

Minnesota Autonomous Bus Pilot Industry Forum Webinar

April 20, 2017

Opening Remarks – Sue Mulvihill

- Welcome
- Panel Introductions
 - Jay Hietpas, MnDOT
 - Dick Wolsfeld, AECOM
 - Daryl Taavola, AECOM
 - Kian Sabeti, WSB
- Webinar Goals



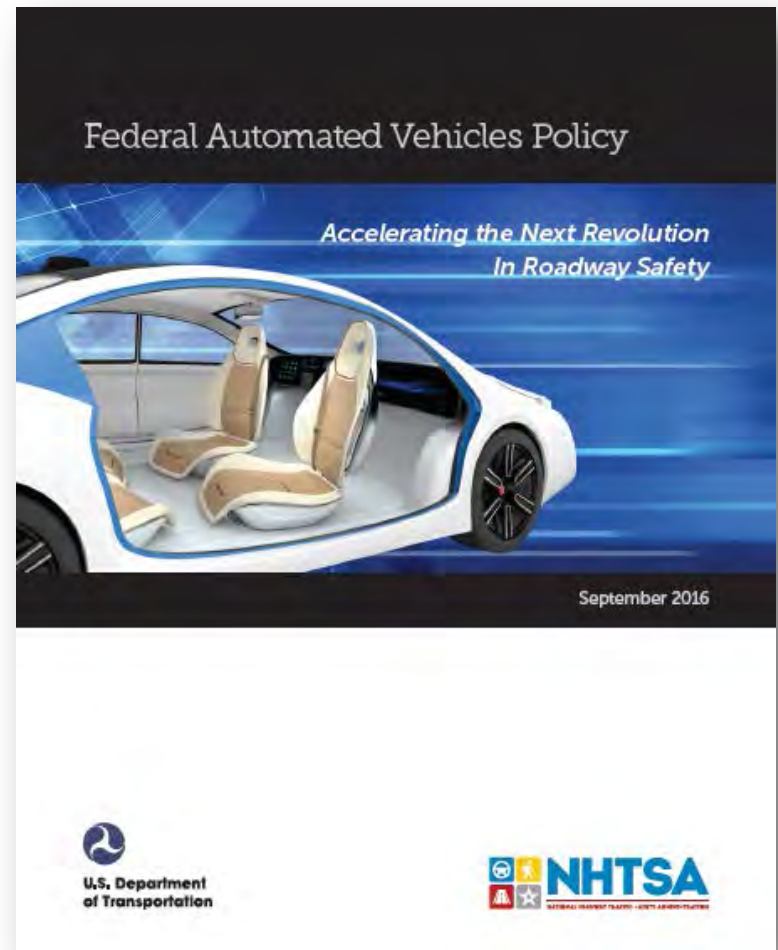
Webinar Agenda

- Pilot Overview
- Partnership Opportunities
- Pilot Concepts
- Selection Process
- Q & A



Minnesota & Automated Vehicles

- MN is “**OPEN for Business**”
- Minnesota Jurisdictional AV/CV Committee
- Minnesota Guidestar
- MnDOT Examining Statutes/Rules
 - ID Statutes/Rules Limiting AVs
 - ID Possibilities within Current Statutes/Rules
 - Currently Not Promoting Legislation



MN AV Bus Pilot Overview – Jay Hietpas

- Background and Goals
- Project Status
- Related Activities
- Pilot Schedule



Minnesota Autonomous Bus Pilot

Project

- Research vehicle and infrastructure requirements to safely operate an **autonomous bus in cold weather** climate conditions

Objective 1

- Define project pilot, perform feasibility study, perform preliminary engineering and solicit for autonomous vehicle technology vendors

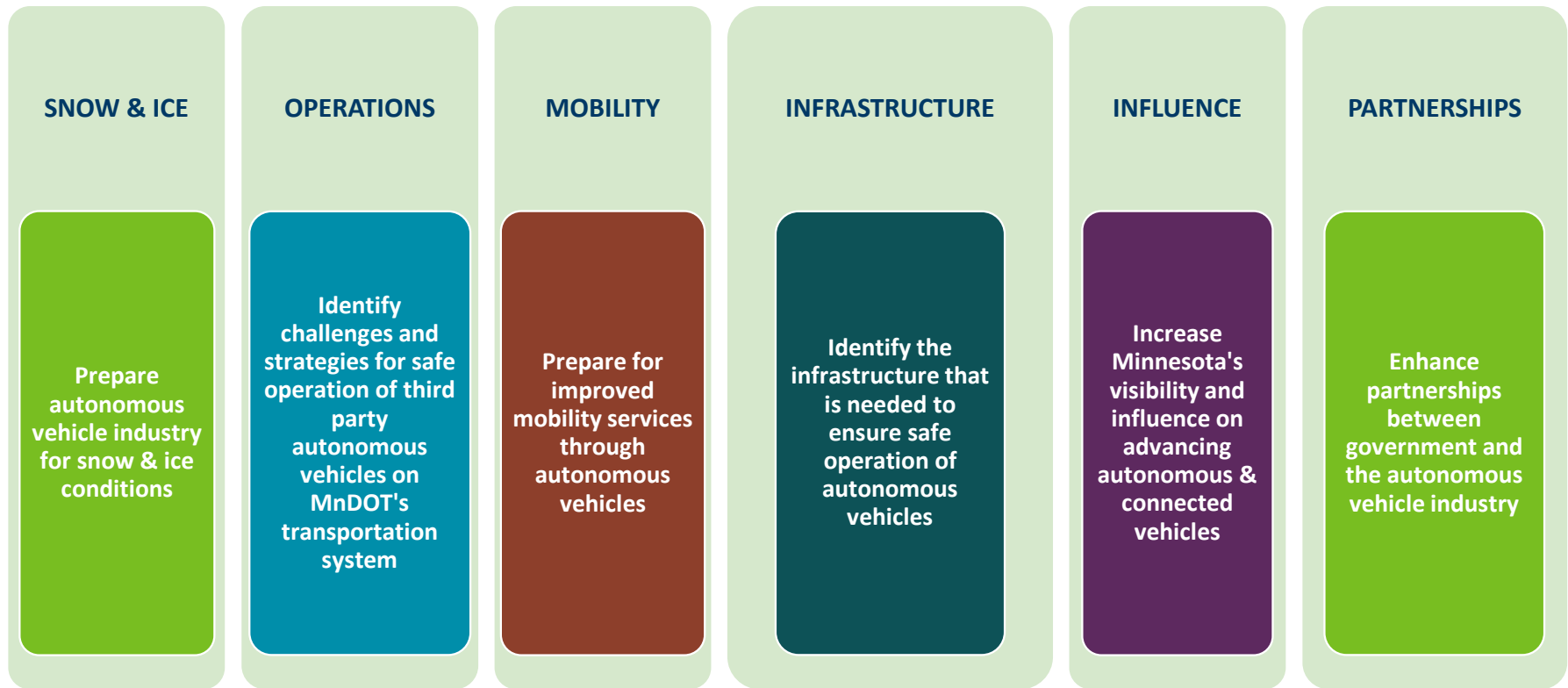
Objective 2

- Finalize design/deployment plan with technology vendor and conduct pilot



Project Goals

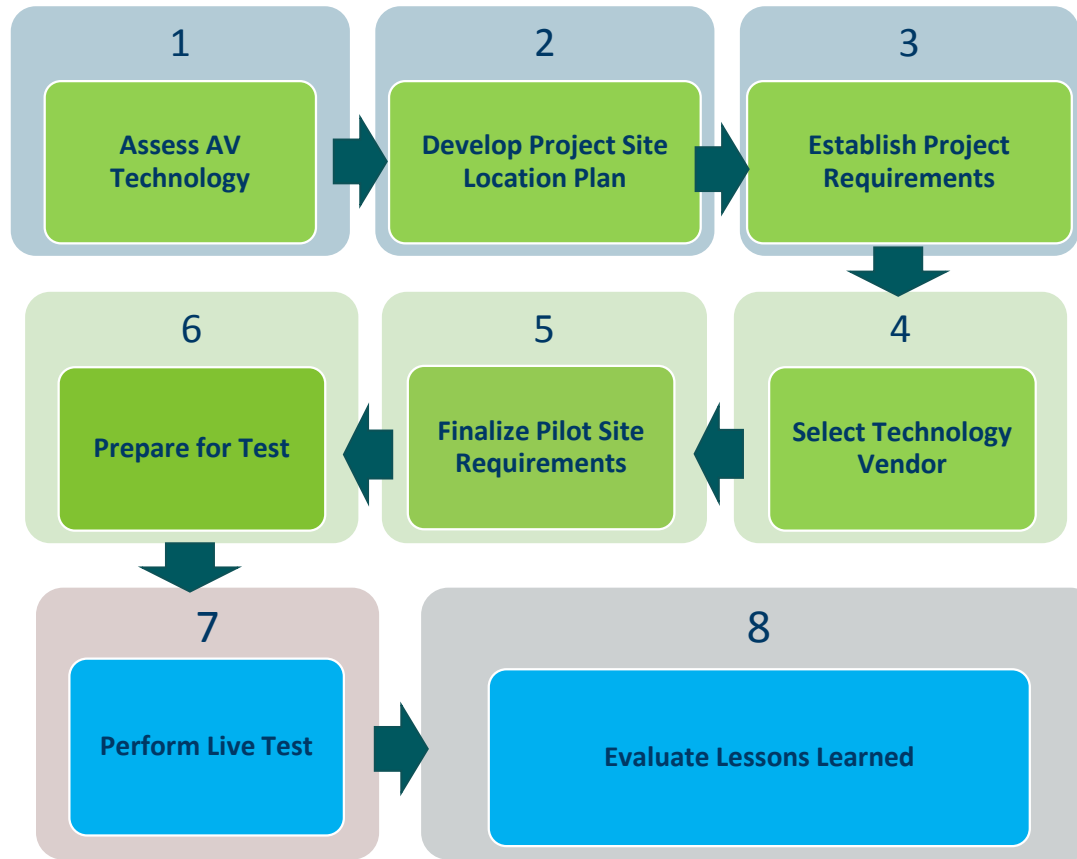
Why are we doing this?



RFP Goal - solicit a technology vendor to come to Minnesota to work with the stakeholders in safely demonstrating the technology

Project Activities

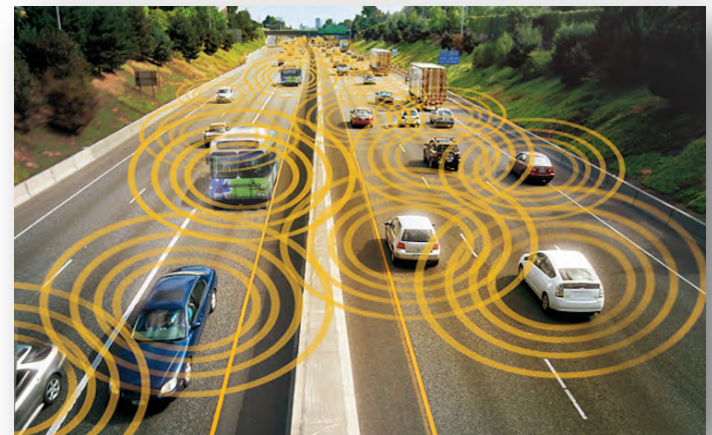
What are we doing?



Project Status – defining pilot requirements and preparing a vendor RFP

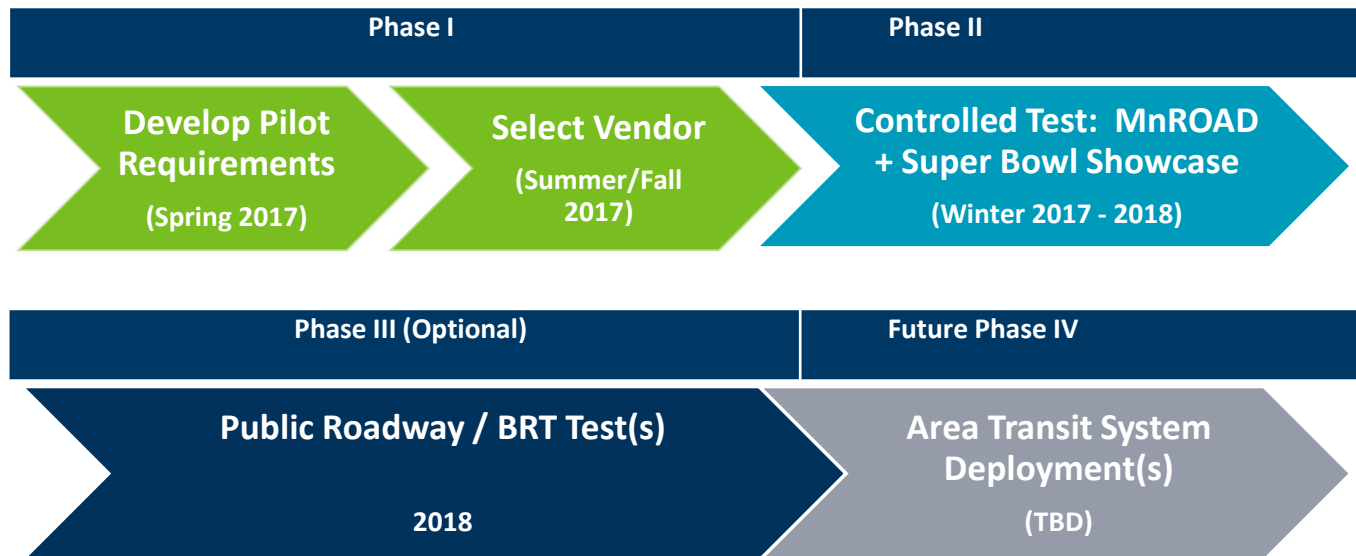
MN Regulatory Review

- **Cursory Findings – No definition of an AV**
 - Regulations
 - Define a “driver” as a “person” and physically in control of vehicle
 - Define a “person” as every natural person, firm, copartnership, association, or corporation
- **Impacts to MN AV Bus Public Roadway Testing**
 - Meet Federal Motor Vehicle Safety Standards (FMVSS) for public roadway use
 - Driver must be trained in use and operation of the AV technologies
 - Must be mechanism to engage / disengage the AV technology
 - Include indemnity, adequate insurance requirements, and other contractual mitigations
 - Successfully complete testing on a private / closed roadway before public roadway operations



Pilot Schedule

When will this happen?



Testing Schedule – allows for testing during winter 2017 - 2018

Possible Super Bowl Venue Showcase

Super Bowl LII

- Possible test showcase for Technology Vendor
- Smart Corridor loop being planned to showcase CAV
- Top Ideas
 - AV for Minneapolis Convention Center & Hotels
 - AV Parking Lot Service
 - Multiple private lots service to venues
 - Service to 3 outer security checkpoints
 - UofM Transitway



Partnership Opportunities – Dick Wolsfeld

- U.S. National Participation
- Industry Partnerships
- Vendor Scope



Possible U.S. National Partners

- **Possible Partners**

- Areas with 80-90% controlled access BRT systems
- Cold climate areas
- Three areas have expressed interest

- **Benefits**

- Leverage input from multiple states
- Multi-state interaction
- Build relationships
- Future testing in other states

- **Other U.S. State Participation**

- Phase 1 – Finalize pilot requirements
- Phase 2 – MN controlled testing
- Phase 3 – Public roadway / BRT testing
- Future – Area Transit System Deployment(s)



AV Industry & Bus Company Opportunities

- **Vehicle Requirement**
 - Full size bus or small shuttle
- **MN AV Bus Pilot Opportunity**
 - Vendors with existing AV buses / shuttles
 - AV hardware/software Retrofit companies who can partner with bus companies and propose to deliver the pilot



Vendor Scope of Work

Phase	Dates
Phase 1 – Pilot Testing Preparation <ul style="list-style-type: none"> Finalize Requirements & High-Level Design Prepare Controlled Site for Testing Provide Autonomous Bus Pilot Test Vehicle 	<ul style="list-style-type: none"> Sept. / Oct. 2017 Sept. / Oct. 2017 Nov. 2017
Phase 2 - Controlled Testing & Super Bowl Showcase <ul style="list-style-type: none"> Conduct Fair Weather Testing Conduct Cold Weather Testing Provide Acceptance Testing Reports Conduct Super Bowl Showcase 	<ul style="list-style-type: none"> Nov. 2017 Nov. / Dec. 2017 Jan. 2018 Jan. / Feb. 2018
Optional Phase 3 – Public Roadway / BRT Testing <ul style="list-style-type: none"> Conduct Fair Weather Testing Conduct Cold Weather Testing Provide Acceptance Testing Reports Prepare Plan for Future Deployments 	<ul style="list-style-type: none"> 2018 2018 2018 2018

MN AV Bus Pilot Concepts – Daryl Taavola

- Pilot Site Concepts
- Demonstration & Testing Concepts



Phase 2: Pilot Site Concepts

Proposed Controlled Test Site - MnROAD



- MnDOT owned and operated
- Low and high speed testing available (30 – 70 MPH)
- Closed loop = 2.5 miles; I-94 high speed segment = 3.0 miles
- Enabling environment, easily accessible and readily available
- Ability to create varying test conditions
- Is an AV proving ground site

Phase 2: Pilot Site Concepts

Proposed Controlled Test Site - MnROAD



Pilot Demonstration Concepts

SAE Levels of Automation

SAE Level	Definition
Level 0	Human driver does everything
Level 1	Automated system on vehicle can sometimes assist the human driver conduct some parts of the driving task
Level 2	Automated system on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task
Level 3	Automated system can both actually conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests
Level 4	Automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions
Level 5	Automated system can perform all driving tasks, under all conditions that a human driver could perform them

Pilot Demonstration Concepts

- **Level of Automation**

- Desire Level 4

- **Vehicle**

- Provided by vendor – full size bus or small shuttle
 - Driver or controller mechanism to engage/disengage AV
 - Federal compliance for Minnesota public roads
 - FMVSS



- **Infrastructure**

- High-definition mapping
 - Other?

- **Testing Environment**

- Controlled and semi-controlled public roadway
 - Weather – dry, cold, wet, snow/ice, salt (day/night)



Potential Demonstration Concepts

Federal AV Policy – Behavioral Competencies

Test Runs	Dry / Cold Weather	Snow / Ice / Salt
Speed Changes	Merges	Parking
On-coming Vehicles	Passing	Car Following
Slow / Stopped Vehicles	Lane Changes	Obstacles
Traffic Signals	Stop / Yield Signs	Work Zones
Emergency Vehicles	Peds / Bikes	People Directing Traffic
Low / High Speed	Locate Parking Lot	Intersection Turns
Detours	Right-of-Way Decisions	Other

Potential Demonstration Concepts

MnROAD Test Cases

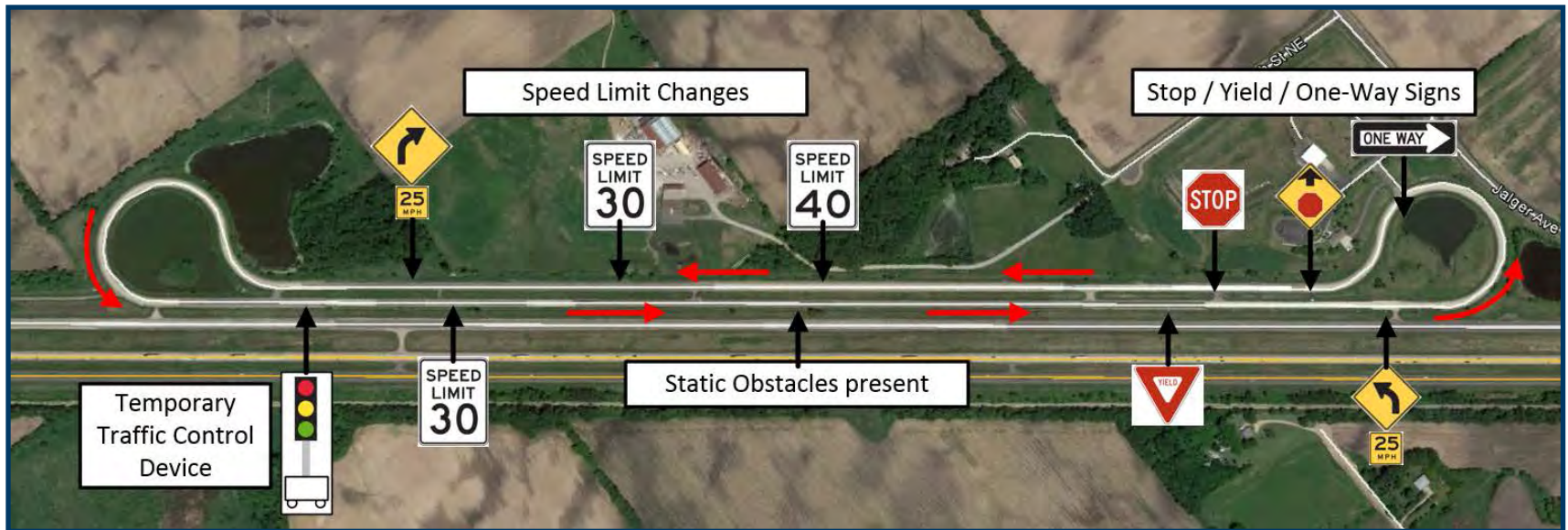
- Dry weather conditions
- Winter weather conditions
- Introduce other conditions
 - Other vehicles
 - Emergency vehicles
 - Pedestrians and bikes
 - Traffic signal
 - Stop / Yield signs
 - Lane obstacles or closures
 - People directing traffic
 - Other NHTSA test cases



Potential Demonstration Concepts

MnROAD Low Volume Loop Sample

- Testing Duration: 2 – 4 weeks



Pilot Site Concepts

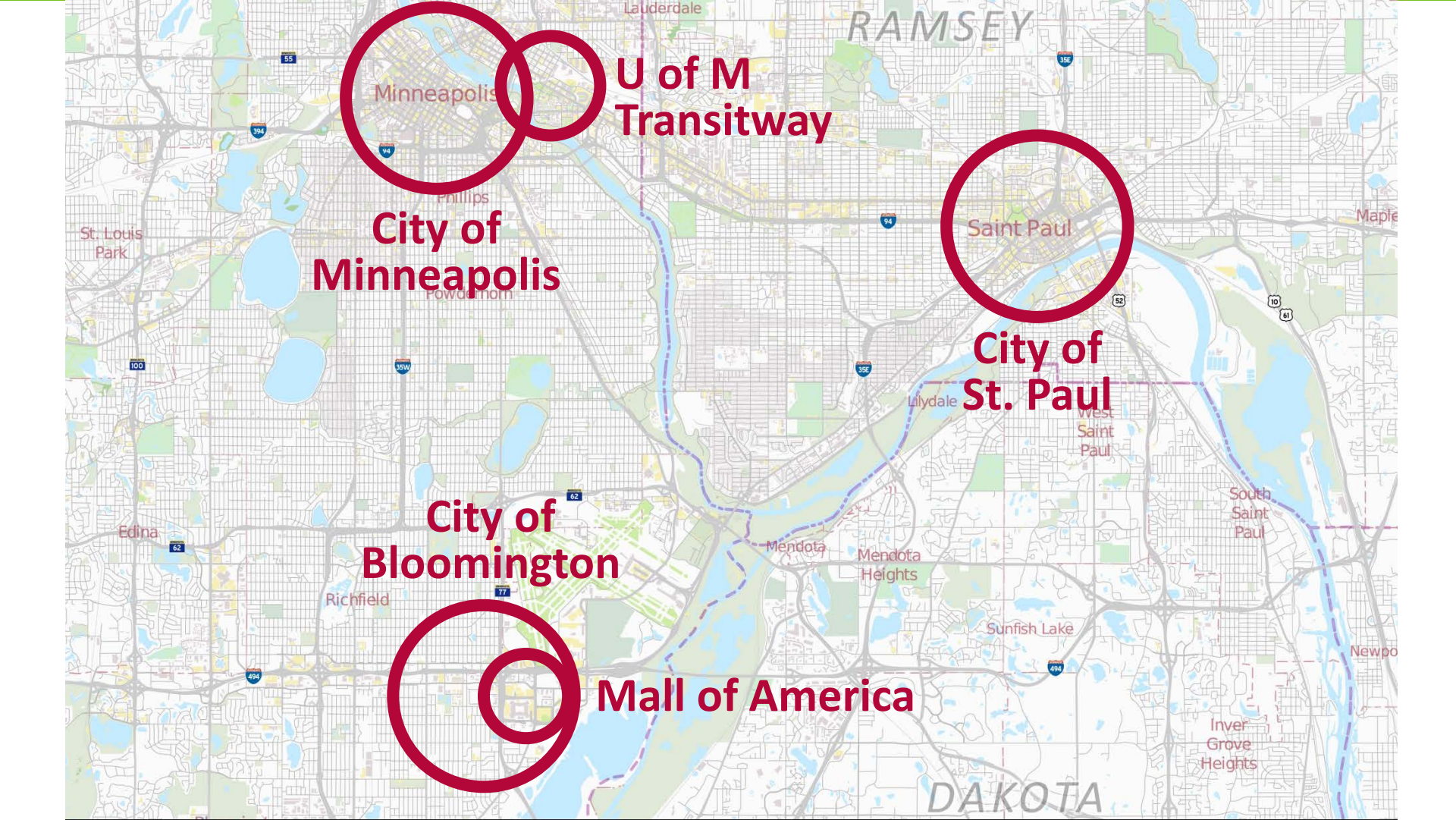
Possible Super Bowl Showcases (open to vendor proposals)

Candidate Site	Ownership	Type of Environment	Miles of Route	Use Complexity	Secure	Speed
Twin Cities Area / Super Bowl Showcase Sites						
Super Bowl Venues	Cities of Minneapolis, Saint Paul, Bloomington	Public Roads; open traffic to all vehicles on road	1- 5 miles (TBD)	Depends on route	Unsecured, open to all traffic	10-30 MPH
Super Bowl Event Parking in Private Lots	Minneapolis / Saint Paul Metro Area	Private Parking Lots w/ other traffic and peds	1- 5 miles (TBD)	Low	Secured, private lots	10-30 MPH

Pilot Site Concepts

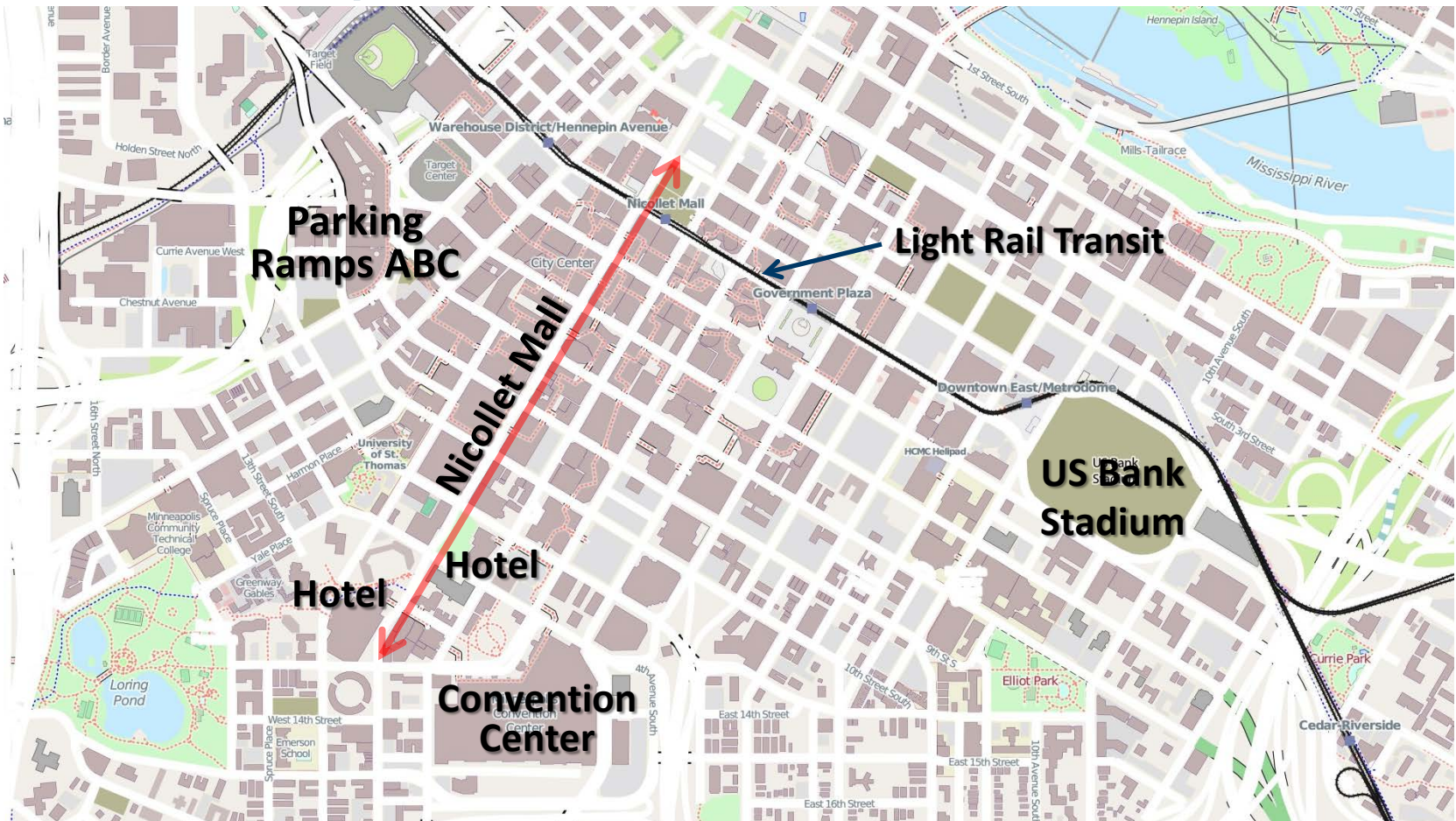
Possible Public Roadway / BRT Sites (open to vendor proposals)

Candidate Site	Ownership	Type of Environment	Miles of Route	Use Complexity	Secure	Speed
Twin Cities Area						
U of M Transitway	U of M	Traffic limited to buses, bikes, peds, emergency vehicles	2.6 miles	Low - Medium	Semi – controlled with road signs, traffic signals	20-40 MPH
Other States						
TBD	TBD					
Other Candidate Sites						
Canal Park in Duluth, MN	City of Duluth, Duluth Transit Authority	Tourists; open traffic to all vehicles on road; peds	1-3 miles	Low - Medium	Semi-controlled geometrics, open to all traffic	30 MPH
Private Companies	Private Industry sites (TBD)	Private Lots or routes w/ open traffic on roads	TBD	Low - Medium	TBD - Secured to Unsecured	10-40 MPH



Phase 2: Super Bowl Concepts

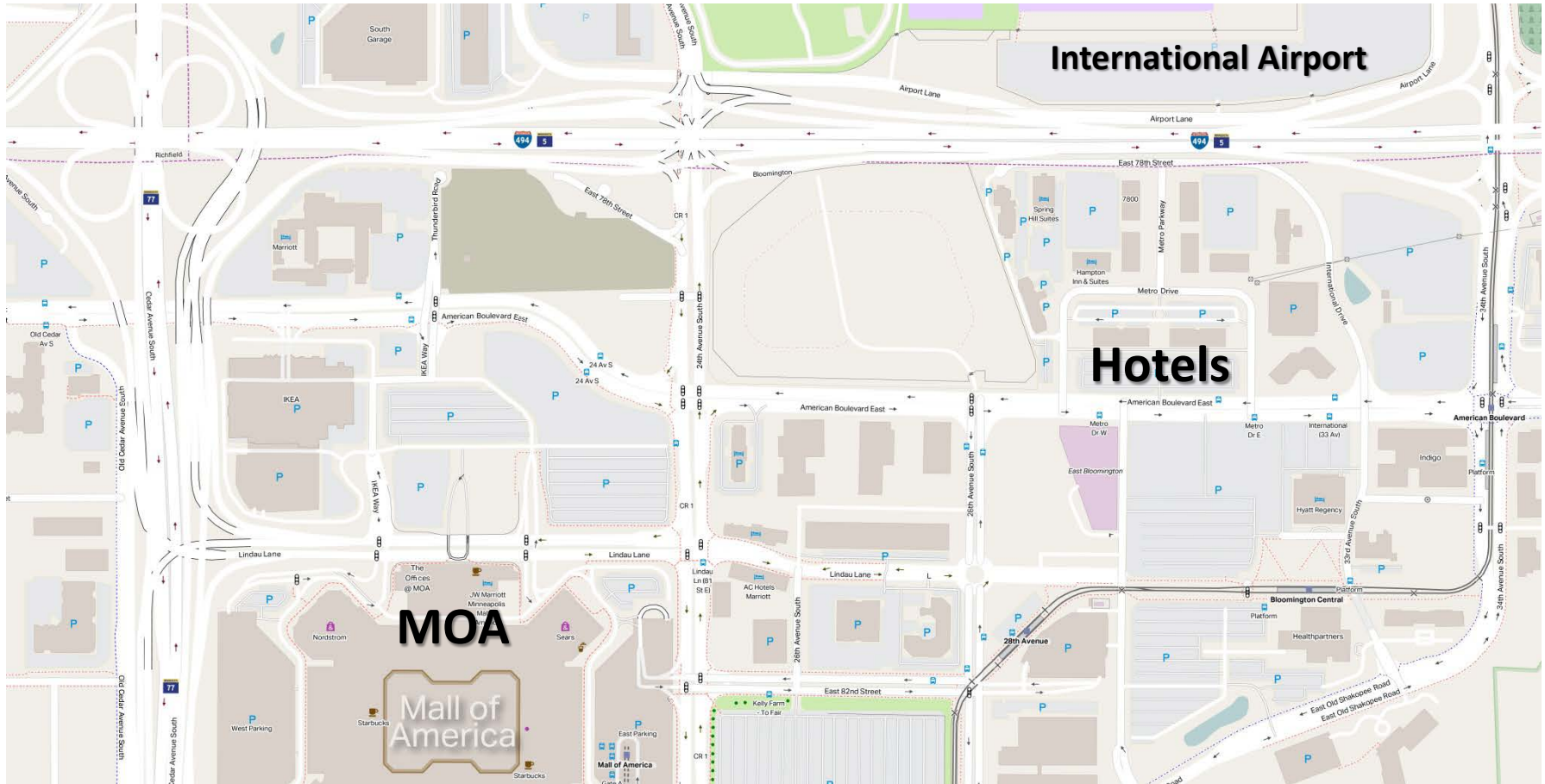
Possible Super Bowl Showcase – Convention Center / Hotels



- Downtown Minneapolis will be site of many events
- Nicollet Mall is designated as "Super Bowl Central"

Phase 2: Super Bowl Concepts

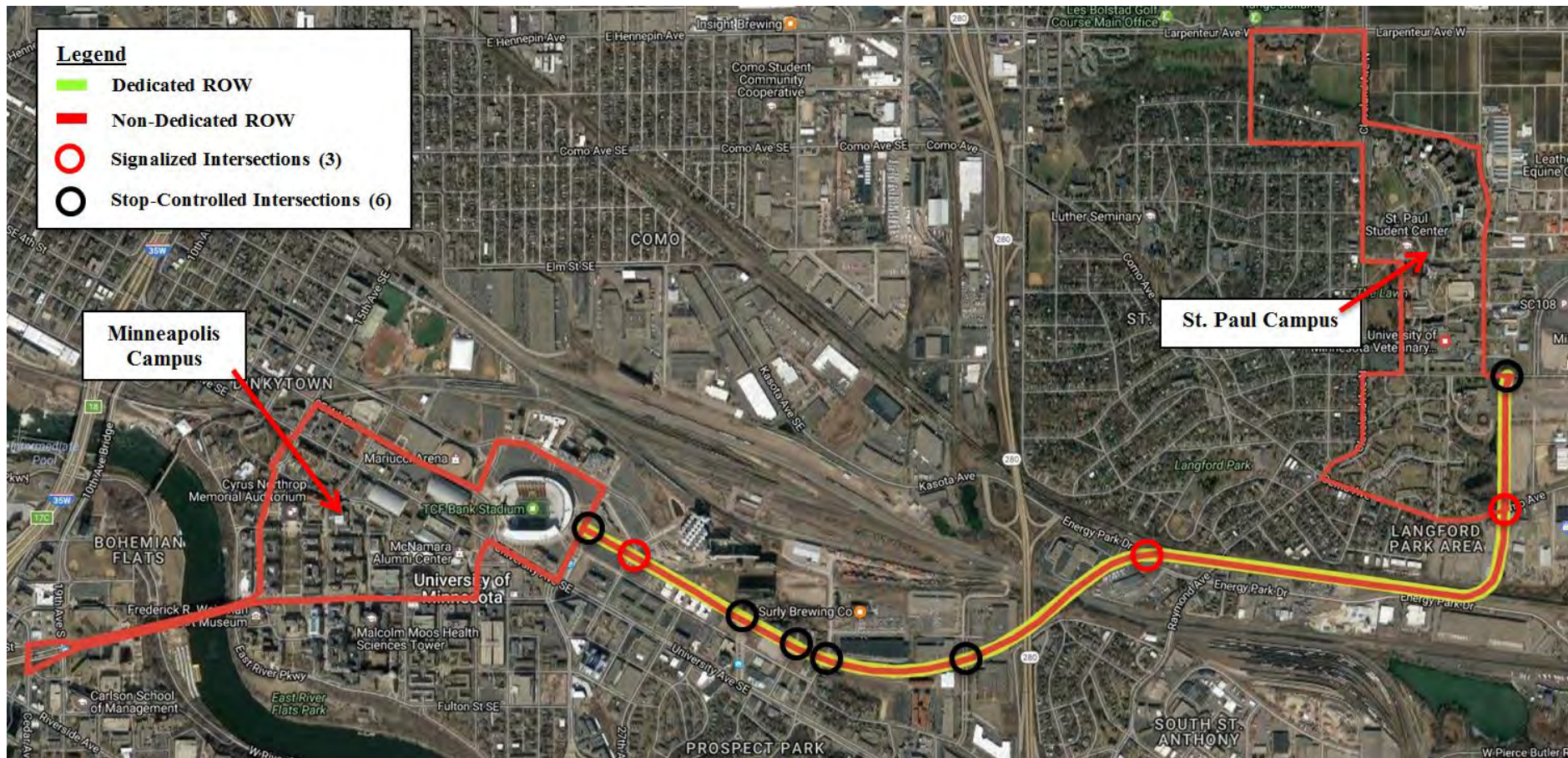
Possible Super Bowl Showcase – MOA Area Opportunities



- MOA is adjacent to hotels and MSP airport

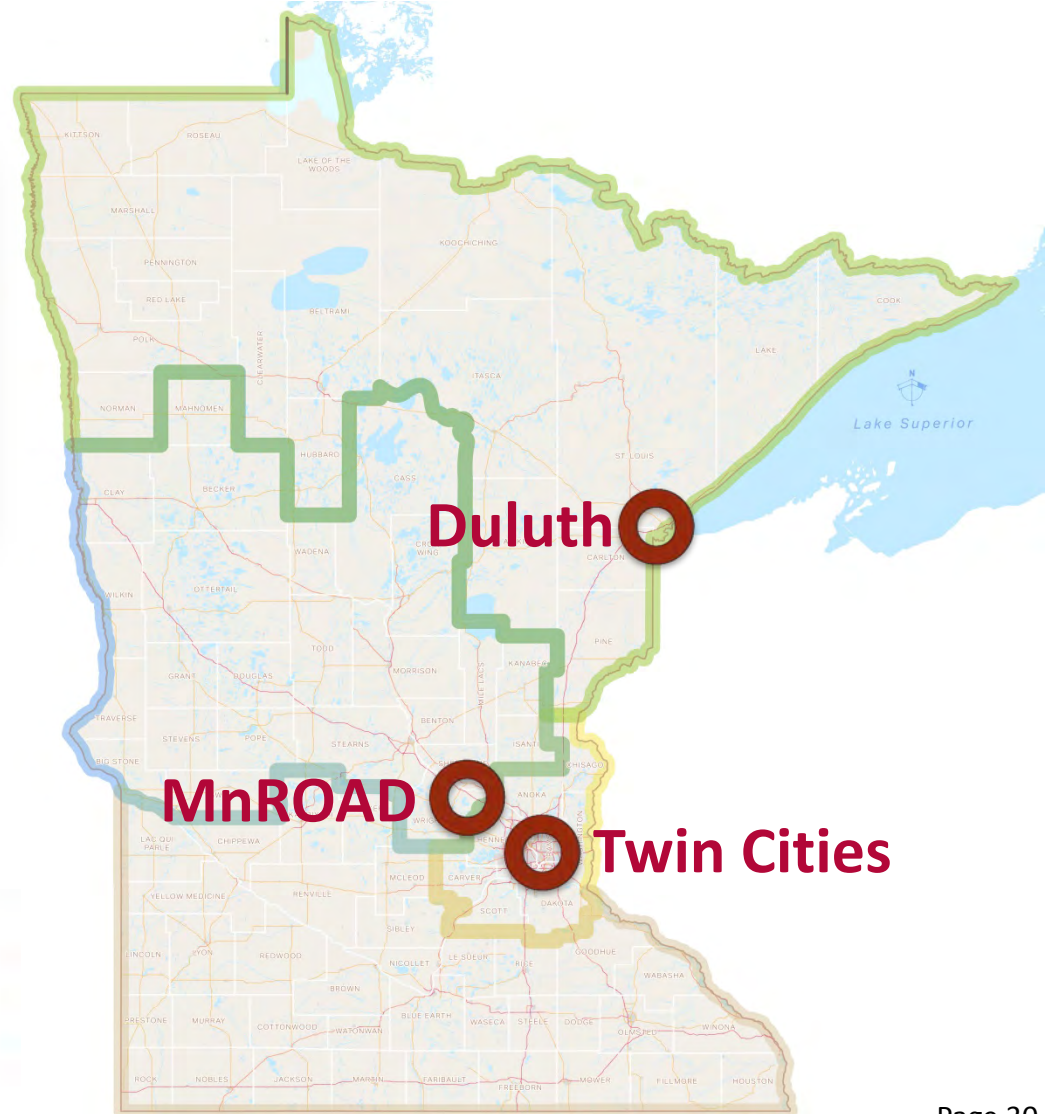
Phase 3: Public Roadway / BRT Site

Possible Public Roadway / BRT Site – U of M Transitway



- Use requires revision to UofM Regents Ordinance and User Agreement

Duluth Area

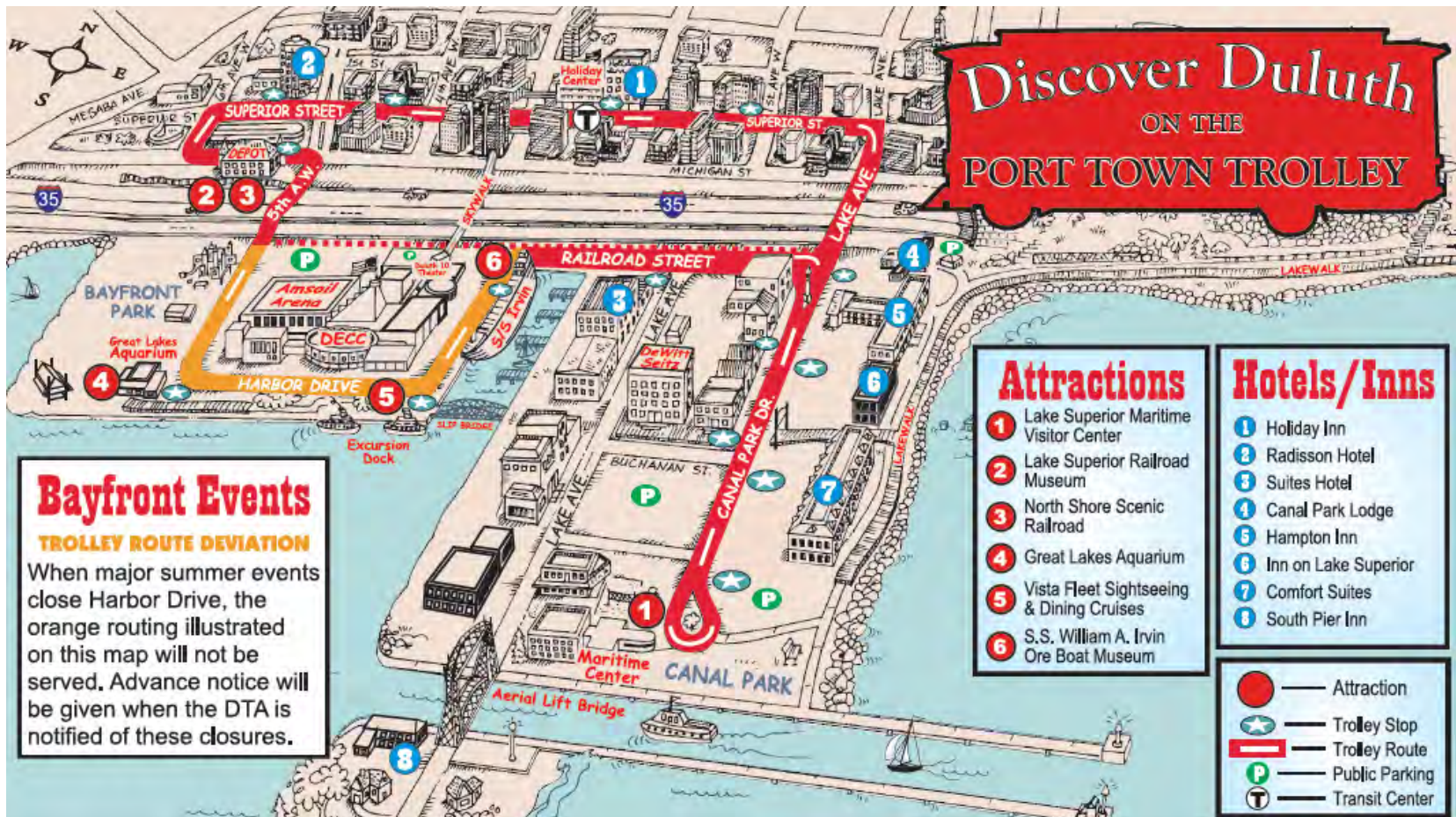


Duluth Area



Phase 3: Public Roadway - Duluth

Possible Public Roadway Test Site – Canal Park in Duluth

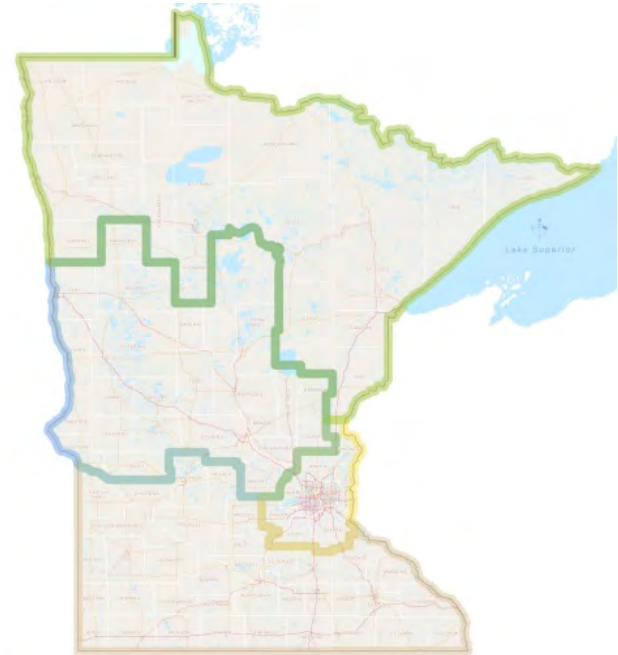


- Possible low speed loop at Duluth tourist site

Phase 3: Private Sites

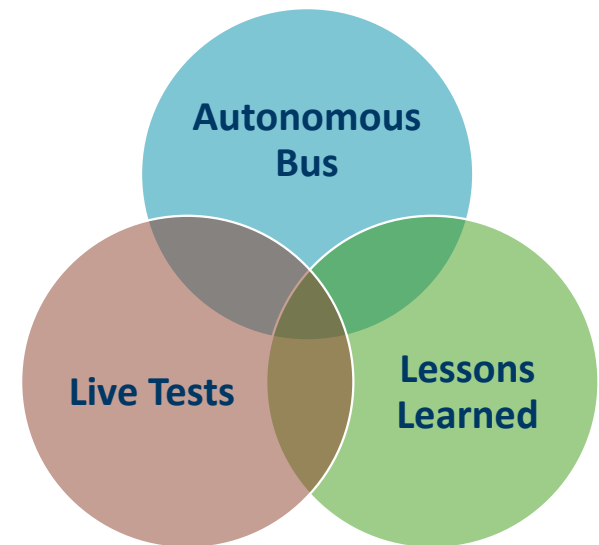
Private Company Campuses

- Discussions underway with private businesses
- Investigating opportunities to support business transportation logistics and movement of employees



Open to Vendor Concepts and Ideas

- Controlled testing logistics
- Public roadway / BRT site recommendation
- Super Bowl showcase ideas
- Proposed vehicle type
- SAE level of automation
- Operational and demonstration strategies
- Back office / control team strategies for test sites



Selection Process – Kian Sabeti

- Selection Process & Contracting Method
- Next steps



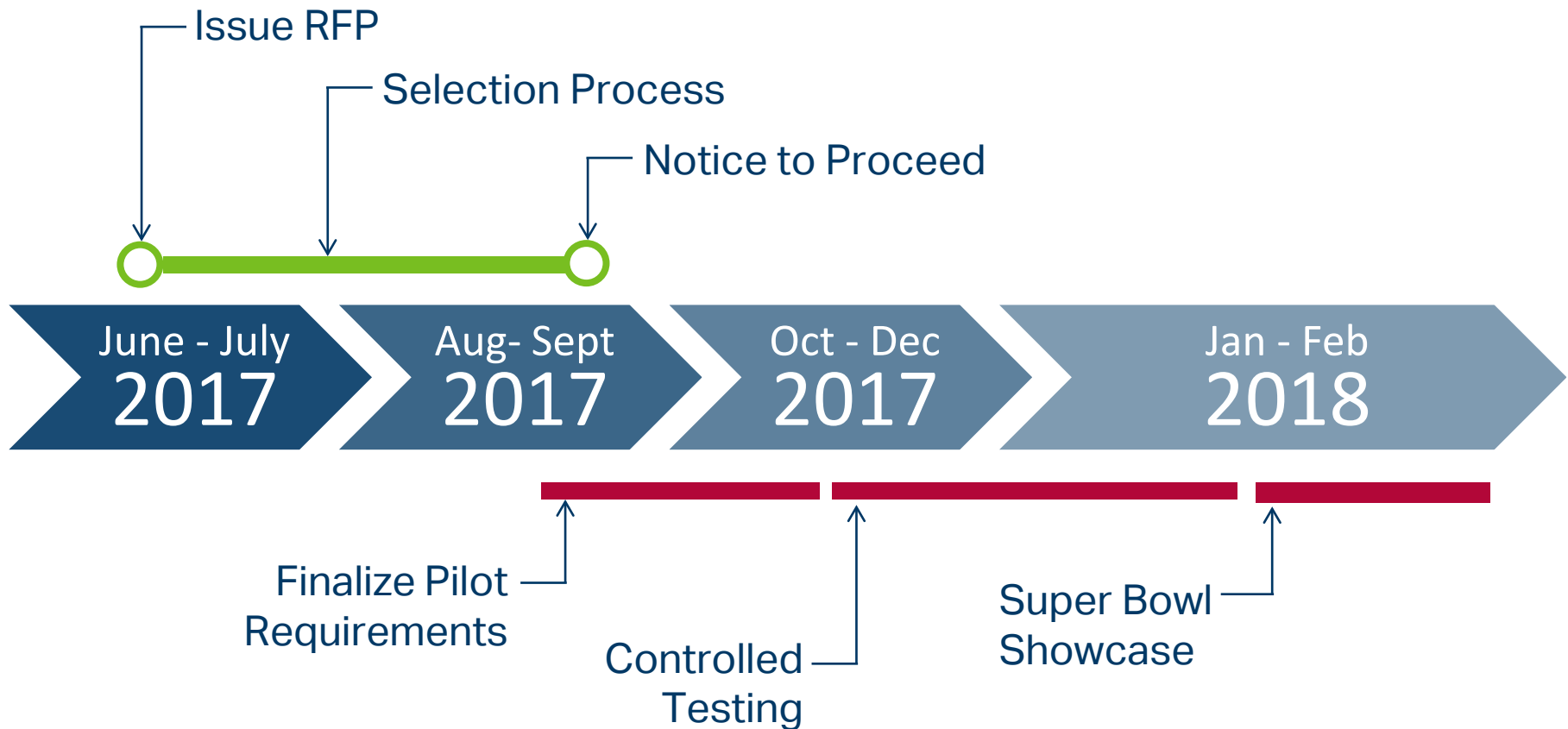
Vendor Selection Process

- RFP for Professional Technical Services Contract
 - **Sample contract available at**
www.dot.state.mn.us/autonomous/



Next Steps

Vendor Selection Process



Key Contract Milestones

Preferred Pilot Elements

Summary of High-Level Concepts

Vehicle

Vendor to provide vehicle

Full size bus or smaller shuttle

Focus on winter weather operations for lessons learned

Demonstrations

First test at controlled site

Super Bowl showcase opportunity

Desire public roadway / BRT demonstration

Questions & Answers



Thank you again!

Jay Hietpas, PE

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