maintain speeds of 35 MPH or less; have lights, reflectors, mirrors, and a parking brake; and all drivers must possess a valid drivers license. Golf carts are different from "neighborhood electric vehicles" which require licensing, insurance, and registration from the Texas Department of Motor Vehicles.

National Standards

The US Department of Transportation and the Federal Highway Administration (FHWA) have prepared guidelines for states and local agencies on e-micromobility, including safety and infrastructure, access and mobility, data, regulations, and funding. Common regulations recommended by local governments include: helmet use, minimum age, braking, lights/reflectors, safety guidelines, yielding to pedestrians, number of riders, number abreast, and parking.

FHWA has conducted research on related topics that are available on the FHWA's e-bike literature review. These topics include:

- Ridership trends
- Safety
- Infrastructure impacts
- Equity

FHWA has also conducted research on the use of e-micromobility on public lands. In August 2019 the Department of the Interior (DOI) issued Order 3376-2019 which aims to increase recreational opportunities for all Americans, especially those with limitations, to encourage the enjoyment of lands and waters managed by the DOI. As technology advances and population grows, public lands are working to determine the feasibility of allowing EMDs in these areas.[58]

United States Code Title 23, Chapter Two, discusses the inclusion of multiple modes of transportation in the design of roadways. This code states that bicyclists and pedestrians shall be given consideration in transportation plans where appropriate except where prohibited. The Code also defines e-bikes as having fully operable pedals, a seat and an electric motor of less than 750 watts; that it can safely share a bicycle transportation facility with other users of the facility; and that it is a Class 1, 2 or 3 e-bike.[59] This is consistent with the State of Texas definition for e-bikes. [60]

Assessing Risks

As the popularity of EMDs continues to grow, understanding the factors that contribute to crashes and injuries becomes increasingly important. This section reviews the common issues that impact safety for EMD users and identifies safety strategies to mitigate the impact of these concerns. Research in this field is largely focused on e-bikes and e-scooters. While there is generally limited data on other forms of EMD crashes, the findings may still pertain to all forms of e-micromobility.

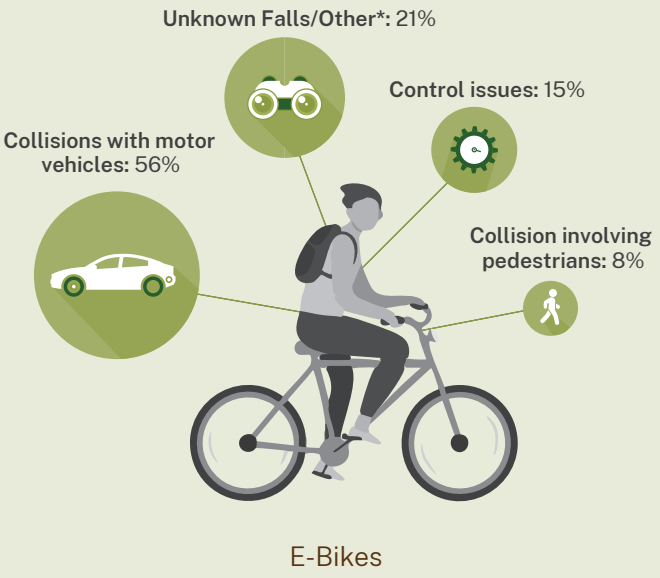
Safety Concerns

Several key factors can significantly influence the risk and safety of EMD users, such as:

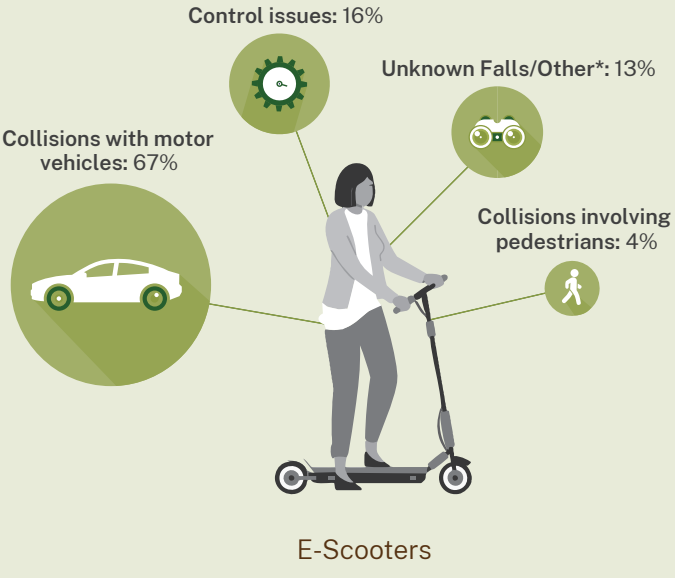
- *Speeds* - which impact crash risk and severity of injury.
- *Vehicle Mass* - which influences the force upon an impact.
- *Surfaces and Pathways* - which impacts the ability to stop and maneuver a device.
- *Visibility* - which influences a users reaction time to hazards.
- *Noise and Distractions* - which impacts a users ability to maintain focus and react to hazards.

These factors and their associated risks are expanded upon in pages 13 through 17.

Hazards Associated in EMD Fatalities[61]



E-Bikes



E-Scooters

*Other hazards include intoxicated riders, hitting a speed bump, residential fires caused by e-bike batteries, and e-scooter-related fires.

Speeds

Speed is a critical factor in the safety of any vehicle, including EMDs. The velocity at which a vehicle travels can significantly influence the likelihood and severity of crashes. Additionally, the likelihood and severity of an injury is directly proportional to the speed at impact. For example, the risk of head injuries to pedestrians when impacted by an e-scooter rider is reduced by up to 49 percent when the speed is reduced from 25 km/h to 15 km/h.[62]

Maintaining safe speeds is crucial, not just for the EMD user, but for all motorists. Vehicle speeds are the leading cause of serious injuries to users of micromobility devices (motorized and non-motorized). E-bikes tend to reach higher speeds compared to e-scooters, making them more likely to be involved in high-speed collisions. However, both types of EMDs can pose significant risks if not operated at safe speeds.

Safety Strategies

- Educate riders on the importance of maintaining control, especially at higher speeds.
- Educate riders on how the device weight and speed impacts the needed stopping distance, maneuverability, and reaction time.
- Apply a system-wide speed limit to the pathway system to encourage safe speeds.

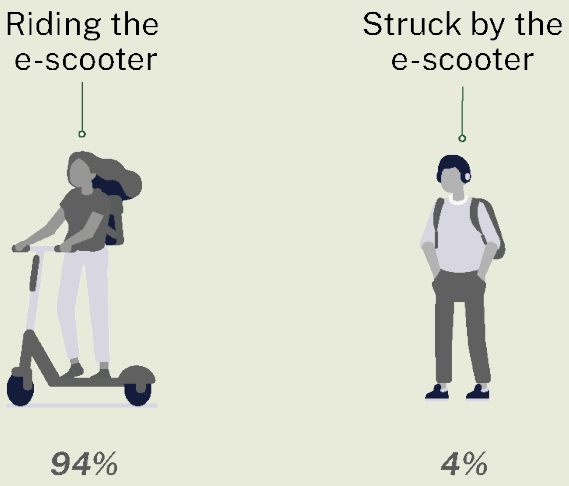
An expanded lists of safety solutions can be found on pages 19 through 24.

Vehicle Mass

The severity of injuries sustained by EMD users in crashes with motor vehicles is closely tied to the kinetic energy at the time of impact. Heavier vehicles possess more kinetic energy due to the physics of motion, which directly impacts the force of the collision. Research indicates that when a heavier vehicle strikes a bicyclist or pedestrian, the resulting force is likely to cause greater injury severity due to the increased momentum.[63]

EMDs vary in size and mass, with golf carts, e-cargo bikes, and e-bikes generally being heavier than e-scooters, e-skateboards, and e-unicycles. Like all vehicles, heavier devices can contribute to more severe injuries in the event of a collision. This is due the greater mass results in a higher force of impact. More mass also contributes to slower response times for to steering, braking, and accelerating.[64]

Distribution of Estimated e-Scooter Injuries by How Victim Was Injured[65]

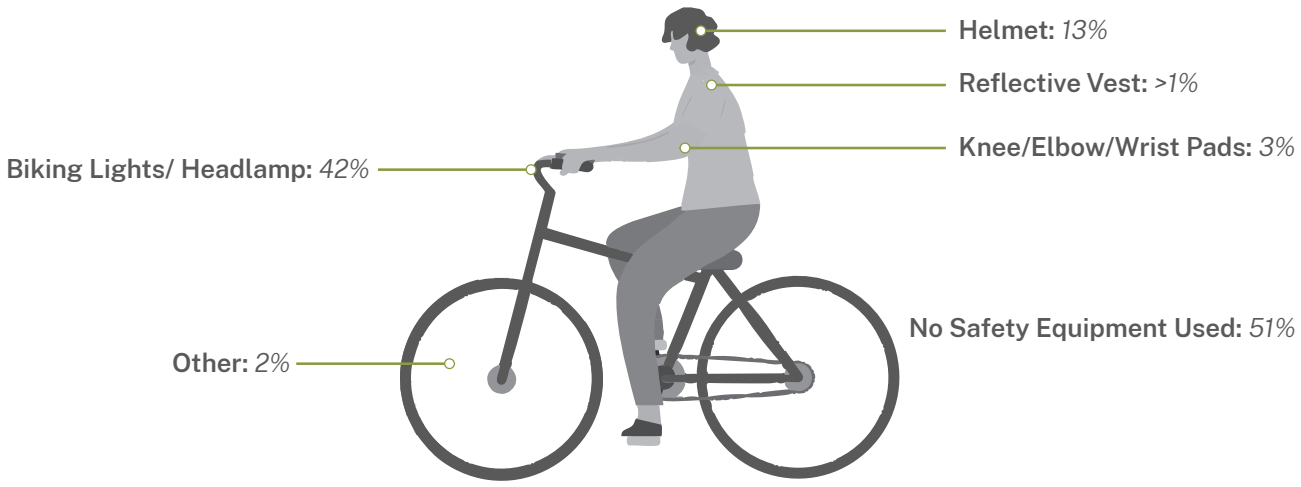


* Two percent of injuries are classified as Other/Unspecific.

Safety Equipment

Many crashes and user injuries can be mitigated through the use of personal safety equipment, such as helmets, reflective material, and lights. For example, studies have shown that bicycle helmets can reduce the risk of head injury by as much as 85 percent. Approximately half of bicycle users do not use any form of safety equipment.[66] Data specific to e-scooter users shows that helmet usage rarely exceeds five percent.[67]

Safety Equipment Usage in Crashes [68]



Safety Strategies

- Encourage riders to wear protective gear, including helmets and reflective material.
- Educate riders on the risks of not wearing safety equipment, particular the high rate of head injuries.
- Implement a public safety campaign to normalize and encourage the use of protective gear for all EMD users.

A comprehensive lists of safety solutions can be found on pages 19 through 24.

Surfaces and Pathways

There are many considerations that impact safety of users as it relates to the surface of a pathway. This include surface material (asphalt, concrete, and gravel), surface quality (irregularities such as potholes), surface condition (wet, dry), and facility (vehicle lanes, sidewalks).

Surface material impacts the ability of the user to control their vehicle. Different surfaces, such as asphalt, concrete, and decomposed granite, can significantly impact rider stability and control. For instance, concrete sidewalks, especially in neighborhoods, can cause high vibration levels, making the user more "wobbly," leading to discomfort and potential loss of control. Among EMDs, e-scooters and e-skateboards are the most impacted by surface material, as they are more prone to vibrations and instability.[69]

Poor surface quality has been linked to increased crash risk. Unexpected potholes, cracks, debris, and uneven surfaces can be difficult for riders to respond to, and lead to falls. EMDs, particularly e-scooters, are highly sensitive to surface irregularities due to their small wheels and lack of suspension. [70]

Wet Surface conditions can lead to hazards including loss of control, brake failures, and electrical dangers. Wet roads decrease traction, and tires can struggle to maintain grip, leading to users losing control when accelerating or breaking. Water on surfaces can also make brakes less effective, making a full stop take longer than on a dry surface. Lastly, water can impact the electric components of the vehicle, leading to potential malfunctions. Each EMD is impacted differently, but caution should be exercised for all types. [71]

Facilities designed for EMD users are uncommon. Unlike motor vehicle facilities that often take a relatively comprehensive process for planning and operations, almost all existing infrastructure shared by EMDs are originally designated for other purposes (such as sidewalks for pedestrians and bike lanes for bicyclists). According to the U.S. Consumer Product Safety Commission, 63 percent of injuries occurred on paved roads, 29 percent on paved sidewalks, and 5 percent on other surfaces.

Safety Strategies

- Educate residents on the rights that EMDs have to pathways and the road.
- Educate residents on the challenges associated with the use of EMDs when wet or hazardous conditions are present and educate users to the effects of slippery surfaces, including decreased traction and longer break times.
- Continue to inspect and address surface irregularities, such as potholes, cracks, and uneven surfaces that can increase crash risk.

An expanded lists of safety solutions can be found on pages 19 through 24.

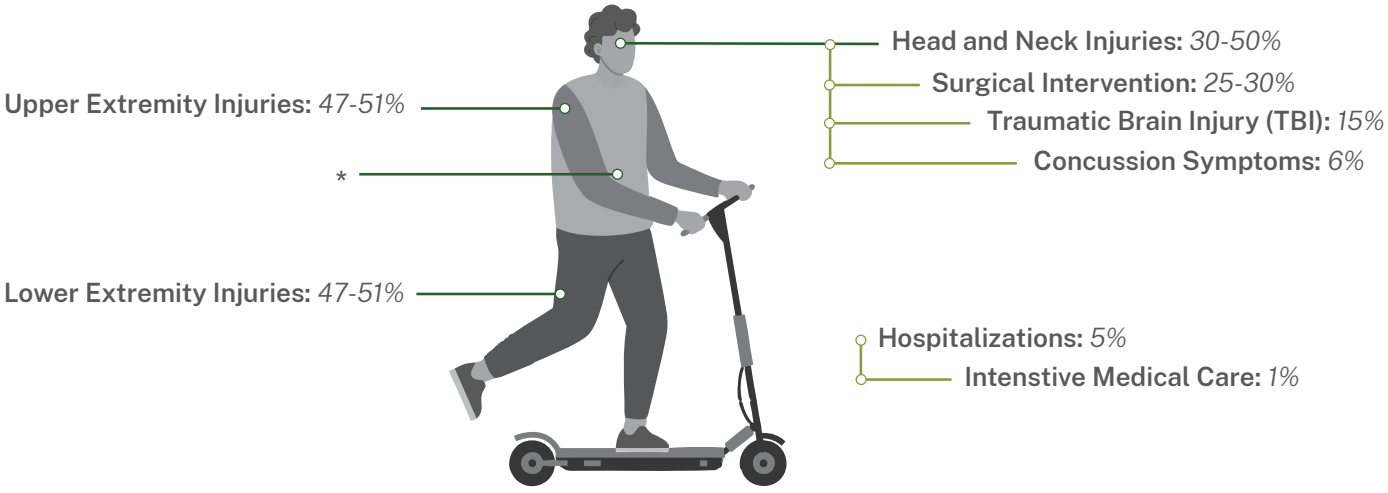
Associated Injuries

Injuries vary across different EMDs, with the most research focusing on e-scooters and e-bikes. E-bike riders are more likely to sustain spine and extremity injuries and have a higher mean Injury Severity Score. In contrast, e-scooter riders are more prone to head, thorax, and extremity injuries. Differences in age, gender, and riding behavior between users of these devices also contribute to the variation in injury patterns.[72] Between 2019 and 2022, the rates of e-bike and e-scooter injuries increased by 293 percent and 88 percent, respectively.[73]

Injury Severity Score

The Injury Severity Score (ISS) is a medical scoring system used to assess the severity of traumatic injuries. Developed by the Association for the Advancement of Automotive Medicine, it calculates injury severity by summing the squared values of the highest injury codes from the three most severely injured body regions. Scores range from 1 to 75, with higher scores indicating more severe injuries.[74]

Trauma Associated with E-Scooter Crashes[75]



*Chest and abdominal injuries are relatively rare, however, there have been reports of rib fractures, pneumothorax, and damage to the structure of the lungs or liver.

Visibility

Low visibility and poor lighting conditions can hinder EMD users' ability to respond to unexpected obstacles and make them less visible to drivers of larger vehicles. A year-long case study in Nashville, Tennessee found that while most e-scooter crashes occur during daylight (69 percent), a significant number also happen in dark conditions (26 percent).[76] Visibility is crucial for both EMD riders and other pathway users to avoid collisions. Research indicates that poor visibility conditions, such as low lighting or inclement weather, can increase the risk of crashes.[77] EMDs, particularly e-scooters, are more vulnerable during low visibility conditions due to their smaller size and lower speed. E-scooters are the most impacted by visibility issues, as they are less noticeable compared to e-bikes. The U.S. Consumer Product Safety Commission found that 75 percent of riders who experienced an injury reported that visibility was not an issue, 23 percent said it was, and two percent were unspecified.[78]

Noise and Distractions

According to the U.S. Consumer Product Safety Commission, 87 percent of riders who experienced an injury said that they were not distracted by noise such as music, although this number does not reflect general urban noise pollution. Noise can be a significant distraction for EMD users, impacting their ability to focus and react to their surroundings. High noise levels can mask important auditory cues, such as approaching vehicles or pedestrian warnings. Research indicates that urban noise pollution can lead to increased stress and reduced situational awareness for riders.[79] EMD users, particularly e-scooter riders, are affected by noise as they rely heavily on their senses to navigate safely. To mitigate the impact of noise, communities can implement noise reduction measures, such as sound barriers and quiet zones, and promote awareness campaigns to educate riders about the importance of staying alert in noisy environments.

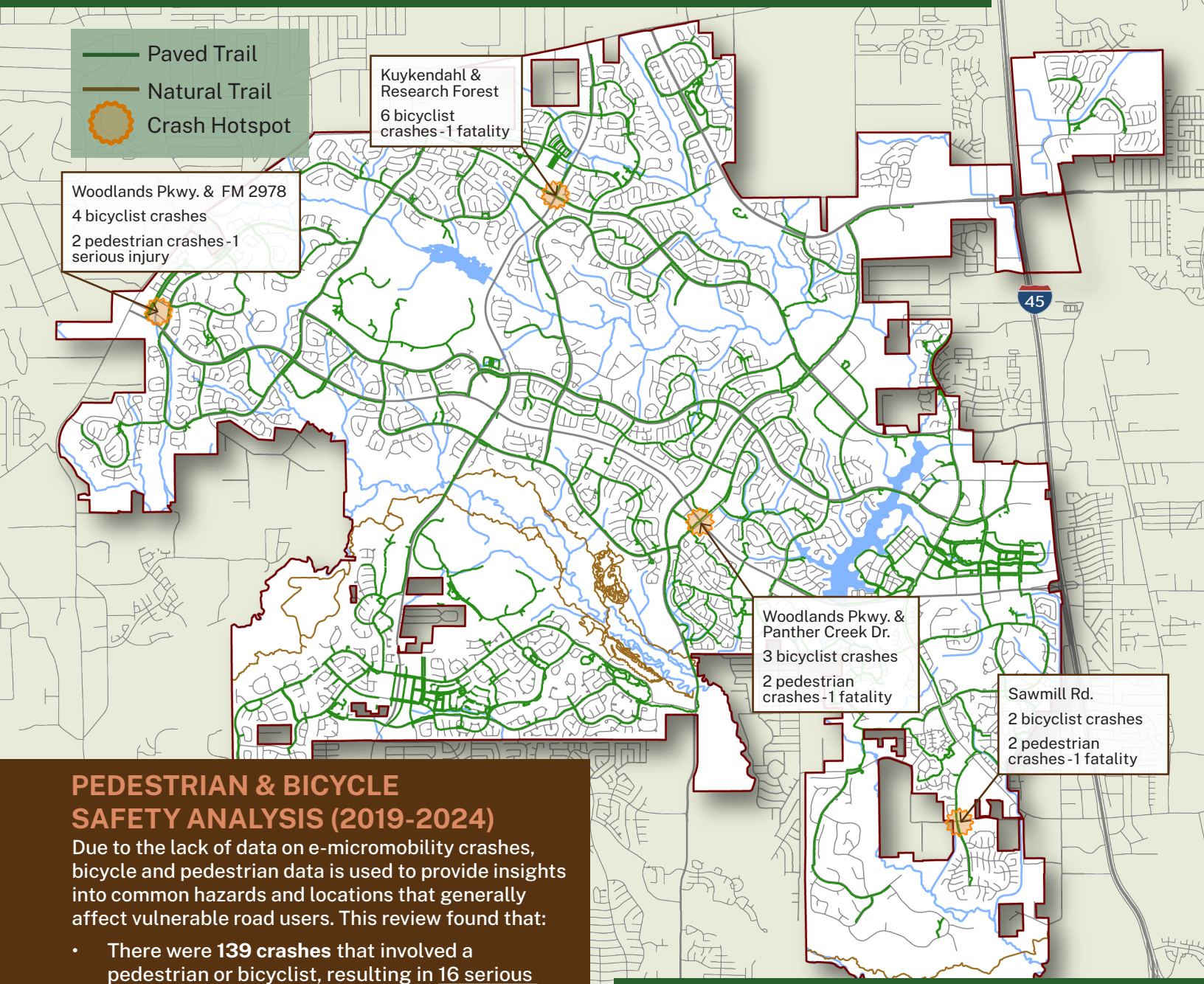
Safety Strategies

- Educate residents on the safety benefits of front and rear lights, as well as reflective material, to enhance visibility.
- Discourage the use of headphones, cell phones, loud music, and other distractions while using an EMD to ensure riders are fully aware of their surroundings.

An expanded lists of safety solutions can be found on pages 19 through 24.

Pathways in the Woodlands

The Woodlands boasts an extensive 220 miles of hike and bike pathways throughout the community. According to the Township's Parks and Recreation Department, every home in The Woodlands is located within a 10-minute walk of a park, pathway, or open space.



PEDESTRIAN & BICYCLE SAFETY ANALYSIS (2019-2024)

Due to the lack of data on e-micromobility crashes, bicycle and pedestrian data is used to provide insights into common hazards and locations that generally affect vulnerable road users. This review found that:

- There were **139 crashes** that involved a pedestrian or bicyclist, resulting in 16 serious injuries and five fatalities
- **72 percent** of non-motorized crashes occurred within 100 feet of a pathway
- **74 percent** of non-motorized crashes occurred at intersections or were intersection-related

Source: TxDOT CRIS Data 1/1/19 to 12/31/2024.
CRIS data does not classify EMD users.

Most pathways in The Woodlands are eight-foot-wide concrete paths located adjacent to roadways. Many are also placed behind neighborhoods with thick tree buffers to immerse pathway users in the natural environment. Unpaved paths are located within the George Mitchell Nature Preserve and have natural surface materials such as decomposed granite.

Safety Solutions

There are a series of common strategies that promote the safe and efficient use of e-scooters, e-bikes, and other EMDs within a community. This section provides best practices to enhance user safety, improve infrastructure, and promote overall operational effectiveness.

E-micromobility safety solutions are organized into four categories:

Operations

Promoting the safe and efficient management of EMDs through maintenance protocols, enforcement, and reporting.

Education

Increasing public awareness and user responsibility through safety campaigns, rider training, and community engagement initiatives.

Regulations

Establishing clear policies for the use of EMDs, including speed limits, parking rules, and operational guidance for users.

Design

Enhancing infrastructure, creating safer riding environments, and improved integration with existing transportation networks.

Operations

Fostering a safe operating environment for EMDs requires a strong foundation of monitoring, infrastructure maintenance, and proactive management strategies. Ensuring that devices are well-maintained, user behavior is monitored, and hazards are addressed in real-time can significantly reduce the risk of crashes and injuries. Further, integrating data-driven solutions and real-time feedback mechanisms can improve safety and efficiency. Solutions could include:

Promote the 311 Service Request System -$- The Woodlands 311 app provides residents with the ability to report concerns in the community, such as downed trees, maintenance issues, and directional signage request. The 311 system is directly linked to The Township's work order system, expediting request processing. By continuing to promote and use the reporting system, maintenance and safety concerns can be address promptly and effectively.

Distinct Data Categories -$- Work with local law enforcement or health agencies to collect crash data for e-scooters, e-bikes, and other e-micromobility modes. This data can be used to better track safety risks and casualty rates and help produce more informed incident reports, enable the community to better understand safety issues and needs.[80]

Maintaining Safe Infrastructure -$$- Poor surface quality and lack of maintenance often contributes to single user crashes. Using durable materials for these pathways can minimize repairs and provide a consistent, safe riding experience. Continuing to prioritize infrastructure maintenance and dedicated routes can reduce crash risks and improve safety for EMD users.

Trail Ranger Program -$$- Rangers monitor trail use and conditions, assist riders with information and first aid, and promote safe riding practices through education and outreach. This program can help reduce injuries and improve the overall trail use experience.[81] The Woodlands Township has an existing rangers program, but it could be expanded with volunteer efforts.

Telematics Data from Third-Party Vendors -NA- Through a partnership with third-party vendors, the Township could analyze real-time data on speed, trip routes, idling time, and acceleration to provide users with post-trip safety feedback. These reports can score each trip based on safety metrics, flag risky behaviors, and offer personalized feedback or tips to drivers. Over time, this system allows for trend analysis, targeted training, and the development of safety incentives.[82]

Approximate Cost

-$- Less than $10,000

-$$- Between $10,000 and $100,000

-$$$- More than $100,000

Education

Through the promotion of helmet use, teaching responsible riding habits, and ensuring riders understand vehicle dynamics, the likelihood of crashes can be reduced. Residents, schools, and the local government all play a role in fostering an informed and safety-conscious e-micromobility culture. The shared burden of safety involves everyone: EMD users, motorists, bicyclists, and pedestrians.

Education in Schools -$- Including safe EMD use education in schools can provide students with the knowledge and skills needed to safely operate their devices. This can include how and where to ride and safety tips for avoiding collisions. School safety programs could also include incentives for safe riding, such as rewards.[83]

Workplace Safety Programs -$- Employers in areas with high e-micromobility use could offer safety training for employees who commute using EMDs.[84]

Community Safety Workshops -$- Communities can organize events that provide hands-on training for new riders with a focus on the safe navigation of intersections and shared spaces.[85]

Education Booths at Community Events -$- Setting up booths at local events offer a high visibility opportunity to provide valuable information and resources to the public, offering tips on safe riding practices and distributing safety gear.

Promoting Helmet Use -$$- EMD users have a higher rate of head trauma during crashes due to increased speed and a higher center of gravity. Helmet usage, especially helmets that protect against facial injuries should be considered for users, especially younger and inexperienced users. This can be promoted through an outreach campaign and leveraging ad spaces, both physical and digital.[86]

Create a Safety Education Coordinator Position -$$- This role would involve promoting safe operating practices not just for users of EMDs, but for all roadway and pathway users including motorists, bicyclists, and pedestrians. Key responsibilities may include distributing safety gear, and providing hands-on training to ensure residents are informed on safety practices. The role could provide coordination for the strategies listed above.

Consumer Guidance

EMDs vary significantly in design, mechanics, and stability. Understanding these differences when purchasing an EMD can help reduce the risk of crashes and injuries. Key features to look for include:

- **Larger wheels**. Larger wheels improve stability and control, reducing the risk of crashes caused by small obstacles.
- **Optimized braking systems.** Hydraulic or electronic brakes offer better stopping power, especially in wet or high-traffic conditions.
- **Suspension systems.** Front or full suspension improves ride comfort on uneven terrain and helps maintain control.
- **Weight distribution and frame design.** A lower center of gravity enhances stability, particularly at higher speeds.
- **Ingress Protection (IP) water resistance rating.** Vehicles with a high IP rating (IP54 or higher) are better suited for wet conditions.
- **Battery range and efficiency.** Riders should consider vehicles with a range of at least 15–25 miles per charge for daily commuting.
- **Smart connectivity.** GPS tracking, app-based diagnostics, and security features help prevent theft and improve user experience.
- **Lighting and visibility features.** Integrated front and rear lights, turn signals, and reflective materials enhance nighttime safety.

Case Studies

Cities across the United States have proactively improved safety for multimodal transportation. Below are case studies highlighting success in each category.

Operations

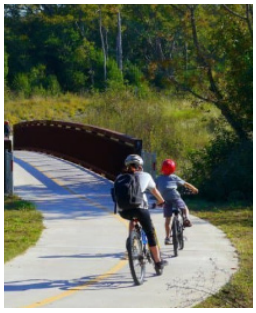
Evolve Houston, a 501(c)3, is a public-private collaboration that convenes public entities, industry leaders, and community residents to accelerate electric vehicle (EV) adoption and deliver real benefits to the community. In 2024, the organization launched a microgrant program to support local efforts in advancing electric mobility. In its second round, the grant funded 12 community organizations focused on EV education, rideshare pilots, and charging access in underserved Houston neighborhoods. The goal is to promote clean, equitable transportation at the grassroots level.[87]

Education

Watch for Me OK is a public awareness campaign from the Association of Central Oklahoma Governments (ACOG) and the Oklahoma Highway Safety Office (OHSO). It raises awareness about pedestrian, bicyclist, and EMD safety through public service messages, events, and partnerships. The campaign also provides educational materials to community leaders, including government staff, advocates, planners, law enforcement, engineers, health officials, parents, and educators. The program's goal is to reduce crashes and fatalities in Central Oklahoma.

Regulations

The City of Austin completed a pilot study in 2019 to allow e-micromobility on certain trails. The pilot was implemented to improve mobility after public requests for more convenient ways to navigate the city's network of protected bike lanes and trails. The pilot program was tested on a limited number of municipal trails, one of which was designated exclusively for e-micromobility. This program included educational pop ups along the trail, had rangers and parking enforcement monitoring speeds, incorporated electronic trail counters, installed etiquette signage, conducted an online survey, and used geofencing to limit speeds of rented scooters.



Design

The City of Boulder, with over 150 miles of bike and EMD friendly infrastructure, is a Vision Zero city aiming to eliminate serious injuries and fatalities through safe street design. The city uses peer enforcement and wayfinding signs to promote compliance with trail rules. Key design practices include separating walking and biking modes at major intersections, using rectangular rapid flashing beacons (RRFBs) for mid-block crossings, color differentiation in landscaping, and establishing dismount zones.[88]

Regulations

Regulatory measures, such as enforcing speed limits, verifying rider age, and discouraging risky behaviors help create a safer transportation network. Regulatory frameworks should be adaptable to technological advancements and pathway design needs.

Amend Township Order 019-09 -$- Should the Township decide to allow EMD vehicles on the pathway network, Township Order 019-19 must be amended to reflect the change. An amendment to Section C, Line iv should be changed to acknowledge which devices are allowed and which are restricted. This section should be further amended to clarify all other restrictions or requirements for EMDs on Township pathways.

Take Action Against Risky Riding -$- Address behaviors such as speeding, riding under the influence, underage riding (for Class 3 e-bikes), carrying passengers, riding on sidewalks, using non-designated paths, and mobile phone use while riding. This can be enforced through speed governors on EMDs, regular monitoring by authorities, and community reporting systems.

Establish Speed Limits -$$- Implementing and enforcing trail system-wide speed limits for EMDs, including tailored speed limits in high-risk areas, can help reduce the severity of conflicts between trail users. The Township should create buffer zones near schools and parks, restricting EMD use or enforcing slower speed caps through signage.[89] For areas with limited sight lines or complicated geometry (such as tight turns) or locations that experience heavy EMD and pedestrian / vehicle traffic, posted speed limits should be no greater than 10 mph.

Graduated Licensing or Tiered Age Access for Higher-Speed EMDs -$$- This includes Class 3 e-bikes and e-unicycles. This mirrors the way many European countries address higher-risk micromobility.[90]

Require Digital Age Verification for Third-Party Vendors -N/A- Third-party operators (if permitted) should be mandated to implement robust age verification systems. These systems can utilize various methods, such as database checks, mobile number identity verification, or biometric authentication, to accurately confirm the user's age.[91]

Geofencing for Third-Party Vendors -N/A- In the event third-party vendors become available, such as Lime or Bird, the Township should require them to use geofencing technology to automatically limit vehicle speeds in high-risk zones such as congested pedestrian areas, school zones, and busy intersections. Geofencing can also be used to designate no-ride or slow-ride zones, improving safety and reducing conflict points on shared pathways.[92]

Consistent Fleet Maintenance and Optimize Fleet Distribution for Third-Party Vendors -N/A- Requiring regular maintenance of e-micromobility vehicles is essential to reduce the risk of mechanical failures and injuries. If third-party vendors such as Lime or Bird operate in the Township in the future, they should be required to follow strict fleet maintenance schedules and provide documentation to ensure vehicles remain safe and functional for users. Additionally, shared micromobility vehicles should be distributed based on usage trends and community demand. The Township should work with vendors to use real-time data to prevent vehicle clustering, maintain availability in underserved areas, and reduce sidewalk clutter in high-traffic zones.[93]

Design

The design of pathways for EMD integration is key to creating a seamless and safe environment for all users. A well-connected network, clear signage, and designated parking areas reduce conflicts between EMD riders, pedestrians, and motorists.

A Well Connected Network -N/A- The Woodlands has an extensive, contiguous network that can lend itself to reducing conflicts between different mobility modes. At points where these users do intersect, it is important to clearly mark these potential conflict points and communicate where to go. Visibility and awareness of these points will help protect vulnerable users.[94]

Clear Wayfinding and Signage -$$- Marking conflict points, route directions, and safe riding zones can help users navigate efficiently.[95] Advance warning signage identifying trail crossings and major intersections will help notify trail users of potential safety hazards at the approach to an intersection. Additional signage near schools can help alert drivers of children traveling along pathways or crossing roadways to reduce conflicts between EMDs and vehicles.

Enhanced Trail Signage -$$- Additional signage should be added to the pathway system to educate users on trail etiquette and safety. Signage should clearly display that EMD users must yield to bicyclists and pedestrians, with pedestrians having the right-of-way to all other users.

Widen Pathways Where Feasible -$$- For new construction or major upgrades, pathways intended for shared micromobility and pedestrian use should be widened where feasible. This allows sufficient space for safe passing, accommodates bidirectional traffic, and reduces the risk of collisions. Wider paths can also better support future increases in user volume.[96]

Textured Pavement for Visual and Tactile Cues -$$- Installing textured or colored pavement along roadways, sidewalks, or pathways to visually and physically distinguish bicycle and micromobility riding areas from pedestrian zones or motor vehicle zones. Tactile surfaces can also alert users with visual impairments to lane transitions or upcoming intersections, improving accessibility. These should be prioritized in areas with high rates of bicycle and pedestrian collisions.[97]

Intersection and Roadways Crossing Safety Measures -$$- Work with the County to design protected crossings for pedestrians, bicyclists, and EMD users and introduce dedicated signal phases for these users, particularly in high crash areas.[98]

Adaptability -$$- Temporary infrastructure offers the significant benefit of flexibility that can evolve as more data is made available on EMDs. Modifying or redesigning sections of pathway to resolve issues that arise is a standard and anticipated aspect of the process. On-site monitoring helps in assessing the outcomes of preliminary measures and allows for necessary adjustments if problems are identified.[99]

Smart Docking Stations -$$$- Technology-enabled docking stations in high-traffic areas may improve vehicle organization, available charging, and improved security.[100]

Gentle Curves in Path Design -$$$- Most existing pathways in The Woodlands were designed with gentle curves, however, any new pathway development should avoid sharp turns and blind corners to improve sight lines. Instead, continue designing new paths with gentle curves and clear sightlines to improve visibility and give riders more reaction time.[101]

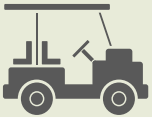
EMD Suitability Matrix

The Electric Micromobility Device (EMD) Suitability Matrix is intended to guide Township staff, board members, and residents on the suitability of each EMD on the different pathways found in The Woodlands today. To identify suitability, each EMD was reviewed for speed, weight, and width and it's relation to the pathway width and surface material. Each was categorized as "Suitable," "Conditional," or "Not Advised."

Suitable. The EMD presents few risks to users of the pathway (beyond what is present for standard human-powered devices).

Conditional. The EMD may be suitable on the pathway, but site specific review and additional regulation may be needed.

Not Advised. There are many risks associated with the use of the EMD on the pathway, creating significant safety hazards for pathway users.

E-Micromobility Device	Pathway Typology		
	Paved Pathway (8 ft)	Paved Pathway (10+ ft)	Natural Pathway (Unpaved)
 E-Skateboard	✓	✓	X
 E-Unicycle	X	X	X
 E-Scooter	✓	✓	X
 E-Bike (Class 1)	✓	✓	✓
 E-Bike (Class 2)	✓	✓	✓
 E-Bike (Class 3)	X	X	X
 Seated E-Scooter	⚠	⚠	X
 E-Minibike	X	X	X
 Golf Cart	X	X	X

**Recommendations are advisory only. See a detailed summary in Appendix A.*

Conclusion

This assessment highlights both the growing presence of electric micromobility devices (EMDs) in The Woodlands and the corresponding need for thoughtful and proactive safety measures. While creating a safe operating environment in The Woodlands for EMD users and others on the Township's pathway, sidewalk, and roadway networks will require ongoing efforts, there are two principle policy options for how the Township may proceed using the information within this ***E-Micromobility Risk Assessment***:

Option 1. Allow Certain EMDs on Township Pathways.

E-bikes and e-scooters make pathways more accessible to a broader range of people, including older adults and those with mobility challenges, while increasing the general use of township pathways. Should the township choose Option 1, key implementation steps could include:

- Amend Township Order No. 019-09 to clarify which EMDs are allowed on the pathways.
- Create a Safety Education Coordinator position to monitor safety trends and inform residents on pathway and roadway safety.
- Amend Township Order No. 019-09 to establish system-wide speed limits to the pathways network and specific speed limits to high risk areas.

Option 2. Do Not Allow Any EMDs on Township Pathways.

By not allowing any EMD's to use Township pathways, it may be easier to recognize when someone is violating the rules. However, the township would still face challenges on regulation and enforcement. Should the township choose Option 2, key implementation steps could include:

- Create a Safety Education Coordinator position to educate residents on safety for EMD users on the roadway and their restriction on Township pathways.
- Provide education in schools and to parents about the restriction of EMD use on Township pathways.
- Expand the Town Center Ranger volunteer program to monitor EMD use on pathways.

Regardless of the Township's preferred course of action, the use of EMDs is increasing and is projected to continue increase over the next decade.[102] Policy and design changes should be reviewed and updated on an ongoing basis to accommodate the changing mobility environment in The Woodlands.

Acknowledgments

This report was prepared for The Woodlands Township by Halff. Project staff include:

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Appendix A.

Sample Bicycle and Pedestrian Ordinance

Source: The Woodlands Pedestrian and Bicycle Master Plan, 2016

Bicycle and Pedestrian Ordinance

CHAPTER <<insert number>>. - BICYCLES. –

ARTICLE 1. - GENERAL PROVISIONS.

§ <<insert number>> - DEFINITIONS.

In this chapter:

(1) CHILD means a person younger than 17 years of age who has not been married or had the disabilities of minority removed for general purposes.

(2) BICYCLIST means a person operating a bicycle.

(3) PARENT means the natural or adoptive parent or court-appointed guardian or conservator of a child.

§ <<insert number>> - APPLICABILITY.

This chapter applies when a person operates a bicycle on a street or bicycle path.

ARTICLE 2. - BICYCLE TRAFFIC REGULATIONS.

§ <<insert number>> - APPLICABILITY OF VEHICLE TRAFFIC RULES.

Bicyclists shall comply with the requirements of this title imposed on a driver of a vehicle, to the extent that the requirements may be applied to operation of a bicycle.

§ <<insert number>> - OBEDIENCE TO TRAFFIC-CONTROL DEVICES.

(A) A bicyclist shall obey the instruction of official traffic signals, signs, and other traffic-control devices applicable to vehicles, unless otherwise directed by a police officer.

(B) Unless a bike lane is specifically designated otherwise, a bicyclist riding in a bike lane may not travel in the opposite direction of adjacent motor vehicles in the roadway.

(C) A bicyclist shall obey traffic signs that prohibit a right, left, or "U" turn, except when the bicyclist dismounts from the bicycle to make the turn. A bicyclist who dismounts shall obey regulations applicable to pedestrians.

§ <<insert number>> - USE OF SIDEWALKS RESTRICTED.

(A) A person may walk, run, or ride a bicycle on a sidewalk, pathway, or path.

§ <<insert number>> - EXITING FROM ALLEY, DRIVEWAY, OR BUILDING.

A bicyclist exiting from an alley, driveway, or building shall yield the right-of-way to a pedestrian on a sidewalk or sidewalk area, or to a vehicle on a roadway.

§ <<insert number>> - PARKING.

(A) A person may not park a bicycle:

(1) in a manner that obstructs pedestrian or vehicle traffic; or

(2) in a space designated as a vehicle parking place or between two designated vehicle parking places.

(B) A person may not attach or secure a bicycle to public or private property in a manner that may damage, impair, or render the property unusable.

(C) A person may park a bicycle:

(1) against a street curb;

(2) in a bicycle rack on a sidewalk; or

(3) against a building.

§ <<insert number>> - RIDING RESTRICTIONS.

(A) Except as otherwise directed by a traffic-control device or a police officer, a bicyclist shall ride:

(1) in the right-most lane available to vehicle traffic where vehicles are prohibited from parking along the right curb;

(2) in the center of the lane where vehicles are permitted to park along the right curb; or

(3) in the right-hand portion of an unlaned street.

(B) A bicyclist may not ride a bicycle between vehicles traveling or standing in the same direction within marked lanes of a roadway.

§ <<insert number>> - RIDING ON RESTRICTED OR PROHIBITED STREETS.

A bicyclist may not ride a bicycle on a street where bicycle riding is prohibited or on a street during the hours that bicycle riding is prohibited on the street.

ARTICLE 3. - BICYCLE HELMETS.

§ <<insert number>> - HELMET REQUIRED.

(A) A child may not operate or ride on a bicycle, sidecar, trailer, child carrier, seat, or other device attached to a bicycle unless the child is wearing a helmet.

(B) A parent may not permit a child to operate or ride on a bicycle, sidecar, trailer, child carrier seat, or other device attached to a bicycle unless the child is wearing a helmet.

(C) Under this section, a helmet must:

(1) be properly fitted and securely fastened to the child's head with the straps securely tightened;

(2) not be structurally damaged; and

(3) conform to the standards of the American National Standards Institute, the American Society for testing and Materials, the Snell Memorial Foundation, or a federal agency with regulatory jurisdiction over bicycle helmets at the time of the manufacture of the helmet.

§ <<insert number>> - APPROVAL OF STANDARDS.

(A) The Woodlands Township Board approves the bicycle helmet standards promulgated by the American National Standards Institute, the American Society for Testing and Materials, and the Snell Memorial Foundation.

(B) The Township clerk shall file a copy of the standards in effect on <<insert date>> in the clerk's office.

OPTIONAL ITEMS FOR FURTHER CONSIDERATION

§ <<insert number>> - PENALTY; ENFORCEMENT.

(A) A person commits an offense if the person performs an act prohibited by this article or fails to perform an act required by this article.

(B) An offense under this article is a Class C misdemeanor punishable by a fine not to exceed:

(1) <<insert dollar amount>> on a first conviction; and

(2) <<insert dollar amount>> on a subsequent conviction.

(C) The court may dismiss a charge against a person for an offense under Section <<insert number>> (*Helmet Required*) on receiving proof that the defendant acquired a helmet for the child who was operating or riding a bicycle in violation of Section <<insert number>> (*Helmet Required*) on or before the 30th day after the citation was issued.

(D) To promote the use of helmets, The Township Board encourages the court to consider deferred dispositions under Article 45.051 (*Suspension of Sentence and Deferral of Final Disposition*) of the Texas Code of Criminal Procedure where appropriate.

§ <<insert number>> - CIVIL ACTIONS.

(A) The city council adopts this article to encourage bicycle safety through the use of helmets and through the promotion of educational efforts.

(B) The city council does not intend this article to be used in a manner to prejudice a person, child, or parent in a civil action arising out of a bicycle accident. The council encourages construction of this article accordingly.

Appendix B.

EMD Suitability Matrix (Detailed)

E-Micromobility Device	Pathway Typology		
	Paved Pathway (8 ft)	Paved Pathway (10+ ft)	Natural Pathway (Unpaved)
E-Skateboard	**Suitable.** While faster than conventional skateboards, e-skateboards do not present a significant safety risk.	**Suitable.** While faster than conventional skateboards, e-skateboards do not present a significant safety risk.	**Not Advised.** The wheel size and lack of control is not suitable for unpaved areas.
E-Unicycle	**Not Advised** The high speeds and maneuverability challenges create heightened safety concerns.	**Not Advised** The high speeds and maneuverability challenges create heightened safety concerns.	**Not Advised** The high speeds and maneuverability challenges create heightened safety concerns.
E-Scooter	**Suitable.** The typical speeds and light weight of e-scooters presents little added risk compared to other modes of micromobility, such as bicycles.	**Suitable.** The typical speeds and light weight of e-scooters presents little added risk compared to other modes of micromobility, such as bicycles.	**Not Advised.** The wheel size and lack of control is not suitable for unpaved areas.
E-Bike (Class 1)	**Suitable.** The speed and weight of Class 1 e-bikes is comparable to human-powered bicycles and does not present a significant safety risk.	**Suitable.** The speed and weight of Class 1 e-bikes is comparable to human-powered bicycles and does not present a significant safety risk.	**Suitable.** The speed and weight of Class 1 e-bikes is comparable to human-powered bicycles and does not present a significant safety risk.
E-Bike (Class 2)	**Suitable.** The speed and weight of Class 2 e-bikes is comparable to human-powered bicycles and does not present a significant safety risk.	**Suitable.** The speed and weight of Class 2 e-bikes is comparable to human-powered bicycles and does not present a significant safety risk.	**Suitable.** The speed and weight of Class 2 e-bikes is comparable to human-powered bicycles and does not present a significant safety risk.
E-Bike (Class 3)	**Not Advised.** The higher speeds (28 mph) of Class 3 e-bikes creates a safety hazard for other pathway users.	**Not Advised.** The higher speeds (28 mph) of Class 3 e-bikes creates a safety hazard for other pathway users.	**Not Advised.** The higher speeds (28 mph) of Class 3 e-bikes creates a safety hazard for other pathway users and may damage unpaved surfaces.
Seated E-Scooter	**Conditional** The high speeds of some models may increase risk to pathway users. Slower speed models may be appropriate.	**Conditional** The high speeds of some models may increase risk to pathway users. Slower speed models may be appropriate.	**Not Advised.** The wheel size and lack of control is not suitable for unpaved areas.
E-Minibike	**Not Advised.** The high speeds present an increased risk to other pathway users.	**Not Advised.** The high speeds present an increased risk to other pathway users.	**Not Advised.** The high speeds present an increased risk to other pathway users and may damage unpaved surfaces.
Golf Cart	**Not Advised.** The width and high speeds of e-golf carts are not suitable for shared-use pathways.	**Not Advised.** The width and high speeds of e-golf carts are not suitable for shared-use pathways.	**Not Advised.** The width and high speeds of e-golf carts are not suitable for unpaved pathways or other shared-use areas.

**Recommendations are advisory only.*