2019

Optimus Ride Application to Test Automated Driving Systems (ADS) on Public Ways in Massachusetts

OPTIMUS RIDE

massDOT
Massachusetts Department of Transportation

BOSTONIA. CONDITA AD 1630.

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Application to Test Automated Driving Systems on Public Ways in Massachusetts

CONTACT INFORMATION:

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Street Address of Company's MA Office (if different):

City, Town of MA Office: ***State:*** ***Zip Code:*** ***Country:***

Mailing Address of MA Office (if different):

CERTIFICATION:

The Applicant certifies that all information contained within this application is true, accurate and complete to the best of its knowledge.

	Jenny Larios Berlin	10/14/2019
Signature of Applicant's Representative	***Printed Name***	***Date of Signing***
Treasurer/Secretary		
Position and Title	***Email address***	***Tel. No.***

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www.mass.gov/massdot

DETAIL #1 – Experience with Automated Driving Systems (ADS)

1.1 – A brief history of the Applicant's business as it regards ADS-equipped vehicles.

Participating in the Autonomous Vehicle Testing Program established by the City of Boston and MassDOT enables Optimus Ride to explore the promise of autonomous vehicles to improve road safety, expand access to public transit, enhance sustainability, and promote economic growth.

To date, Optimus Ride has driven many thousands of miles autonomously on public roads in Boston and logged many thousands more in the state of Massachusetts. Optimus Ride began testing its autonomous driving system on public roads in the Seaport in the summer of 2017 and has been operating commercially since 2018. At the beginning of 2019, we announced the launch of additional commercial programs in three communities across the United States: Halley Rise by Brookfield Properties in Reston, VA, the Brooklyn Navy Yard in Brooklyn, NY, and Paradise Valley Estates in Fairfield, CA.

Optimus Ride is an MIT spinoff company with deep experience with building self-driving technology and operating mobility services. Our founders built self-driving technology while at MIT and entered into the DARPA Urban Challenge in 2007 (one of the six teams that finished the race). Since then, we have built fully autonomous cars, trucks, forklifts and other ground vehicles. Our team also has experience in designing and building shared-electric vehicles (MIT CityCar) as well as managing shared fleets (Zipcar). Optimus Ride was founded in 2015.

We are continuously grateful to the State of Massachusetts and the City of Boston for enabling the development of the autonomous vehicle industry and for its support of Optimus Ride. Thank you.

1.2 – A general summary of the Applicant's experience testing on private ways (closed to the public) and public ways (while the road was open to other road users)

	Operations Site	Headquarters	Union Point	Halley Rise	Brooklyn Navy Yard	Paradise Valley
1.2 A	Location	Boston, MA	Weymouth, MA	Reston, VA	Brooklyn, NY	Fairfield, CA
1.2 B	Operations Start Date	May 2017	May 2018	July 2019	August 2019	November 2019
	Purpose	Research & Development	Commercial	Commercial	Commercial	Commercial
	Road Classification	Public + Private	Public	Public	Private	Private
	Road Types	*Please see Appendix E for map of various sites.*				
	Description of Testing Activities	Conduct testing activities and operate autonomous service for employees that exposes our vehicles to real-world scenarios, including other mobile and static vehicles, pedestrians, and pets.	Point-to-point internal mobility service within a private community.	Closed-loop course that picks up and drops off passengers between their office and an offshoot overflow parking lot through an active construction site.	Closed-loop course that transports public ferry riders to and from the ferry docking area to entry/exit point for the Brooklyn Navy Yard.	Point-to-point internal mobility service within a private, gated retirement and assisted living community.
	Hours of Operation	Monday–Sunday 6AM – 12AM (EST)	Monday–Friday 6:30AM – 7PM (EST)	Monday–Friday 9AM – 6PM (EST)	Monday–Sunday 7AM – 10:30PM (EST)	Monday–Saturday 12PM – 8PM (PST)
	Photographs	*Please refer to Deployment Photos in Appendix F*				
1.2 C	Amount of Testing Conducted on Public Ways	16,000 Hours	13,000 Hours	2,000 Hours	*Service conducted on private ways.*	*Service conducted on private ways.*
	Amount of Testing Conducted on Private Ways	*Testing conducted on public ways.*	*Testing conducted on public ways.*	*Testing conducted on public ways.*	3,500 Hours	Alpha Phase*
1.2 D	Vehicle Type(s)	*Polaris GEM E4 Polaris GEM E6*	*Polaris GEM E4 Polaris GEM E6*	*Polaris GEM E4 Polaris GEM E6*	*Polaris GEM E4 Polaris GEM E6*	*Polaris GEM E4 Polaris GEM E6*
1.2 E	SAE Level Tested	*Level 4*	*Level 4*	*Level 4*	*Level 4*	*Level 4*

**During the Alpha Phase service is provided to a closed user group as we prepare to open the service to the greater community.*

	Operations Site	Headquarters	Union Point	Halley Rise	Brooklyn Navy Yard	Paradise Valley
1.2 F	ODD: Geographic Conditions	Urban streetscape in the Raymond L. Flynn Marine Park. During business hours, the area is densely populated and highly trafficked. Open and publicly accessible.	Suburban neighborhood in a master planned community. Predominantly flat topography. Open and publicly accessible.	Office park in a suburban area outside of Washington, DC, with slight incline/decline topography. Open and publicly accessible.	Private, flat, urban area within a dense metropolitan region (Brooklyn). Brooklyn Navy Yard is gated with restricted 24-hour access.	55+ Life Plan Community in a hilly suburban environment. Paradise Valley Estates is a private, gated community.
	ODD: Roadway Types and Situational Constraints	Testing is conducted on single-lane local roads, various intersection types, and roundabouts. Roads are multi-modal, containing double articulated buses, semi-trailer trucks, personal-use vehicles, bikes, scooters, etc. Region is very unique and highly active in its road activities. It is currently undergoing significant active construction with traffic officers often directing traffic, especially during the cruiseship season. Area contains several unprotected left turns and unsignalized crosswalks.	Suburban neighborhood in South Weymouth, MA. Service conducted on single-lane local roads with various intersection types and a roundabout. Roads are multi-modal, containing personal-use vehicles, bikes, scooters, and pedestrian crosswalks. The community is home to many residents with pets and small children.	One lane in each direction with three and four-way intersections. Area contains a parking lot where we pick up and drop off passengers. Halley Rise is currently undergoing construction, with many active work zones. Area contains several unprotected left turns and unsignalized crosswalks. Roads are multi-modal, containing semi-trailer trucks, personal-use vehicles, and bikes, among others.	One lane in each direction with four-way intersections. Roadway also includes ferry dock road, which is a mixed pedestrian, vehicle, cyclist roadway with one lane in each direction. Roads are multi-modal, containing buses, semi-trailer trucks, personal-use vehicles, bikes, and scooters, among others.	Operation takes place in residential streets with single lane roadways in each direction. There are also parked vehicles on both sides of the roadway. The roadway does not contain a physical median. In this community, our vehicles share the road with personal vehicles, golf carts, and motorized wheelchair users.
	ODD: Speed Ranges	25 mph maximum	30 mph maximum	15 mph maximum	15 mph maximum	15 mph maximum

	Operations Site	Headquarters	Union Point	Halley Rise	Brooklyn Navy Yard	Paradise Valley
1.2 F ***(cont)***	ODD: Environmental Conditions	To date, we have tested publicly in: • Clear and Fair Weather • Light Rain and Fog • Moderate Rain and Fog Private course testing: • Heavy Rain and Fog • Light Snow • Moderate Snow • Heavy Snow • Severe Weather	To date, we have tested publicly in: • Clear and Fair Weather • Light Rain and Fog • Moderate Rain and Fog Private course testing: • Heavy Rain and Fog • Light Snow • Moderate Snow • Heavy Snow • Severe Weather	To date, we have tested in: • Clear and Fair Weather • Light Rain and Fog • Moderate Rain and Fog • Light Snow	To date, we have tested in: • Clear and Fair Weather • Light Rain and Fog • Moderate Rain and Fog • Heavy Rain and Fog • Light Snow	To date, we have tested in: • Clear and Fair Weather • Light Rain and Fog
		For more information on testing and service conditions, please refer to the 1.2.F Expansion tables on the following pages				
1.2 G	Government Entity/ Testing Approver	MassDOT and City of Boston	MassDOT, Town of Weymouth, and Southfield Redevelopment Authority	Brookfield Properties	Brooklyn Navy Yard Development Corporation	Paradise Valley Estates
1.2 H	Results of the Testing	Testing conducted on public and private ways in Massachusetts has contributed toward the robustness of our autonomous capabilities and has enabled us to provide a valuable first-and-last mile mobility service at these locations. Our presence has also led to opportunities to educate the general public about autonomous vehicle technology through community engagement and the in-vehicle user experience. Below, please see passengers moved for each site as of the submission of this report.				
	Passengers Moved	No commercial passengers have been moved.	7,000	23,000	21,000	Alpha Phase

1.2.F (EXPANSION) – Operational Design Domain - Time of Day and Environmental Conditions

Time of Day - Boston

Daytime Conditions	Nighttime Conditions
• Optimus Ride's core business hours are 6am-7pm, which is when the bulk of our manual data collection, mapping, and autonomous on-road testing occurs • Optimus Ride provides its employees an internal autonomous connection service from Silver Line Way to 88 Black Falcon during the hours of 8:45am-10:15am, Monday-Friday • Optimus Ride provides its employees an internal autonomous lunch service from 88 Black Falcon down Drydock from 11:30am-2pm, Monday-Friday	• Manual data collection, mapping, and autonomous on-road testing typically extends into nightime hours • During wintertime, our testing program continues operating hours as normal, testing during sunset hours (3:30-4:30pm), past twilight (4:30-5:30pm), and into astronomical twilight

Environmental Conditions

As described in the Time of Day section, Optimus Ride participates in daily testing and service routes. Below, please find information regarding how weather conditions impact our R&D testing, as well as our internal mobility service.

Autonomous Testing Activities

Weather Condition	Operation
1) Clear and Fair Weather	• Autonomous Testing Activities: Uninhibited - sensor and control systems operate as designed in clear weather. • Silver Line Way Connection: Uninhibited - sensor and control systems operate as designed in clear weather. Service proceeds as usual. • Lunch Service: Uninhibited - sensor and control systems operate as designed in clear weather. Service proceeds as usual. • Manual Driving for Data Collection: Uninhibited - the sensor and control systems are not required for manual operations in clear weather.
2) Light Rain and Fog	• Autonomous Testing Activities: Uninhibited - sensor and control systems operate as designed in light rain and fog. • Silver Line Way Connection: Uninhibited - sensor and control systems operate as designed in light rain and fog. Service proceeds as usual. • Lunch Service: Uninhibited - sensor and control systems operate as designed in light rain and fog. Service proceeds as usual. • Manual Driving for Data Collection: Uninhibited - the sensor and control systems are not required for manual operations in light rain and fog.
3) Moderate Rain and Fog	• Autonomous Testing Activities: Restricted - autonomous operation limited depending on severity of precipitation and fog, autonomous testing will be halted if sensor false alarms exceed a safe rate for operation. • Silver Line Way Connection: Restricted - autonomous operation limited depending on severity of precipitation and fog, autonomous service will be halted if sensor false alarms exceed a safe rate for operation. Service may continue in manual mode. • Lunch Service: Restricted - autonomous operation limited depending on severity of precipitation and fog, autonomous service will be halted if sensor false alarms exceed a safe rate for operation. Service may continue in manual mode. • Manual Driving for Data Collection: Uninhibited - the sensor and control systems are not required for manual operations in moderate rain and fog.

Manual Driving for Data Collection

Weather Condition	Operation
4) Heavy Rain and Fog	• Manual Driving for Data Collection: Uninhibited - the sensor and control systems are not required for manual operations in heavy rain and fog.
5) Light Snow	• Manual Driving for Data Collection: Uninhibited - the sensor and control systems are not required for manual operations in light snow.
6) Moderate Snow	• Manual Driving for Data Collection: Uninhibited - the sensor and control systems are not required for manual operations in moderate snow.
7) Heavy Snow	• Manual Driving for Data Collection: Inhibited - out of an abundance of caution due to potentially slippery road conditions and limited visibility, manual data collection is severely restricted or halted.
8) Severe Weather	• Manual Driving for Data Collection: Inhibited - out of an abundance of caution due to potentially hazardous road conditions, manual data collection is halted.

1.3 – A description and summary of any major crashes that resulted during testing on public ways by the Applicant:

Optimus Ride has had no major crashes on public ways to date, and therefore nothing to report on this question.

DETAIL #2 – Operational Design Domain

In keeping with the MOA requirements, Optimus Ride's Operational Design Domain (ODD) designates how the ADS is designed to properly operate, including but not limited to geographical conditions, roadway types, speed ranges, environmental conditions, and other domain constraints for testing which is anticipated to occur in Massachusetts within the approval period. Though each site has a specific ODD that is analyzed for its unique operating conditions, the system is generally capable of operating under the following conditions:

2.1 – Any time of day, including:

- Daytime (Sunrise – Sunset)
- Nighttime (Sunset – Sunrise)

2.2 – Environmental Conditions:

- Clear and Fair Weather: no rain, fog, or snow
- Light rain and fog: less than 5 mm/hr rate of rain and fog with limited impact on visibility
- Moderate Rain and Fog: less than 10 mm/hr rate of rain and fog with limited to moderate impact on visibility
- Light Snow: less than or equal to 10 mm/hr rate of unmelted snowfall, and visibility of at least 1 km
- Moderate Snow: greater than 10 mm/hr and less than or equal to 25 mm/hr rate of unmelted snowfall, and visibility of at least 1/2 km

2.3 – Road Typologies and Speeds:

- Typical urban roads with multi-modal uses (mixed traffic)
- Maximum Operating Vehicle speed of 25 mph and maximum operating traffic vehicle speed limits of 35 mph

2.4 – Situational Constraints:

- Construction and active work or school zones (including Traffic Officers)

There are several different regions in the state of Massachusetts that would satisfy the operational design domains described in this application. As a result, Optimus Ride expects to continue its expansion in the state. We expect to provide additional requests throughout the approval period to engage in testing in other available areas through the regional MOA.

DETAIL #3 – Summary of Training and Operations Protocol

3.1 – A general description of the training and instruction provided on private facilities and public ways

The Optimus Ride training program provides all employees who will be handling the vehicles a comprehensive understanding of policies, procedures, regulations, safety protocols, and vehicle usage tools. This training is conducted by our Operations Training Manager and is delivered through classroom study as well as in-vehicle operation both on private test tracks and public roadways. Before an employee is allowed to handle a vehicle, they are required to complete all training and become officially certified. After certification, employees are partnered with experienced personnel until such time as they have completed several in-vehicle driving hours to gain the 'experienced' level classification.

Our driver training program lays the foundation for all testing and service operations at Optimus Ride. During the program, employees are introduced to Optimus Ride's safety protocols for operation, focusing on preparing employees to handle the vehicle in both complex and routine situations likely to be experienced during test-driving.

Our driver training is designed to promote safety as the top priority. To this end, we use our private facility at the outset of our training, followed by supervised training on public ways once the test driver has a demonstrated understanding of vehicle operation. To safely handle the vehicle under all circumstances, test drivers are trained on how the vehicle and underlying ADS performs under normal conditions as a baseline and are then introduced to applicable warning systems, including software and hardware malfunctions.

3.2 – Evaluation of Test Drivers' Experience, Qualifications, etc.

Optimus Ride performs the following evaluations when hiring and onboarding Test Drivers:

- Background check
- Driving record check
- Defensive driving online course and certification
- Basic driving assessment using our vehicle in manual mode
- Standard internal assessment of operation of ADS, including startup, proper engagement and disengagement of ADS, issue logging and disengagement reports, and system limitations in all conditions.
  - If testers do not pass this assessment, we review training material and do not proceed until candidates demonstrate successful mastery. We provide individuals with a period to prepare for re-assessment.
  - Training and assessments are ongoing, with site and operations audits.

Test Driver Evaluation Process

Our training program curriculum is as follows:

1. Introduction to Facility and Resources
   1.1. Introduction to Vehicle, Software, and Annotations
2. Software Architecture & Autonomous Runs
3. Scenario Based Training
4. Safety Driving and Software Operating / Customer Service
5. Autonomous Testing Certification
   5.1. Review in Preparation for Post-Training Examination
   5.2. Assessment Results and Evaluation

Below, please find relevant descriptions regarding sections 1.1, 2, and 3 of the above training program curriculum which focuses heavily on operating the Optimus Ride ADS.

1.1 – Introduction to Vehicle, Software, and Annotations

During this module, test-drivers-in-training (TDITs) are first introduced to the vehicle and ADS through informational briefings. Our TDITs receive a high-level overview of the system and its subsystems, as well as detailed explanation of key connection points across those subsystems. Our goal during this initial phase is for trainees to perform basic software tasks to engage and monitor autonomous operation. To advance to the next training phase, TDITs must demonstrate proficiency in their knowledge of our system architecture and basic operational protocol.

2 – Software Architecture & Autonomous Runs

After classroom training, the next phase centers on observing in-vehicle operation. We begin this phase by allowing our TDITs to accompany expert test drivers on various routes. Through observation, TDITs will learn about the nominal driving conditions. Once the Operations Training Manager has certified that the TDIT can move on in his/her training, the trainee can advance to operating the vehicle in controlled environments, primarily in our indoor test facility. In this controlled environment, the trainee's abilities are evaluated once more. Upon successful completion of indoor training, the TDIT will advance to the next phase.

3 – Scenario Based Training

Our final phase of training is active, supervised training on public ways. This training prepares the test drivers for operating the vehicles under a variety of on-road scenarios. This phase introduces our trainees to routine maneuvers, road environments, and general operating conditions. We train all TDITs to safely and smoothly maneuver the vehicle over a range of speeds and road/weather environments, and to engage and disengage the ADS in a variety of conditions. As trainees become more experienced testing on public roads, we begin to introduce progressively more difficult test procedures such as emergency maneuvers. Once TDITs demonstrate operational mastery, the Operations Training Manager certifies the trainee as an approved Test Driver. At this time, the Test Driver may operate the vehicle alongside other certified Test Drivers at Optimus Ride.

3.3 – Checklist Before Operation on Public Ways

- Test drivers must have access and understanding of all company processes and resources relevant to the role
  - How to document operational data
  - How to document and report issues
  - How to properly communicate amongst one another as operators and other internal stakeholders
  - Demonstrate proper annotation techniques
- Test drivers must know how the car operates when the ADS is engaged
  - Demonstrate proper startup and shutdown procedures
  - Identify vehicle limitations and differences in operation from a typical consumer passenger vehicle
  - Identify appropriate application of all disengagement methods
  - Confirm understanding of operational design domain including street conditions, speeds, and regulation requirements
  - Understand and demonstrate successful application of company emergency protocol, as assessed by simulation-based testing

3.4 – Hours of Training

All employees who will be handling the vehicles undergo a total of 80 hours of supervised Test Driver training at the outset of their career at Optimus Ride. After the first 40 hours of the training program, TDITs are subject to an evaluation. After receiving and incorporating feedback into their operating practices, TDITs become certified Test Drivers. After certification, Test Drivers spend the remaining 40 hours of the total 80 hours both shadowing experienced test drivers and performing hands-on operation under supervision. During this time, Test Drivers are also exposed to site-specific processes and onboarding techniques.

3.5 – Test Driver's Roles and Responsibilities When the ADS is Engaged

Summary of Test Driver's Role

- Monitor the environment to safely operate vehicle
- Follow testing plan provided by engineers
- Identify and communicate external risks and/or sub-optimal behaviors from the vehicle to the Safety Associate

Training Program Responsibilities and Operating Policies for Test Drivers Emergency Situations

Optimus Ride Test Drivers are trained to respond to emergency situations while operating a vehicle equipped with an activated ADS. Test drivers can recognize when the ADS and/or vehicle is not functioning properly so that they can take safe control of the vehicle and report on any issues they notice. Our test drivers know the capabilities of the ADS and the vehicle so they do not inadvertently exceed those capabilities. Test drivers know how and when to take over the steering, braking, and acceleration of the vehicle and can control the vehicle appropriately even in degraded modes of operation.

Road Test Conditions

Our engineers prepare the necessary information that trained test drivers will require in order to safely operate the ADS under applicable on-road test conditions. This information includes relevant instructions regarding the nominal, compromised, and emergency operation of the vehicle during the ADS activation and potential disengagement, as well as instructions for managing emergency situations that pertain to all motor vehicles, such as a brake or power steering system failure. Situations covered by instruction include, but are not limited to, parking, high/low volume traffic, merging, following distance, turning and stopping. Trained test drivers are informed in advance of any updates to the ADS that may affect ADS performance.

3.6 – Safety Associate Roles and Responsibilities When the ADS is Engaged

Summary of Safety Associate's Role

- Monitor all systems in the vehicle
- Able to interpret and process data quickly
- Communicate to the Test Driver what the vehicle sees and is doing
- Troubleshoot general software issues during tests
- Take note of any anomalies during operation, to then report to engineers for further analysis

Responsibilities and Operating Policies

The safety associate is responsible for monitoring the system and taking notes on the system's performance for our engineering team to analyze. They are the primary conduit for communicating information related to system performance to the Test Driver so the Test Driver can exclusively focus on the safe operation of the vehicle. If conducting passenger rides, the safety associate may also communicate with the passengers by greeting, orienting them to the vehicle, and answering any questions they may have related to the vehicle's operation.

3.7 – Testing Without Safety Associate

Not applicable.

3.8 – Applicant's Process, Protocols, and Physical Systems for Monitoring the Test Driver

3.8.A – Rules of Engagement

The Optimus Ride Test Driver Training Program includes coverage of all "rules of engagement" generally expected of all test drivers. These rules include, but are not limited to: identifying the Operational Design Domain for the ADS in the testing area and how to identify when operating conditions are outside the ODD, whether and when another vehicle may be passed during an on-road test drive, prohibitions on excessive speeding, a maximum number of consecutive hours a test driver may operate a test vehicle, and restrictions on the use of portable electronic devices as well as other devices that may be considered distracting from safety driving or performing tasks needed during software operating. Finally, our test drivers are given specific instructions on when and how to report various HAV behaviors of interest, using internal tools for documenting and logging vehicle operation, interactions, and disengagements.

3.8.B – Maintaining Test Driver Awareness and Monitoring

As part of the test driver monitoring program, Optimus Ride conducts random auditing of test driver and safety associate behavior through video collected by dash cameras to ensure that we are consistently implementing all required rules and regulations of the role while safety driving. Test drivers are encouraged to take a moment between service rides to address any potential distractions and evaluate the system's performance before re-engaging autonomous service or testing. Our service is currently designed to operate with both a test driver and safety associate, with the expressed purpose of the safety associate to co-pilot and support the test driver in any capacity necessary. This includes keeping the test driver engaged, alert, and monitoring their awareness levels at all times. The safety associate is the primary conduit for communicating information related to system performance to the test driver. The test driver is exclusively tasked with the safe operation of the vehicle while the safety associate independently verifies that the system is operating as expected.

If, during random audits of the dash camera footage, the performance of test drivers and safety associates does not meet trained expectations, demonstrates unsafe behavior, negligence, or willfully harmful behavior, Optimus Ride begins a scaled corrective and/or disciplinary process depending on the circumstances of the violation. Potential consequences include anything from a verbal warning up to and including termination.

OPTIMUS RIDE: SCALED DISCIPLINARY APPROACH FOR TEST DRIVERS AND SAFETY ASSOCIATES
Behavior Below Training Standards
Behavior: Any employee required to act as a Test Driver or Safety Associate must participate in the rigorous training program described in Detail #3 - Summary of Training and Operations Protocol upon hire. If an employee is observed behaving in a manner that is below our training standards, disciplinary action will result. **Consequence**: Behavior that does not meet our expectations will result in a verbal warning and will require retraining and re-certification with regard to the actions and behaviors deemed substandard.
Unsafe Behavior
Behavior: Optimus Ride defines unsafe behavior as behavior that is risky or careless that could have resulted in an accident were it not for luck or swift action. **Consequence**: The follow up disciplinary action depends on the severity of the infraction. Unsafe behavior will result in a formal written warning and will require retraining and re-certification with regard to the actions and behaviors deemed unsafe.
Grossly Negligent and/or Willfully Harmful Behavior
Behavior: Optimus Ride defines these behaviors as acts which display extreme indifference or intentional disregard for the safety of the employee engaging in the behavior, company property, or third party observers and which are likely to cause foreseeable harm. **Consequence**: Grossly negligent and/or willfully harmful behavior will result in immediate termination.

Optimus Ride continually seeks to implement best practices from established industries as well as those within our own industry. The scaled disciplinary process described above is representative of Optimus Ride's current disciplinary approach but does not preclude our ability to modify and enhance our approaches moving forward.

DETAIL #4 – First Responders Interaction Plan

4.1 – Emergency Contact Information

	PHONE NUMBER	EMAIL ADDRESS
OPTIMUS RIDE	**********	**********

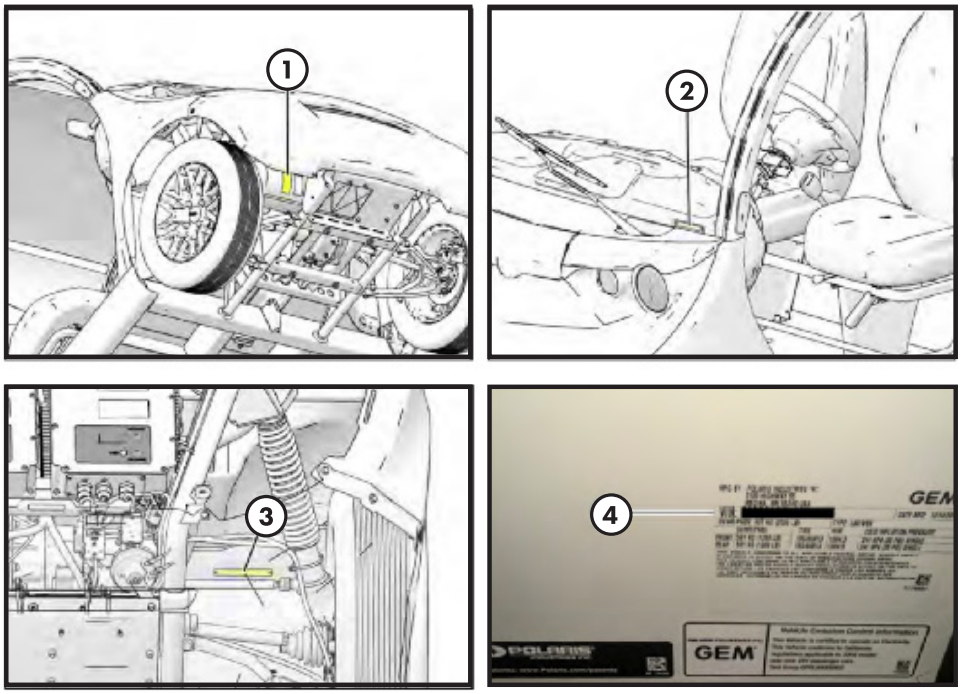
4.2 – Identifying the Vehicle

- The vehicle is a Polaris GEM E4 or Polaris GEM E6.
  - The number of doors on the vehicle determines the model. The E4 has four doors, the E6 has six doors. This document applies to both models. Each of these models are in Optimus Ride's fleet and may be used at any time.

Polaris GEM E6

Polaris GEM E4

- Identifying GEM vehicle identification number (VIN) and the motor serial number.
  - The motor serial number (1) is located on the motor case in front of the right front wheel. The VIN (2) is located on the left side of the upper dash panel, inside the windshield and is also stamped on the lower aluminum frame behind the axle on the driver's side (3). The VIN can also be located along with the manufacturing label on the left hand side rear of the roof panel (4).



4.3 – How to:

4.3.A – Recognize whether the ADS is engaged, safely disengage the ADS, and detect and ensure that the ADS has actually been deactivated

The vehicle drive mode can be determined by two indicator lights on the dashboard that show the state of the vehicle. If the vehicle is in autonomous mode, a green light will illuminate that is labeled "autonomous." If the vehicle is being driven manually, a white light will illuminate that is labeled "manual."

4.3.B – Vehicle Immobilization

This vehicle is equipped with an autonomous driving system. This system works under the following conditions: a laptop is connected to the car, software is on, and the mode button has been pressed to engage autonomous mode. The most efficient way to disconnect this ADS system is to turn the vehicle off with the key. Other ways to disable the ADS are to do the following: take over the steering wheel, press the brake, press the accelerator, change the gear selector to N, or pull the emergency brake. All of these will disable the ADS and the car will no longer drive under the ADS system.

4.3.C – Safely interact with our electric vehicles

Service Disconnect Procedure

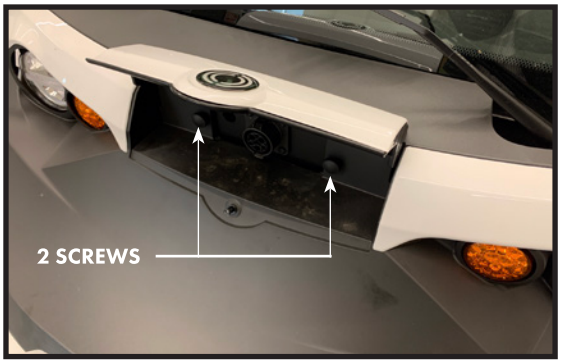
The following items must be disconnected to consider the vehicle immobilized or disabled

- Auxiliary 12V Battery
- Main Battery Disconnect
- 48V Accessories (if vehicle is equipped with heater & heated windshield, disconnected individually)

Steps to Disconnect Power

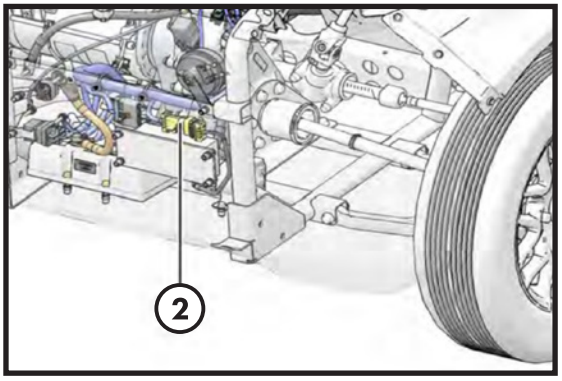
Remove the Hood

- Lift the vehicle charger cover (this is at the center between the headlights under the car's emblem), remove the two screws by hand, and pull towards you to remove.

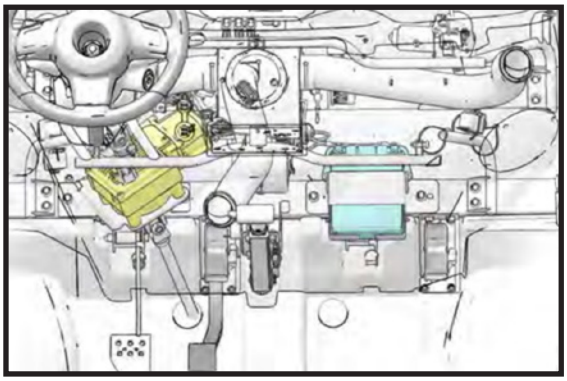


Disconnect the Auxiliary 12V System and Negative Battery Cable

- 12V system disconnect is located beneath the horn assembly, accessed from the hood on the right-hand (RH) side when facing the front of the vehicle (2). See photo below for location:

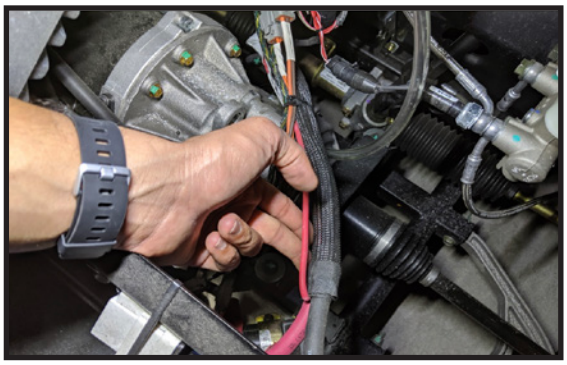


- 12V negative battery cable is located under the dashboard on the passenger, or right-hand (RH) side when sitting in vehicle. See photo below, battery is indicated in teal. Dashboard can be removed by taking out the 6 rivets on the top and lifting it towards the roof of the car.



Disconnect the Main Battery System

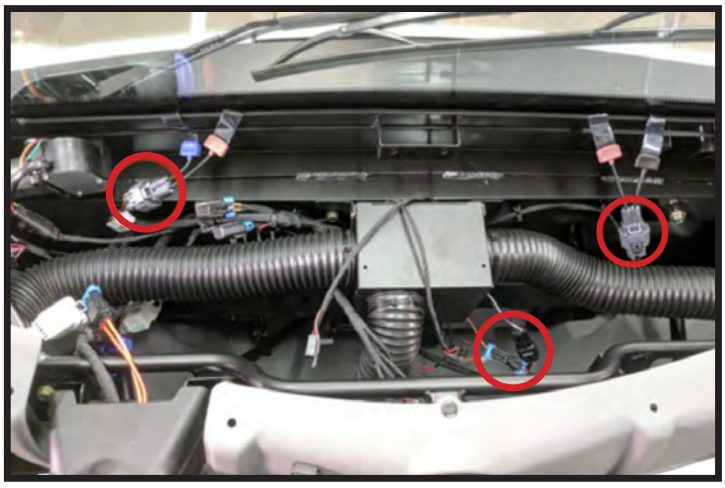
- Located under the hood next to the motor, horn assembly, and the 12V system disconnect point, locate the thick black and red wires shown below.



- The thick black wire will lead to the connection point shown below. Disconnect the black wire and the main battery system will be disconnected.

Disconnect the Auxiliary 48V Accessories

- Located at the bottom of the front windshield accessed from under the hood, the 48V accessories are circled in red in the photo below:



- Disconnect each of these three connectors to ensure the system is disabled.

4.3.D – Safe Removal from the Roadway – Vehicle Towing

- It is highly recommended that the vehicle be placed on a flatbed for removal from the roadway. The vehicle's maximum tow speed is 10 MPH and any towing over this speed will damage the drivetrain and may cause it to seize. This will make the car unable to be pulled behind a truck. If towing at speeds below 10 MPH is required, be sure to:
  - Place direction selector in **NEUTRAL**
  - Turn key switch **OFF**
  - Verify the parking brake is not engaged

4.4 – Any additional information as deemed necessary regarding hazardous conditions or public safety risks associated with the operation of the test vehicle:

- Improper contact between battery terminals can result in electrical shorts. Electrical shorts can result in burns.
- Remove all jewelry or metal objects that could come in contact with battery terminals as you work in or around the battery compartment, including (but not limited to): rings, chains, wrist watches, bracelets, etc.
- The vehicle frame and other chassis components **ARE NOT** used as a conductor (ground path) for electrical components and are therefore not at ground potential.

DETAIL #5 – Voluntary Safety Self-Assessment

Optimus Ride is developing an autonomous vehicle platform for testing and mobility-as-a-service (MAAS) purposes. Currently the vehicle platform utilized for testing is classified as a Low Speed Vehicle according to FMVSS 500. However, our ADS is designed to be agnostic to the vehicle platform and could therefore operate on different vehicle types. This assessment covers the operation of the Optimus Ride ADS on any vehicle platform. The Voluntary Safety Assessment includes the following safety elements from NHTSA's AV Policy Guidance 2.0:

1. System Safety
2. Operational Design Domain
3. Object and Event Detection and Response
4. Fallback (Minimal Risk Condition)
5. Validation Methods
6. Human Machine Interface
7. Vehicle Cybersecurity
8. Crashworthiness
9. Post-Crash ADS Behavior
10. Data Recording
11. Consumer Education and Training
12. Federal, State, and Local Laws

Each safety element addressed below follows the guidance given by the Voluntary Safety Assessment template and where necessary indicates if:

- This safety element was considered during product development efforts for the subject feature; or
- This safety element is not applicable to the subject product development effort.

System Safety

Optimus Ride's design, validation and deployment procedures incorporate system safety processes based on industry best practices which are reinforced through the company's safety culture. The safety of the system is evaluated at each phase of the design and validated through ongoing design reviews and testing. We monitor the system's safety performance during pilot programs to improve the overall safety of our system.

Requirements, Design, and Analysis

- Utilize the principles of Safety Guided Design to integrate the safety analysis of the ADS with its design to allow for continuous iteration and re-evaluation of safety goals as the design is changed
- Follow Safety Engineering practices with the use of Hazard and Risk Assessment (HARA) and Safety Analysis to develop safety requirements
- Utilize state-of-the-art, test-driven development practices

Verification and Validation

- Testing of the system at each stage to evaluate the system's performance related to hazards and risk reduction
- Perform simulations in a manner to verify initial performance and increase coverage of variations in the operating scenarios
- Perform closed course testing to gain confidence in the system's performance
- Perform public road testing in a controlled and regulated manner

Fielded Systems

- Proper training for operation and maintenance of the system
- Monitoring of safety critical issues for proper response, bug reporting, tracking, and analysis
- Proper configuration management to ensure the correct version of the system is in use

Operational Design Domain

The Optimus Ride ADS is designed to operate within a predetermined, physically constrained, 'geofenced' environment. Within each operational site, the ODD is defined by considering the capabilities, the ADS, and any distinctive characteristics of the geofenced area. For each ODD, the capability of the system is assessed according to the roadway types as well as the appropriate operational speed of the Optimus Ride vehicle and surrounding traffic. Any environmental conditions unique to an area are analyzed as well.

Once the ODD has been defined, tests using various methods determine operating limitations for the ADS. These findings are incorporated into our training program so test drivers are prepared to identify when the system may be outside its ODD so they can take the appropriate precautions. Regions within the ODD can be designated to further control the vehicle's operation.

Object and Event Detection and Response

The Optimus Ride vehicles are designed to handle all objects and obstacles commonly found on public driving roads. This includes, but is not limited to, pedestrians, motorists, and bikers. Our system is designed to make the appropriate behavioral decisions to any in-road situation in accordance with the MassDOT Driving Manual. In the event of unusual or unforeseen circumstances that create obstacles to safe operation, the Optimus Ride system will assess road conditions and plan a safe path around the obstacle. If unable to successfully plan a safe path, the Optimus Ride system will safely stop and the test driver will take over control of the vehicle.

Fallback (Minimal Risk Condition)

The Optimus Ride ADS is designed to monitor and respond to various faults throughout the system. The system is designed to allow a safe and smooth transition to take control of the vehicle. Depending on the situation various actions can be taken as determined by the system which has been analyzed to give the test driver the most control over the system. For specific types of faults the system may determine to bring the vehicle to a stop, release control back to the test driver or inform the test driver to take control of the system.

The Optimus Ride system requires supervision from a human test driver during public road testing. Their primary responsibility is to take control of the vehicle in situations where the autonomous system is not capable of responding to the driving situation or system failure in an acceptable manner. During autonomous testing of any kind, an appropriately trained safety operator will always be present to monitor the system's performance. The autonomous control of the vehicle can be overridden by the certified Test Driver by several different mechanisms in any fall back situation. The test driver can take over at any point in vehicle operation, no matter what functions or maneuvers the autonomous system is executing.

Validation Methods

Optimus Ride is committed to creating safe autonomous technologies, first and foremost. To accomplish this, Optimus Ride fosters a safety culture from the beginning of our product development cycle until our user's vehicle departure experience. Our validation process is designed with regard to best practices in the industry, including relevant vehicle safety and validation standards. Validation of the ADS is done at the design, software (code), hardware (component) and systems (AV) level.

- **Validation of the Operational Design Domain (ODD)** - Through data collection and analysis, we are continuously evaluating the ODD for changes and adjusting our test plans to match the environment. This ensures we are continuously checking any assumptions about our system's safety relative to the dynamic constraints of the ODD.
- **Software Simulation Testing** - Optimus Ride believes that autonomous driving systems cannot be fully realized through in-vehicle testing alone. As such, we have integrated a highly sophisticated simulation platform to conduct complex virtual testing, based on both in-vehicle tests and variations of real data. All ADS software is run through a suite of simulated test scenarios that are being continuously expanded.
- **Closed Course Testing** - Optimus Ride has the capability to perform tests on our custom indoor test track and outdoor test track. These tracks allows us to test and validate hardware and software subsystems. They also enable us to safely test a multitude of driving scenarios.
- **Road Testing** - Once our system has been thoroughly tested using the methods listed above, our safety engineers perform a final assessment of our vehicle for public road use before approving outdoor testing. When performing outdoor tests, Optimus Ride operators are trained to be highly aware and concerned for public safety. All of our drivers and vehicle systems prioritize safety above all else and strive to avoid all potential safety risks.

Human Machine Interface

The Optimus Ride ADS is designed as a Level 4 system that incorporates best practices for the interfaces required for the support of humans as test drivers and for passenger interaction. For test drivers, the vehicle controls are the same as a typical road vehicle, including the control of lights, wipers and the horn. The ADS has interfaces that convey the condition of the system and the mode (e.g., autonomous, manual) it is operating in.

Vehicle Cybersecurity

Optimus Ride follows security-driven design principles and uses approaches consistent with industry best practices for cyber security. This includes security design reviews, recurring internal security audits, regularly monitoring vulnerability notices and applying security patches, and established internal security design principles. Cybersecurity attributes of the Optimus Ride system include, but are not limited to, industry-standard encryption for bidirectional authentication and encryption of all communications with Optimus Ride servers, private key infrastructure, full disk encryption onboard all vehicles, and multi-factor authentication for user authentication. Our sensors have not been modified so all cyber security features inherent in those systems have persisted into our system.

Crashworthiness

Currently, Optimus Ride utilizes the Polaris GEM e4 and e6 models as a vehicle platform for our autonomous vehicles. These vehicles meet all US federal safety standards for low-speed vehicles (LSVs) under NHTSA FMVSS 500. Optimus Ride has retrofitted our vehicles to accompany our autonomous technology. These additions do not interfere with any safety critical functions on the vehicles nor do they alter the vehicle frames or any other item related to crashworthiness. Occupant protection devices are unmodified from the vehicle manufacturer and confirm the applicable testing and regulations required by FMVSS 500.

Post-Crash ADS Behavior

The Optimus Ride ADS system is designed to come to a stop if the vehicle deviates from its intended operation, a behavior which is typical when involved in an accident. The trained test driver is responsible for moving the vehicle into a safe location, if possible, or for responding to a minor incident which will not impact the system's operation. The safety operators are trained to respond according to the guidelines set forth within the MOA.

Data Recording

The Optimus Ride autonomous system has been designed to collect event, incident, and crash data for the purposes of recording the occurrence of malfunctions, degradation, or failures in a way that can be used to establish the cause of any such issues. Data is collected for both testing and operational purposes including for event reconstruction from the sensors onboard the vehicle. For crash reconstruction purposes, this data will be stored, maintained, and readily available for retrieval. We will collect data associated with all events including, but not limited to, fatalities and personal injuries as well as damage to any vehicle involved. Our vehicles will record all information relevant to any event as well as the performance of the system during the event such that the event can be reconstructed. This data includes information relating to the status of the autonomous system and if the system or the test driver was in control of the vehicle at any time.

Privacy

Optimus Ride vehicles will only be operated by certified test drivers employed by the company. We have tight access controls to ensure that only authorized personnel have access to the data collected, and all the logged data is encrypted at rest. Employees of Optimus Ride are aware of what types of data will be collected, how it will be stored, and how it will be used. All employees of Optimus Ride have signed confidentiality agreements as part of their employment with the company. Through these agreements, all of our employees have agreed not to disclose confidential information without the company's authorization unless required by law. Mirroring our employee confidentiality agreements, all of our pilot participants must read and sign a consent form that conforms with Massachusetts law that clearly and transparently explains what data will be collected, how it will be stored, and how it might be used. In the event that Optimus Ride chooses to disseminate any recordings taken during our testing or pilot phases, we will remove any personally identifying information including, but not limited to, license plate numbers of vehicles and pedestrian faces.

Consumer Education and Training

Optimus Ride has done a substantial amount of work to understand and integrate potential users' experience into our vehicle and pilot service. This has taken form in several ways, namely through onboarding and educating the users of our pilots in Massachusetts, New York, Virginia, and California. In addition to our user education activities, we have grown our community engagement efforts by attending relevant events and hosting community members at our headquarters in Boston's Seaport District.

For example, in March of 2019, Optimus Ride welcomed members of the greater Boston community into our headquarters for an event titled Robot Block Party: Rides! These participants represented many Massachusetts constituencies: Back Bay, Dorchester, and Braintree in Boston, as well as Cambridge, Lynn, Lexington, Franklin, and Newton. During the event, we enlisted a group of Optimus Ride employees from various disciplines for our participants to engage with to learn more about autonomous vehicles and the technology that makes them possible.

The Optimus Ride team is committed to advancing our mission of safer, sustainable, and more equitable cities. We will continue to engage community and pilot members in education efforts, while also designing consumer education models and training materials to further our mission of equitable mobility solutions.

Federal, State, and Local Laws

The Optimus Ride system is designed to make behavioral decisions to any in-road situation and will act according to the MassDOT Driving Manual. Our autonomous system is designed to follow all traffic laws including federal, state, and local laws. Optimus Ride test drivers are educated on how to correctly respond to emergency situations when operating a vehicle equipped with an activated Autonomous Driving System (ADS). Test drivers are trained to recognize when the ADS and/or vehicle is not functioning properly so that they compensate and report as needed. Our test drivers are specifically instructed to take control of the vehicle in order to avoid a violation of any traffic laws.

APPENDIX A
SUBMITTED TO MASSDOT

DETAIL #7 – Drivers in Testing Program

APPENDIX B
SUBMITTED TO MASSDOT

DETAIL #8 – Insurance Requirements

APPENDIX C
SUBMITTED TO MASSDOT

DETAIL #9 – Additional Questions

9.1 – Please explain why the organization is applying to test in Massachusetts.

Optimus Ride Inc. is a Massachusetts-based self-driving vehicle company. In order to maintain Massachusetts as our corporate headquarters, we require the ability to test in the state's public ways. Our research and development program is primarily based at our Boston headquarters, granting us immediate access to a diversity of busy and complex operating design domains. This is crucial to the on-going development of fully driverless and safe autonomous moblity systems. It is important to Optimus Ride to continue collboarating with the cities and state of Massachusetts for its public way testing efforts.

9.2 – Will the organizations' efforts create temporary or permanent employment in the Commonwealth?

Yes, the company's efforts will create both temporary and permanent positions. Optimus Ride has a healthy summer internship and co-op program to ensure that locally cultivated talent is able to pursue their career interests without having to leave the state. Ideally, the company attempts to successfully convert the majority of temporary employees to permanent status. Optimus Ride has a dedicated talent acquisition team to support the company's permanent employment growth needs, which includes a mix of exempt and non-exempt employment opportunities for different skill levels. We maintain all our open position posting on our website (www.optimusride.com/careers).

9.3 – Does the organization have a long-term vision of automated mobility? If so, what does that look like?

Optimus Ride's long term vision is to provide a safe, sustainable, equitable, and accesible autonomous mobility system. This looks like a fully driverless fleet of vehicles that are also shared and ideally electric. They would be distributed throughout different parts of the state to enable first/last - mile connectivity and intra-community transportation with the goal of enabling individuals to easily choose a carless or limited personal vehicle ownership lifestyle.

9.4 – Please explain how your organization attempts to address the priorities identified in the Regional Memorandum of Agreement for AV testing, with particular attention to the societal benefits enumerated.

Safer Streets, Better Access, More Reliable. Optimus Ride Inc. is a shared electric autonomous mobility system focused on first/last mile connectivity and geofenced transportation service. The goal of first and last mile connectivity is to facilitate increased usage of commuter rail, bus, and subway systems by expanding the catchment area thus reducing individual vehicle miles traveled to high frequency areas. The goal with geofenced mobility is to reduce the need for parking in communities to reclaim land for human scale needs, reduce the amount of vehicles driving in a community, and engage in traffic calming with the Optimus fleet through vision zero speeds. With the reduction of vehicles, increased access to transit, and focused community support for all the citizens that inhabit it, we are able to deliver on safer streets, better access, and more reliable service. We expect to continue this work in our current areas of deployment and look forward to expanding to others within the state of Massachusetts to support the above stated goals.

Testing Plan – City of Boston

During the life of the MOA, Optimus Ride plans to continue autonomous testing throughout the Ray Flynn Marine Industrial Park and expand testing into the South Boston Seaport area. Expanding the testing area to the bounded area defined below will enable Optimus Ride to bridge its testing operation from the Marine Industrial Park to South Boston Seaport.

Ray Flynn Marine Industrial Park	
• Drydock Ave • Black Falcon Ave • Harbor Street • Channel Street • Design Center Place • 6th Street • Tide Street	• Fid Kennedy Ave • Northern Ave (from Massport Haul Road to Tide Street) • Ballard Way • Seafood Way (from Northern Ave to Fid Kennedy Ave)
South Boston Seaport – Bounded	
• (Includes Above Ray Flynn Marine Park in addition to the following roads) • Dorchester Ave (from Summer Street to Congress Street) • Congress St. (Dorchester Ave. to Boston Wharf Rd./West Service Rd.) • Summer Street (from Dorchester Ave to Pappas Way) • West First Street • E Street (North from West First Street) • D Street (North from West First Street) • Fargo Street	• Cypher Street • B Street (from West First St. to West Second St.) • A Street (from West 2nd Street to Congress Street) • Necco Street • Melcher Street • Boston Wharf Road • West Service Road Extension (Congress Street to South Boston Bypass) • South Boston Bypass (West Service Rd Ext. to Richards St/Cypher St.) • Richards St (A Street to South Boston Bypass)

Pilot Service Tests

Optimus Ride plans to continue its pilot service tests in the Ray Flynn Marine Industrial Park in accordance with approved phases: C1 — Optimus Ride "Closed User" Group Demo, and C2 — Optimus Ride "Broader User" Group Demo (approval document included in Appendix D).

Testing Conditions

Throughout the expansion process, Optimus Ride will continue to observe industry standard safety policies and procedures. These include continuing to observe weather restrictions, including not testing during severe rain and fog. Optimus Ride will also continue to report on progress quarterly, as well as continue participating in public education and community engagement.

APPENDIX D – Passenger Test Plan Approval

City of Boston | 1 City Hall Sq. | Boston, MA 02201

Ryan Chin & Jenny Berlin
Co-Founders
Optimus Ride
88 Black Falcon
Boston, MA 02210

January 5, 2018

Dear Ryan and Jenny,

The City of Boston has had the opportunity to review your request advance to testing to include passengers within the Flynn Marine Industrial Park and nighttime and moderate precipitation testing without passengers. Based upon your progress to date - with over 200 miles of safe testing in the Marine Park we are pleased to permit this request through an updated section of the Test Plan.

This letter confirms approval from the City of Boston to amend the Optimus Ride Test Plan from March 2017, through the creation of a "Requirement #4" and accompanying Phase C1 and Phase C2 in the Test Plan. Pending reciprocal MassDOT approval, this permits the carriage of passengers in two separate testing phases.

As stated in Mayor Walsh's Executive Order on Autonomous Vehicles, the City is committed to the goal of having AV technology "ensure more equitable access to opportunity for those least well served by transportation options today, including seniors, youth and those with physical disabilities." We thank you for working with the City to ensure that a portion of the passengers in this pilot reflect those user groups.

The City appreciates your efforts to bring safe and reliable transportation solutions to the people of Boston and continuing to share your learnings as detailed in the quarterly reports. We thank you for your continued attention to safety in your operational procedures and look forward to the feedback from passengers in the coming months.

Sincerely,

Gina N. Fiandaca
Commissioner, Boston Transportation Department

CC: Kate Fichter, Assistant Secretary for Policy Coordination, MassDOT

Requirement #4: Passenger Carriage

The intention of permitting passengers in autonomous vehicles is to test real world use cases, human-machine interfaces, and to socialize the technology to a broader audience. For both safety and understanding of how well passengers will augment the current testing operations, there will be a phased approach.

OPERATIONAL DESIGN DOMAIN

Optimus Ride is approved to test autonomous vehicles without passenger at nighttime and during inclement weather, defined as rain at 2.5mm/hour-7.5mm/hour. ***Passenger carriage testing must occur in fair weather conditions only.***

Phase C1: Optimus Ride "Closed User" Group Demo			
Who	What	Place	Milestone
Passengers pre-selected by Optimus Ride. At least fifteen percent of passengers to be seniors, people with a mobility impairments, vision impairments or other sensory impairments that make driving their own vehicle problematic.	Trips that explore the passenger experience and potential use cases to service connections beyond a typical walkshed (.25 miles) within the Marine Park	Raymond Flynn Marine Park	40 passengers

Phase Progression: Summary of Phase C1 Requested by City and MassDOT

Phase C2: Optimus Ride "Broader User" Group Demo			
Who	What	Place	Milestone
Passengers opting in through Optimus Ride's ride-hailing or through other arrangements with tenants, employees, or guests of the Marine Park area.	Trips that explore the passenger experience and potential use cases to complement public transit	Raymond Flynn Marine Park	No-limitations on number of passengers

PHASE PROGRESSION

A letter/report documenting learnings from Phase C1 should be submitted to all parties listed on the MOU with the request to move to Phase C2. Review and feedback of this report will be completed in a swift manner by the City of Boston. Phase progression approval will be determined by the Commissioner of the Boston Transportation Department.

PRIORITY USER GROUP

Continuing to build upon the goals identified herein, it is important to think about how this technology can unlock access to new groups. If necessary, the City can work with Optimus Ride to identify a small pool of seniors and individuals with mobility impairments willing to be part of the passenger experimentation.

WAIVERS

Each passenger must consent through the **Optimus Ride Vehicle Passenger Waiver** developed by Optimus Ride. A Photo/Video release, which can be part of the Passenger Waiver, must be issued to each passenger to record video or photograph passengers during their trip. An opt-in to sharing email addresses with the City for future follow-up on autonomous vehicle efforts should be included in the registration process.

PAYMENT

To build towards equitable access to this technology in its early stages and as to not conflate this experimentation with current Ride-for-Hire regulations, passenger trips in autonomous vehicle test rides must be free of charge.

SHARED RESEARCH AGENDA PHASE C1

In addition to the data sharing agreed to in quarterly reports under the current testing plan, the following should be detailed for the Closed User Group Demo.

Metric	Reason for Sharing
Number of Passenger Trips	*to assess exposure of the technology*
Passenger home zip code	*to assess exposure of the technology*
Map of Typical route(s) used for passenger test	*to assess use cases and curb planning*
Qualitative feedback on the user experience	*to help focus future research and public outreach initiatives*
Qualitative feedback on curbside operations	*to help future city operations and management of the public realm*
Email Contact information for passengers who opt-in	*to assist the City with community engagement in future AV policy development*

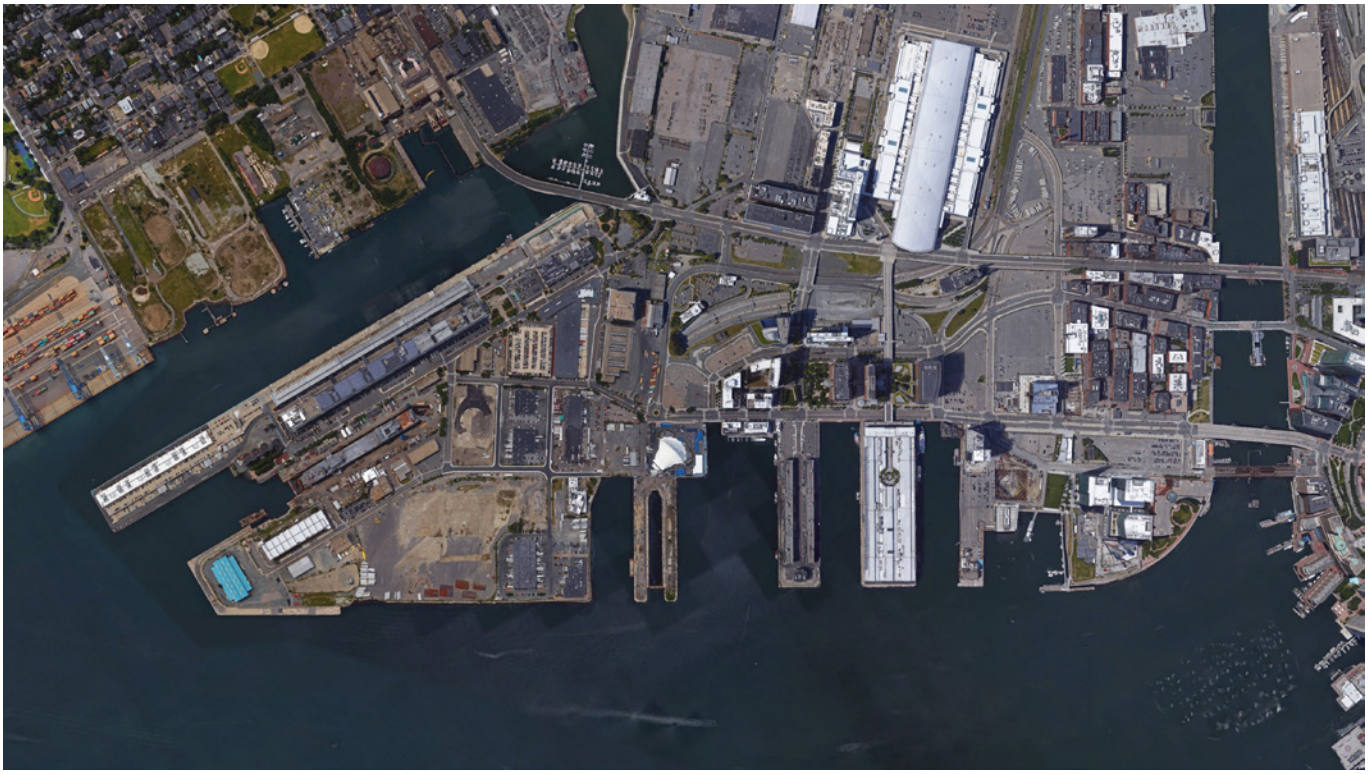
SHARED RESEARCH AGENDA PHASE C2

In addition to the data sharing agreed to in quarterly reports under the current testing plan, the following should be detailed:

Metric	Reason for Sharing
Average Number of Passengers per Trip	*to assess shared use of service*
Passenger home zip code	*to assess exposure of the technology*
Origin and Destination coordinates of each trip *(blockface level specificity)*	*to assess use cases complementary to public transit and curb-use planning*
Qualitative feedback on the user experience	*to help focus future research and public outreach initiatives*
Qualitative feedback on curbside operations	*to help future city operations and management of of the public realm*
Email Contact information for passengers who opt-in	*to assist the City with community engagement in future AV policy development*

APPENDIX E – Maps of Operational Sites

SEAPORT DISTRICT

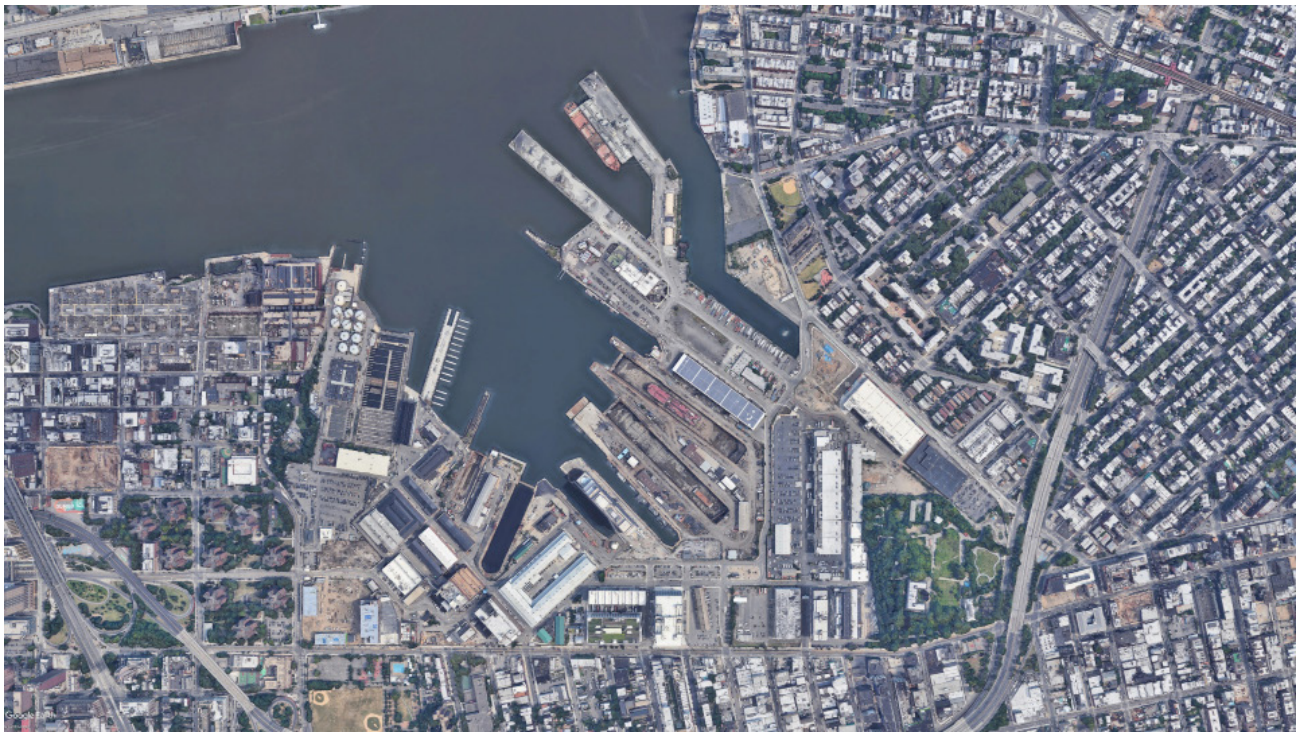


HALLEY RISE

PARADISE VALLEY

UNION POINT

BROOKLYN NAVY YARD

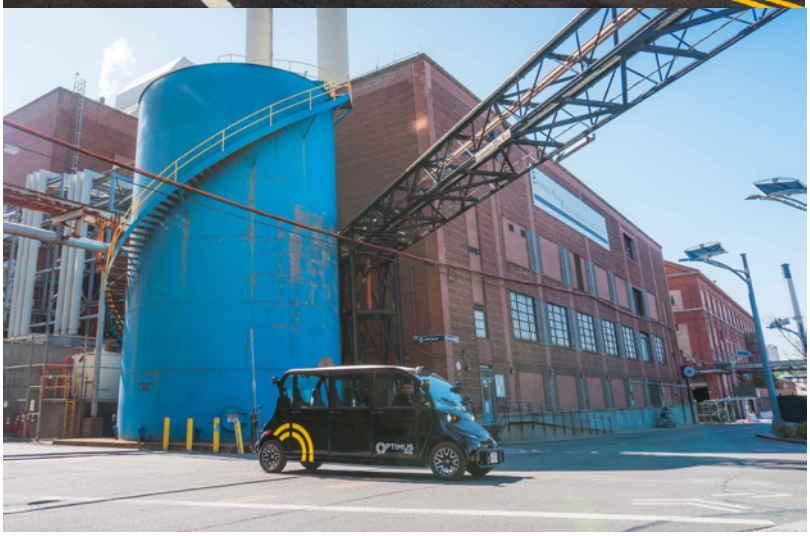


APPENDIX F – Deployment Photographs

SEAPORT DISTRICT

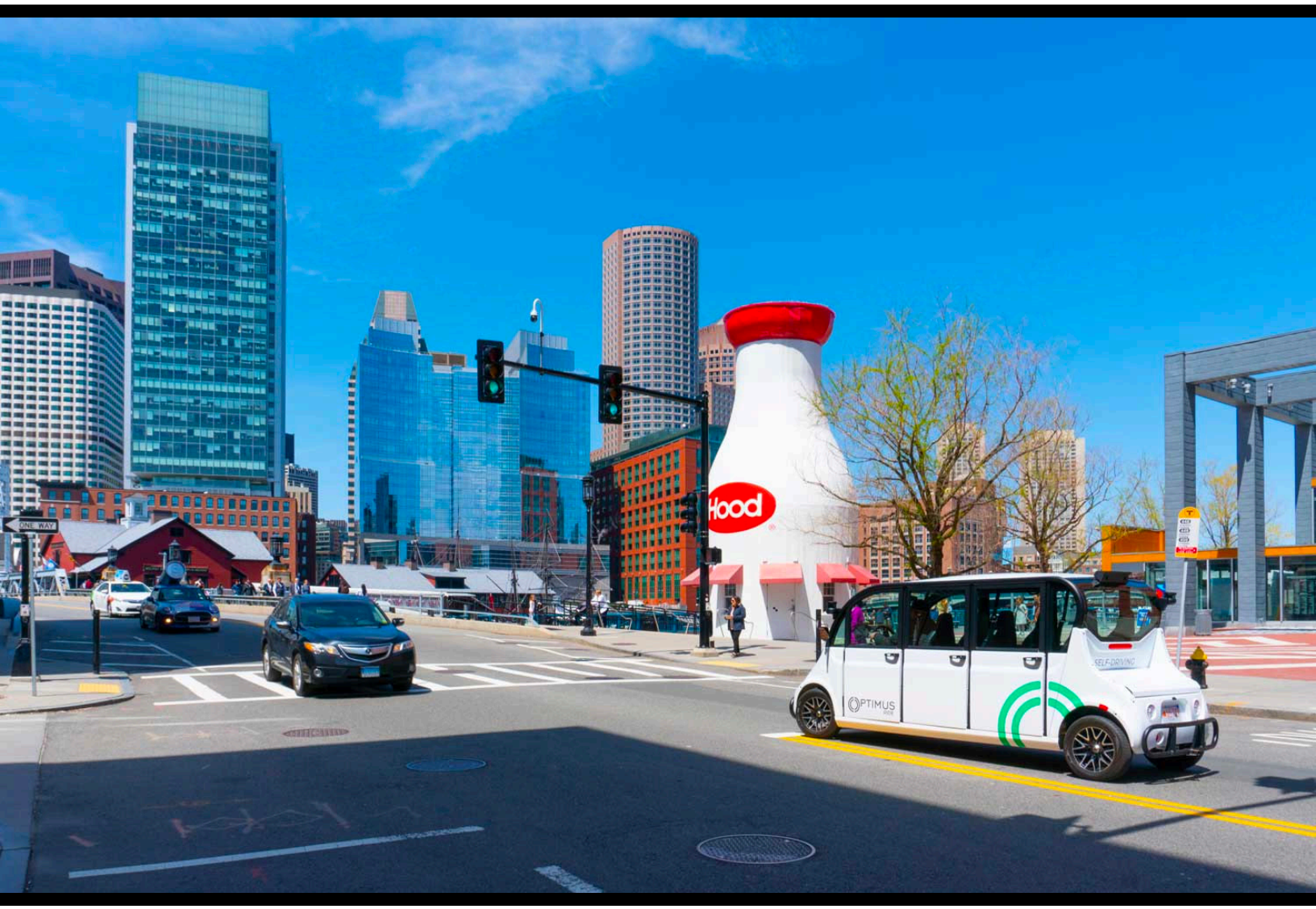
UNION POINT

BROOKLYN NAVY YARD



HALLEY RISE

PARADISE VALLEY



OPTIMUS RIDE

massDOT
Massachusetts Department of Transportation

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