Ben Pierce
5/20/2016

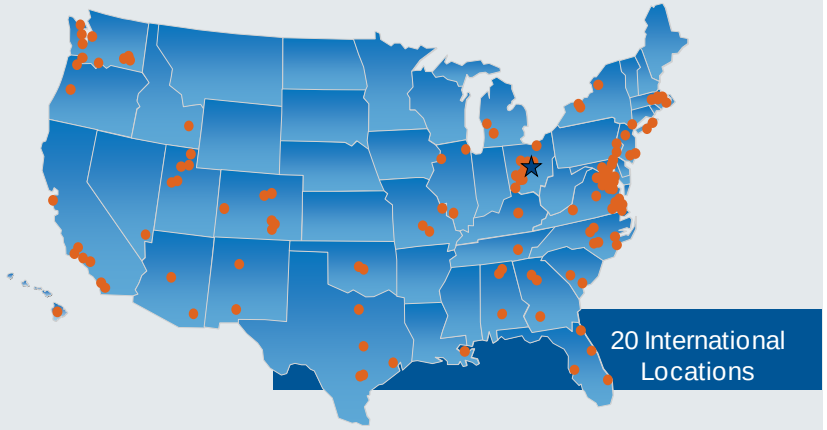
Connected and Autonomous Vehicles Primer and Predictions

Battelle
The Business of Innovation

What We Are

- Global enterprise
  - Applying science and technology to real-world problems
  - Managing machinery of scientific discovery and innovation
  - Creating commercial value by bringing new technologies to international marketplace
- Non-profit, charitable trust formed by Will of Gordon Battelle in 1925

- Generates $6.5 billion annually in global R&D
- Oversees 22,000 employees in 120 locations worldwide



Coming to Grips with Terminology

"Connected Cars"	"Connected Vehicles"	"Autonomous Vehicles"

• Generally refers to vehicles with Cellular Connectivity
  • "On-Star"
  • "WiFi On-Board"
• Describes the ability for a vehicle to access the Internet while in motion
	• Vehicles equipped with a special WiFi Radio operating on the 5.9 Ghz Spectrum
	  • Includes in-vehicle radios (OBE
	  • Includes roadside radios (RSE)
	• "Dedicated Short Range Communications or DSRC"
	• Vehicle-to-Vehicle (V2V)
	• Vehicle-to-Infrastructure (V2I)
		• Vehicles with embedded sensors that can operate "by themselves"
		  • Radar, Lidar, Optical, etc. are sensors
		• "Super-Cruise"
		• "Forward Collision Warning"
		• "Parking Assist"

Connected Car Concepts

Automotive WiFi

Audi Connect
Fiat Group

Ford – “Bring your own Access Point”

Tesla – OTA Updates

Smartphone Connectivity and Infotainment Extensions

Google’s Auto Android Installed in Hyundai Sonata

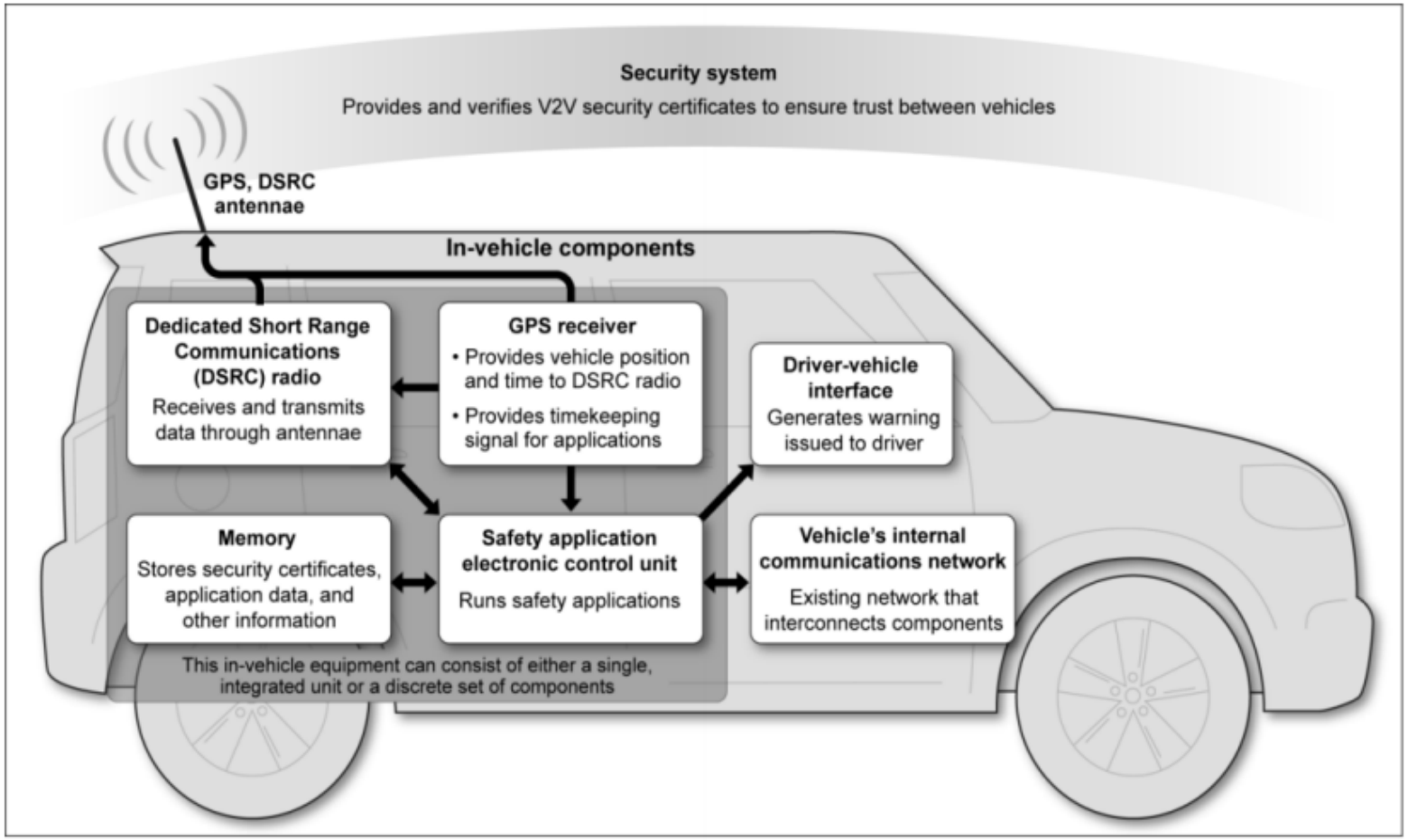
Source: CHRISTIE HEMM KLOK/WIRED

Apple Carplay Available in Several Makes/ Models

Source: Apple

Connected Vehicle Concepts

Vehicle Hardware



Sources: Crash Avoidance Metrics Partnership and GAO.

Connected Vehicle Concepts

Roadside Hardware

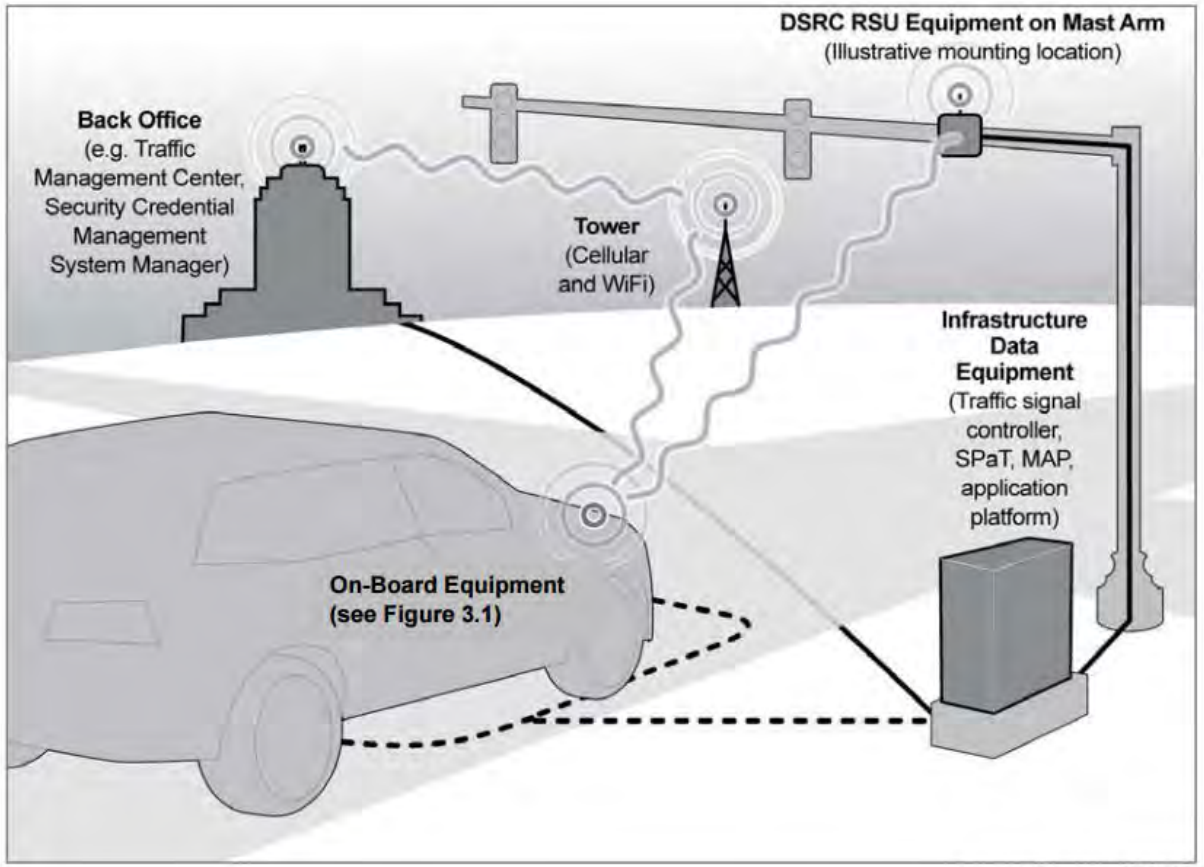


Image Source: USDOT

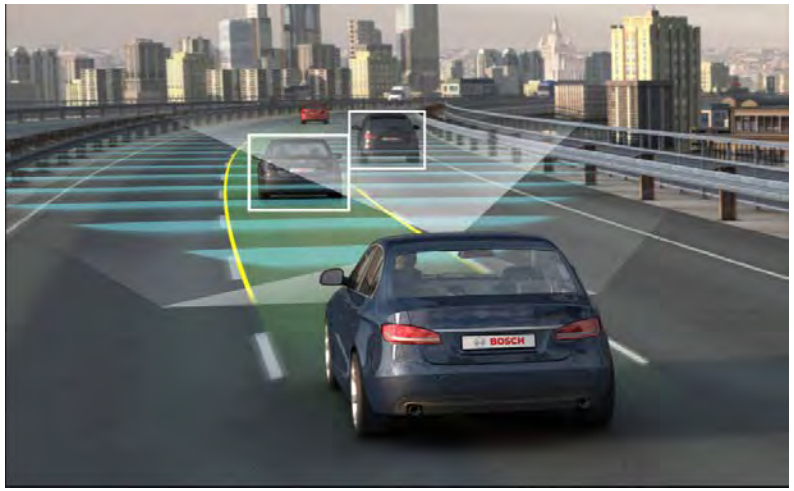
Connected Vehicle Concepts (cont.)

Software Applications

Table 2-1. Safety Applications[19]

V2I Safety	V2V Crash Avoidance Safety
• Red Light Violation Warning • Curve Speed Warning • Stop Sign Gap Assist • Spot Weather Impact Warning • Reduced Speed/ Work Zone Warning • Pedestrian in Signalized Crosswalk Warning (Transit)	• Emergency Electronic Brake Lights (EEBL) • Forward Collision Warning (FCW) • Intersection Movement Assist (IMA) • Left Turn Assist (LTA) • Blind Spot/ Lane Change Warning (BSW/LCW) • Do Not Pass Warning (DNPW) • Vehicle Turning Right in Front of Bus Warning (Transit)

Autonomous Vehicle Concepts



Self Driving Cars

Source: Motor Authority

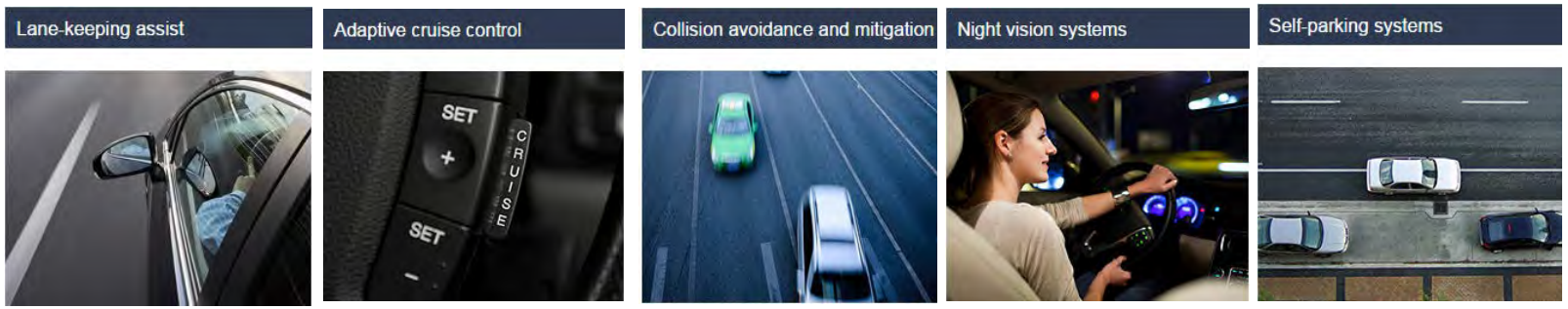
Picture: EasyMileEZ10 shuttle during the demonstration in Vantaa (Finland)

Self Driving Transit Vehicles

Source: EasyMile

Driver Assist Technologies

Source: Bankrate

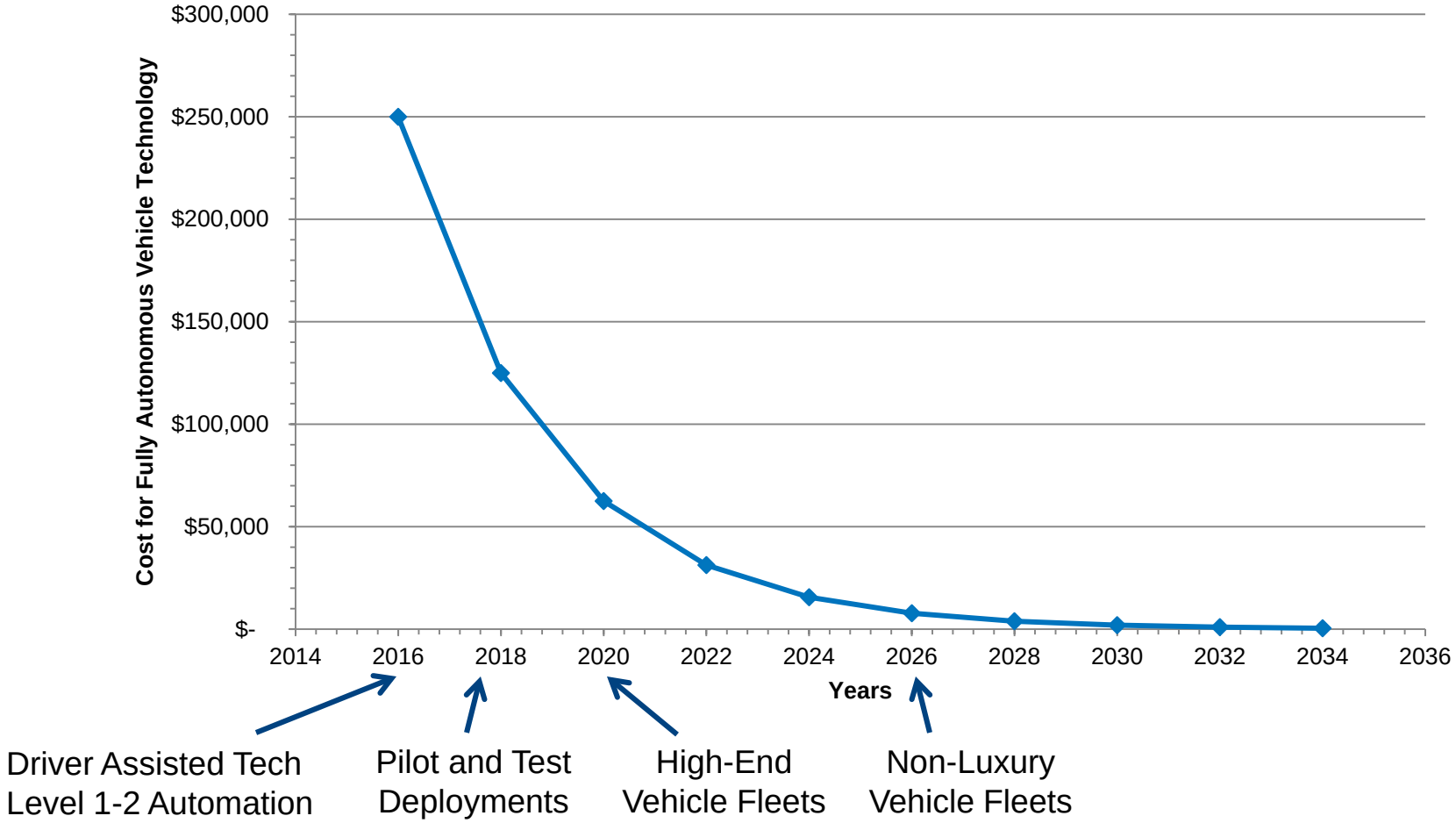


Will Connected Vehicles Become Adopted (and When)?

- NHTSA issued Advance Notice of Proposed Rulemaking in 2014
- Official Notice of Proposed Rulemaking expected at any time.
- Will likely require DSRC in all new Light-Duty Vehicles by 2025

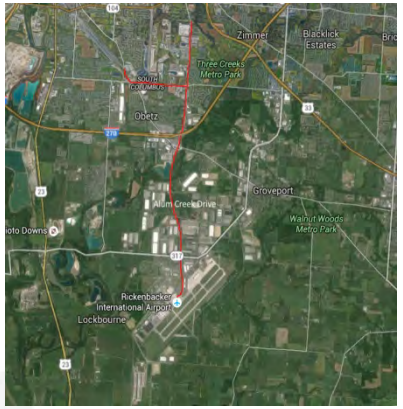
FAST Act's Advanced Transportation and Congestion Management Technology Deployment grant program

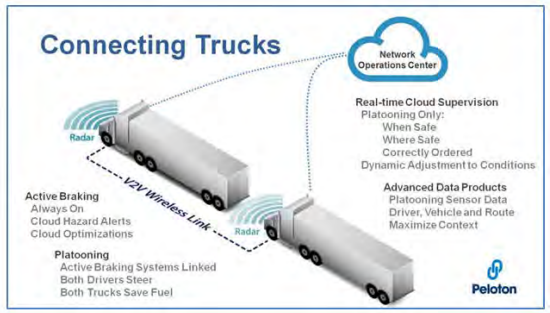
The Big Question on Autonomous Vehicles…When?



Columbus Smart City Challenge

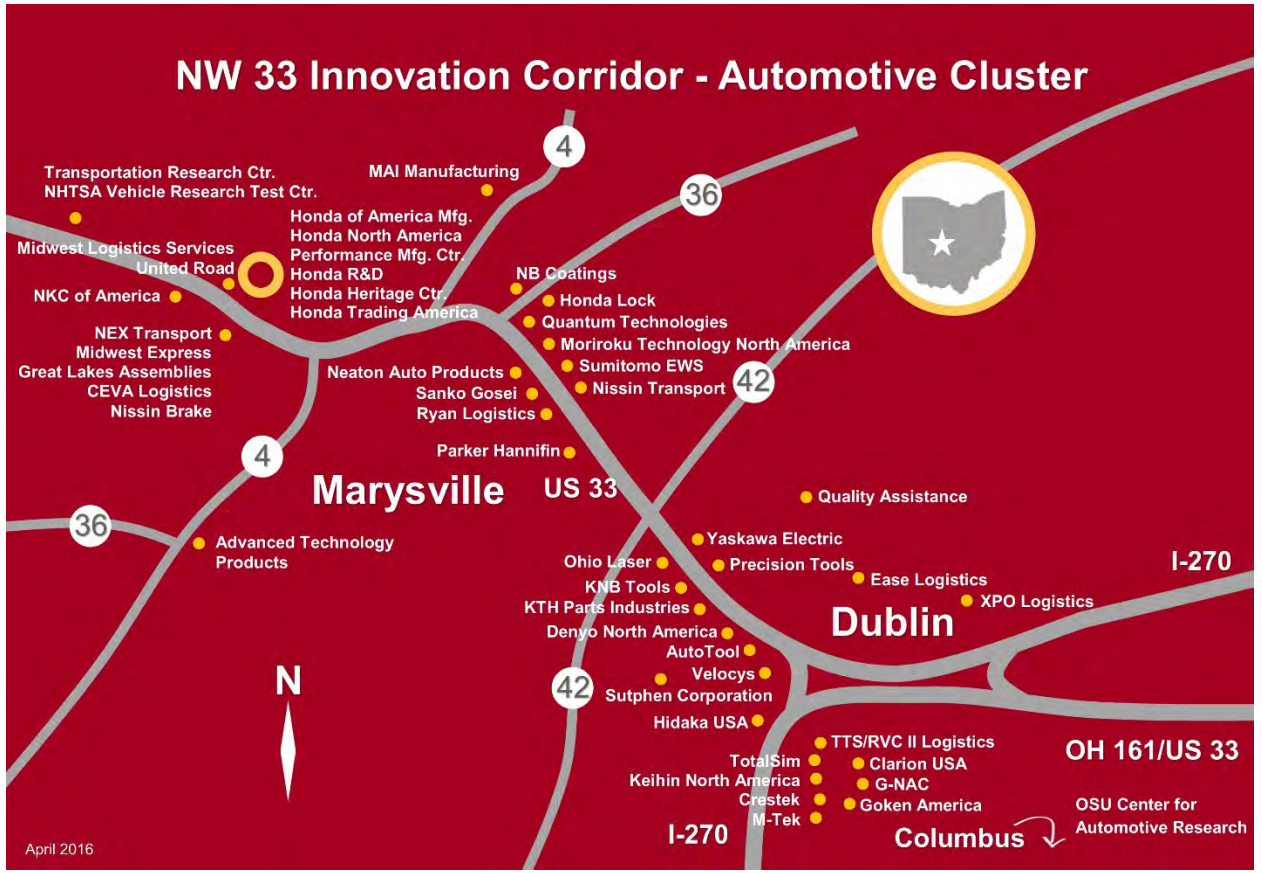
- Columbus is one of seven city finalists
- $40M Grant from US DOT
- Technology Deployment
  - 6 AV's
  - 10 Truck Platooning Vehicles





#SMARTCOLUMBUS

US 33 CV/AV On-Road Test Bed



THANK YOU

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The next disruptive technology

HOW AUTONOMOUS CARS WILL FUNDAMENTALLY RESHAPE OUR CITIES, AND WHY IT SHOULD MATTER TO YOU.

Who are we?

Rick Stein, AICP
Founder, Principal
Urban Decision Group

Justin Robbins, AICP
Senior Planner
OHM Advisors

Jason Sudy, AICP
Founder, Principal
Side Street Planning

Today's message:

As a planning-related professional:

- What should you be doing right now?
- What will you have to understand in the next few years?
- How do we prepare for the future?
- We should start thinking about this now!

A word from the experts...

...on electricity

“When the Paris Exhibition [of 1878] closes, electric light will close with it and no more will be heard of it.”

Oxford professor Erasmus Wilson

...on trains

“No one will pay good money to get from Berlin to Potsdam (on a train) in one hour when he can ride his horse there in one day for free.”

King William I of Prussia, 1864


on cars...
SLW 287R

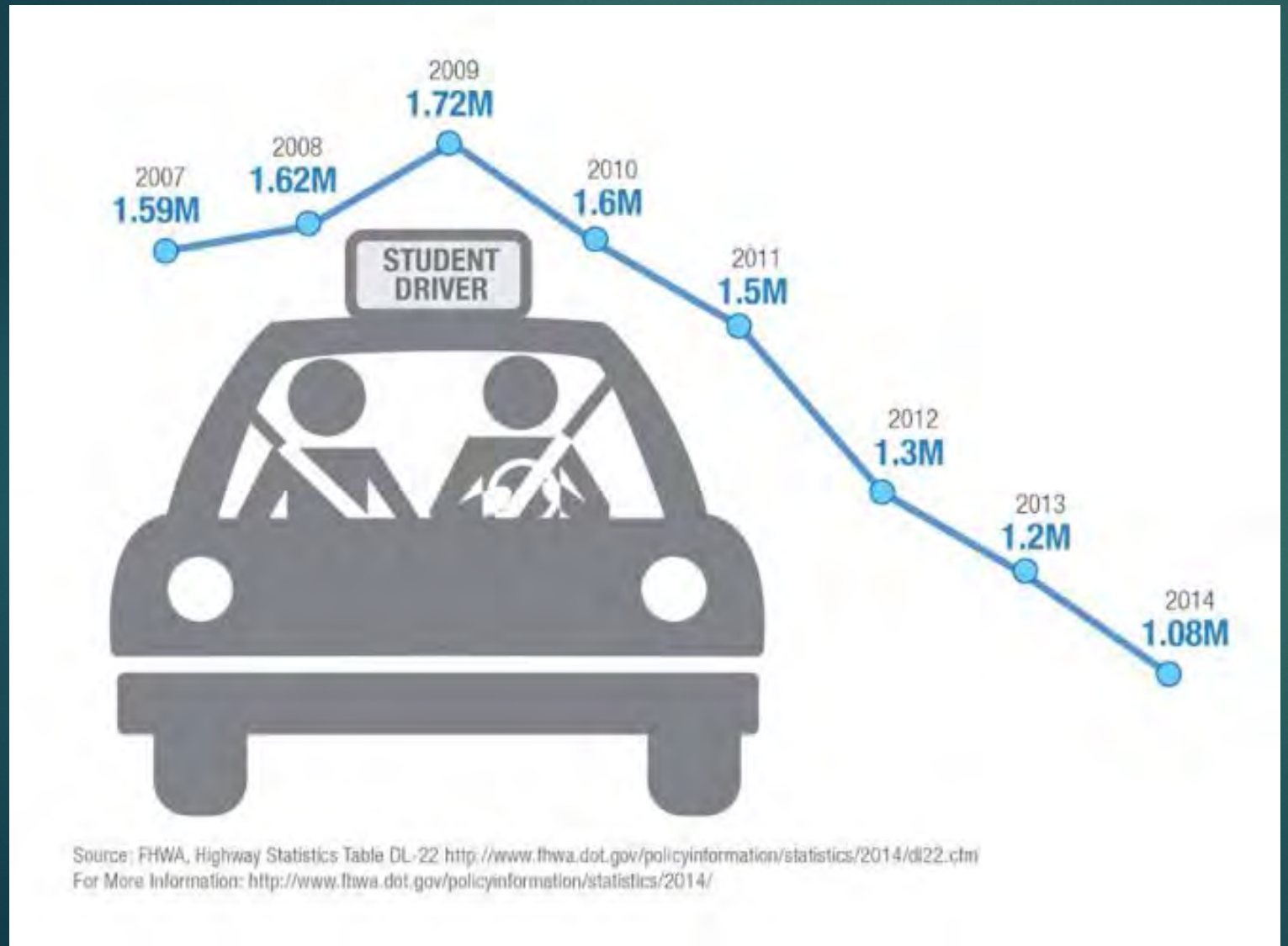
“The horse is here to stay but the automobile is only a novelty — a fad…”

The president of the Michigan Savings Bank advising Henry Ford's lawyer, Horace Rackham, not to invest in the Ford Motor Co., 1903.

Trending

Shifting Driving Patterns

Fewest 16-Year Old Drivers Since the 1960s



Growing Awareness

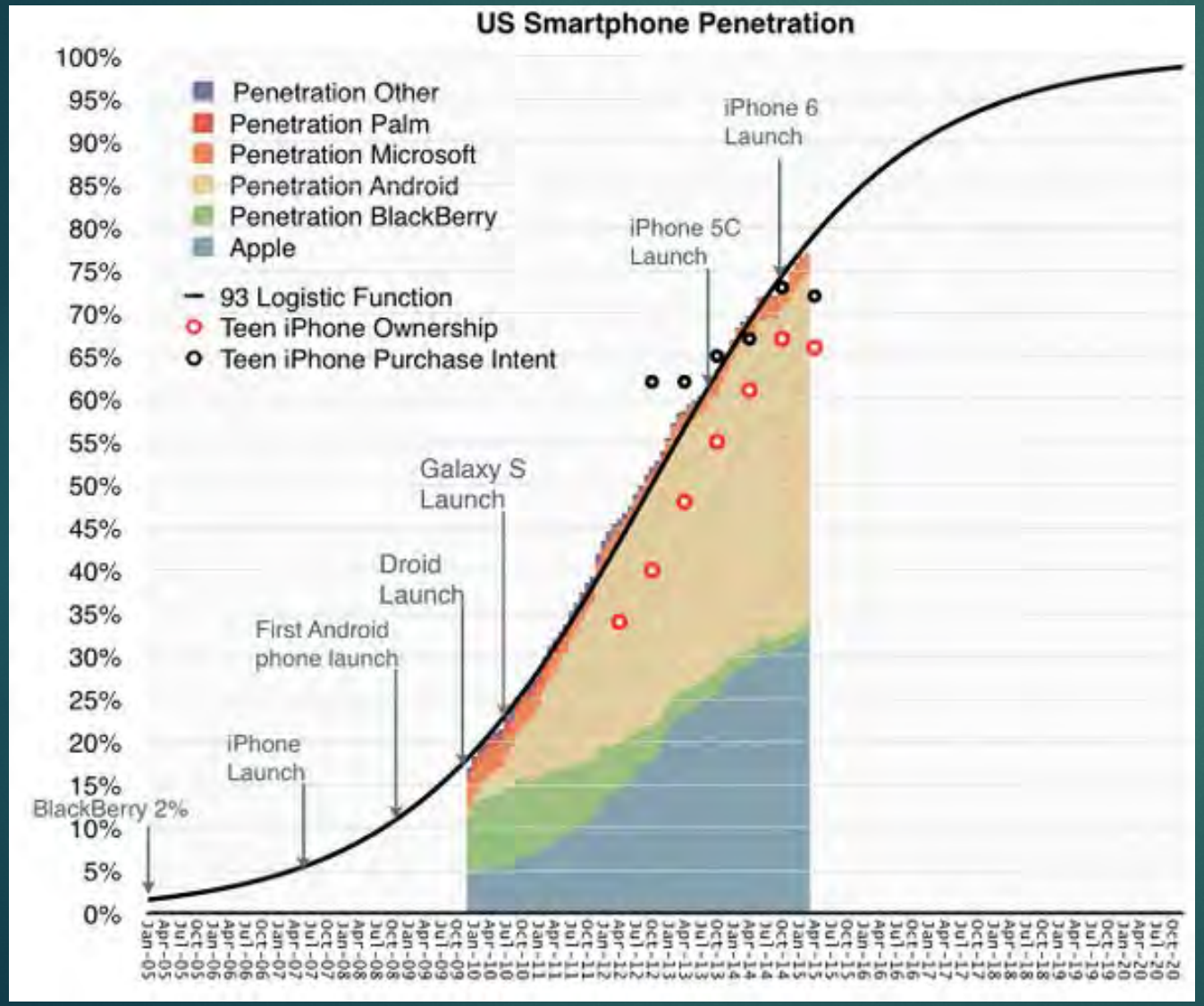
TIME MAGAZINE (3/7/16)

RAND CORPORATION (2014)

PWC (2013)

Where have we seen this before?

Smartphone adoption rates in USA



Current Investors

Partial List of Leading Corporations

Source: CB Insights: 30 Corporations Working on Autonomous Vehicles (4/18/16)

NHTSA Levels of Automation

Level 0 - No-Automation: The driver is in complete and sole control of the primary vehicle controls – brake, steering, throttle, and motive power – at all times.

Level 1 - Function-specific Automation: Automation involves one or more specific control functions.
(eg. electronic stability control or pre-charged brakes)

Level 2 - Combined Function Automation: Automation of at least two primary control functions designed to work in unison.
(eg. adaptive cruise control in combination with lane centering)

Level 3 - Limited Self-Driving Automation: Driver cedes full control of all safety-critical functions to the vehicle under certain traffic or environmental conditions. Driver is expected to be available for occasional control, but with sufficient transition time.
(eg. Google car)

Level 4 - Full Self-Driving Automation: The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip.
(coming...)

Summary so far...

Summary so far…

If you still don’t belive this is coming…

Summary so far...

If you still don't belive this is coming...

YOU.

Summary so far...

If you still don't belive this is coming...

YOU. ARE.

Summary so far...

If you still don't belive this is coming...

YOU. ARE. WRONG.

For the professional...

History of City Development

Pre-1940s

Site Development - United States Typical

Post-War

Automotive Oriented

Post-War

Site Development - Suburbs

One of four different styles of the Jubilee

One of four different styles of the Colonial

Levittown IN 1957

One of five different styles of the Pennsylvanian

One of four different styles of the Country Clubber

Post-War

Site Development Auto-dominated Sites

This is our chance…

This is our chance...

to undo our past mistakes.

This is our chance…

to undo our past mistakes.

- ROADWAY NETWORKS
- NEIGHBORHOOD PLANNING
- SITE DESIGN

How will this impact… EVERYTHING?

- Insurance industry
- Health insurance – drastically fewer accidents and youth deaths
- Need for increased communications technology
- Hacking dangers of on-board computers
- Overall economy
  - Lost industries
- Land prices re-evaluated when parking demand shrinks
- Automotive industry
  - Public transportation
  - Commercial drivers
  - Taxi & Uber
  - Bus and train
  - Commercial hauling
  - Automotive companies – volume of vehicles needed per year?
  - Automotive workers – volume of vehicles needed per year?

Current Driving Realities

ENO Center for Transportation

Preparing a Nation for Autonomous Vehicles (2013)

U.S. Motor Vehicle Crash Information

Total Crashes per year in US	5.5 million
% human cause as primary factor	93%
Economic Costs of U.S. Crashes	$300 billions
% of U.S. GDP	2%
Total Fatal & Injurious Crashes per Year in U.S	2.22 million
Fatal Crashes per year in U.S.	32,367

Source: ENO table - U.S. Crash Motor Vehicle Scope and Selected Human and Environmental Factor Involvement

Estimated AV Impacts

ENO Center for Transportation

Preparing a Nation for Autonomous Vehicles (2013)

Estimates of Annual Impacts from AVs in the United States

AV penetration rate:	10%	50%	90%
Lives saved	1,100	9,600	21,700
Fewer Crashes	211,000	1,800,000	4,220,000
Travel Time Savings (in million hours)	756	1680	2772
Fuel Savings (in million gallons)	102	224	724

Source: ENO table - Estimates of Annual Economic Benefits from AVs in the United States

Impacts for Planners

- Site Design
- Corridor / neighborhood design and planning
- Community-wide comprehensive and strategic planning
- Land Use
- Zoning Codes and guidelines
- Public Realm design
- Transportation systems
- Active transportation impacts – pedestrians and bicyclists

Potential Unknowns

Potential Adoption Models?

Individual ownership

- Likely scenarios / adopters
  - Exurban and low-density suburban
  - Older demographic

Shared ownership

- Likely scenarios / adopters
  - Denser urban environments
  - Younger demographic
  - Current ride service users
  - App-based ride service (think driverless-UBER)
  - Could be subscription or individual ride pricing model

Adoption

Potential Approaches

New way to think about transportation options:

- You buy mobility, and not machines!
- Transportation as a service, rather than an ownership model

Source: Barclays Research Insights on Disruptive Mobility (2015) – Barclays Bank PLC

Where and How Fast?

Study Area: Central Ohio

Where and How Fast?

Parcel Data – Land Use

Transportation Infrastructure & Usage Characteristics

Commuting Characteristics

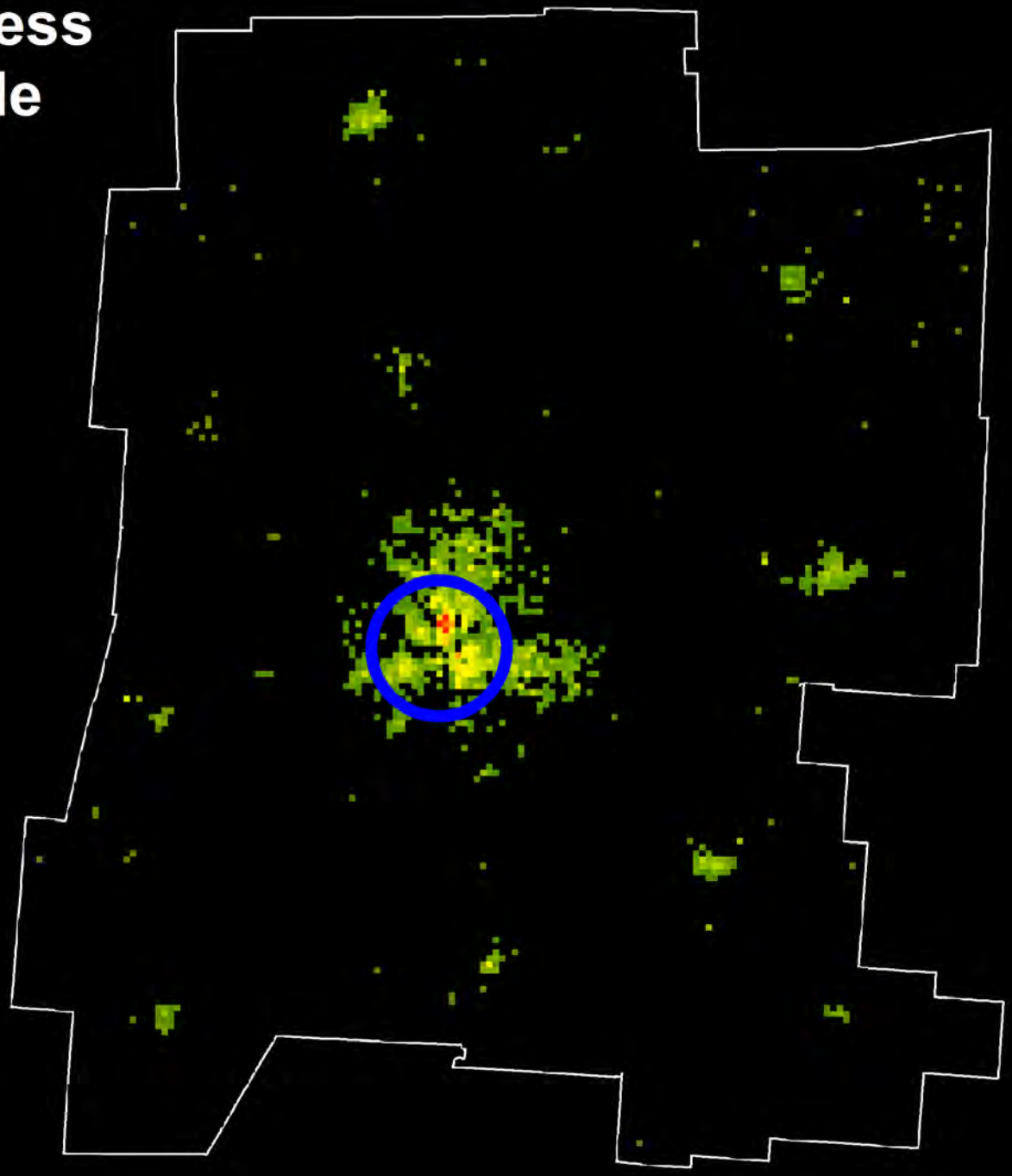
Housing Characteristics

Business & Service Characteristics

Population by Age and Density

Income Characteristics

Today: Adoption Readiness Conditions are Favorable for Adoption

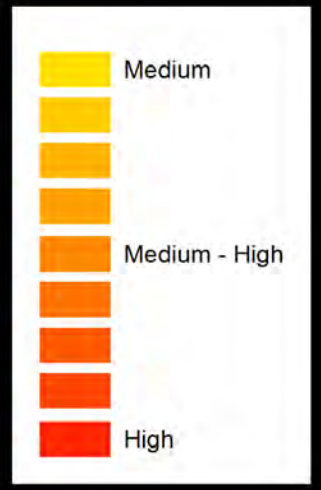


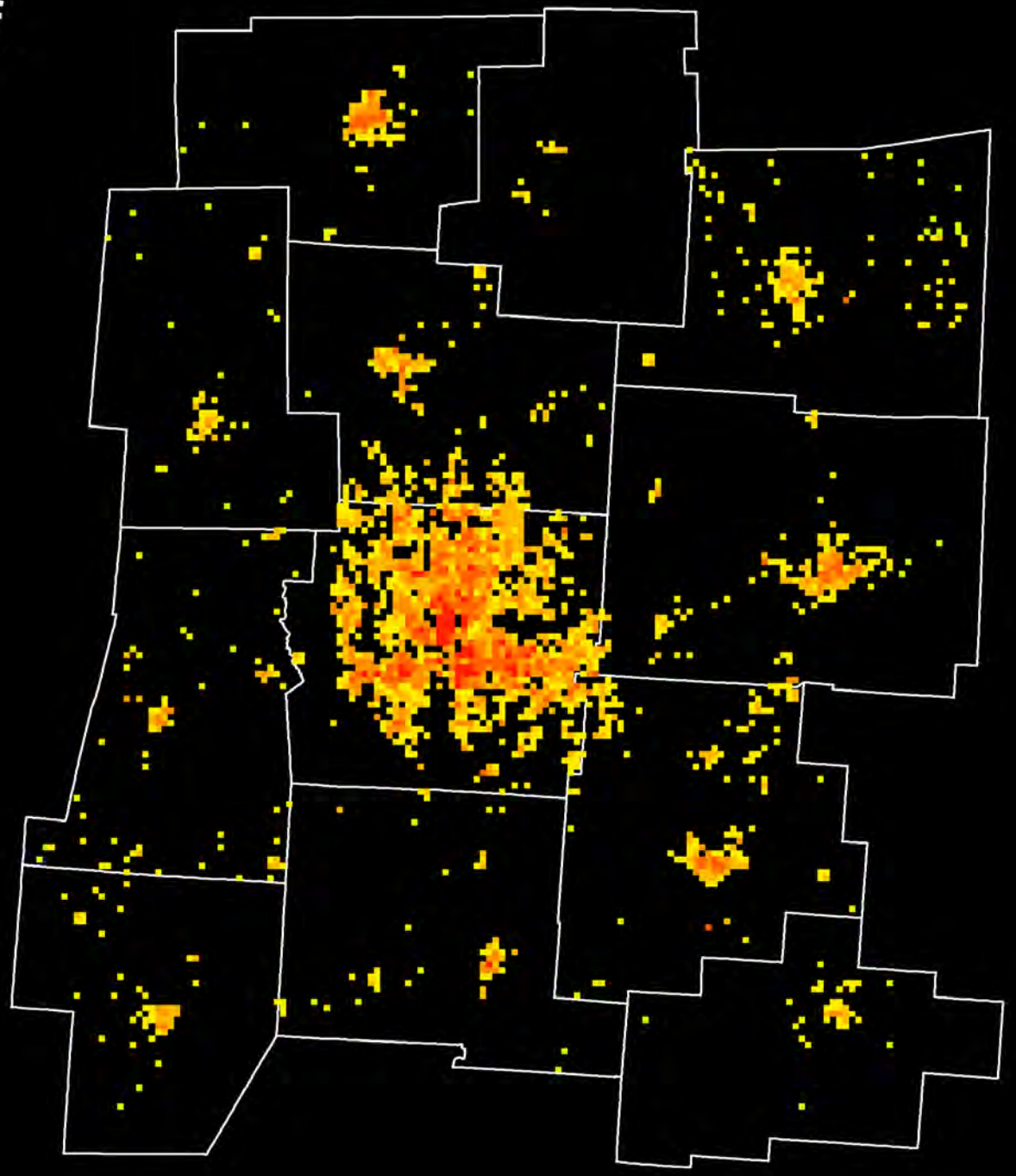
Adoption Readiness (Today)

- Weinland Park
- Victorian Village
- University
- German Village

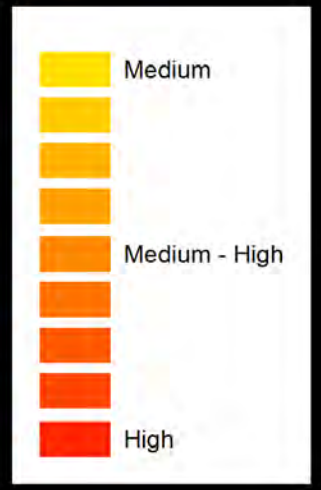
* Strong correlation with location of universities

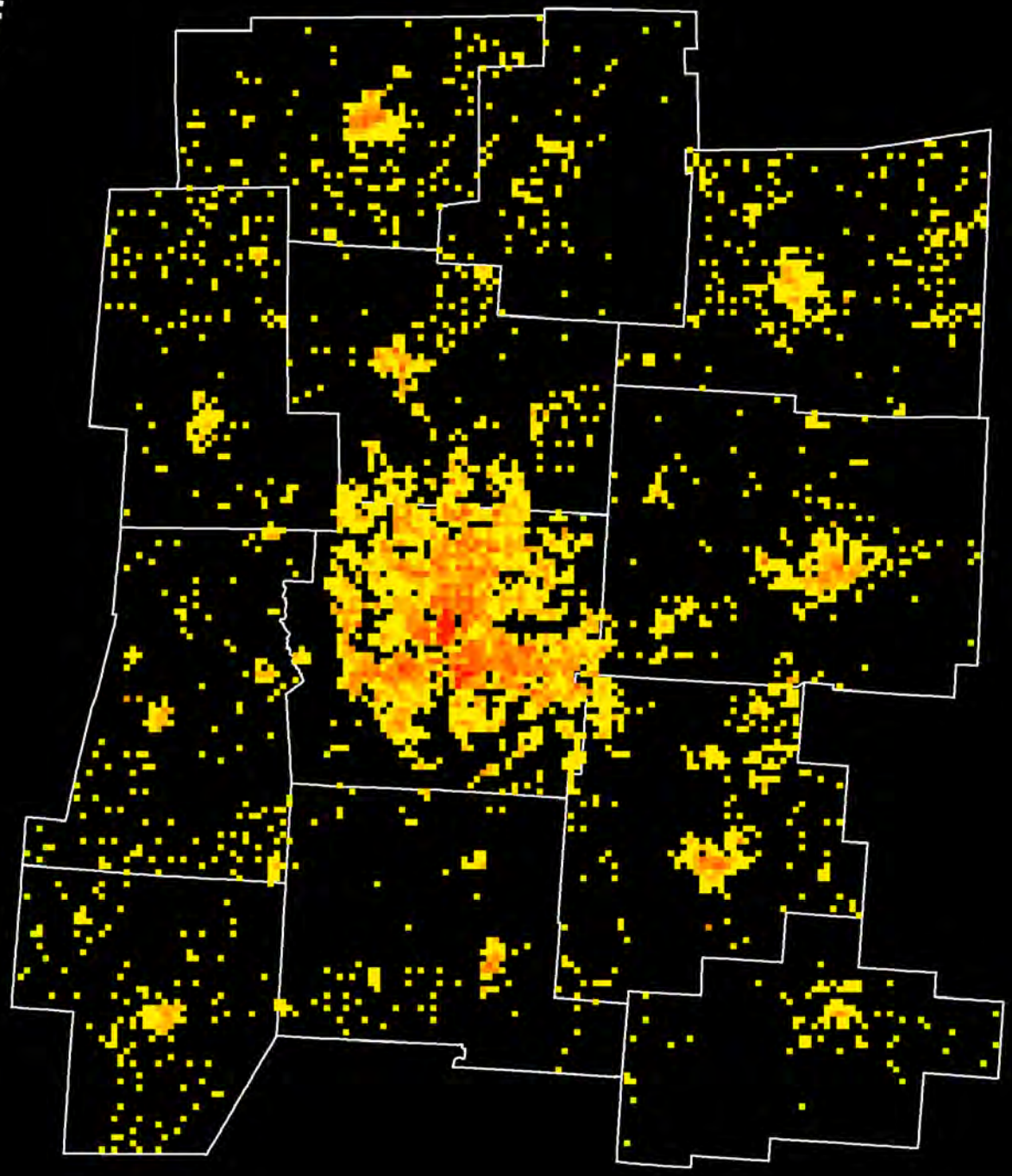
Year 2020: Probability of 9% of All Traffic at Level 2



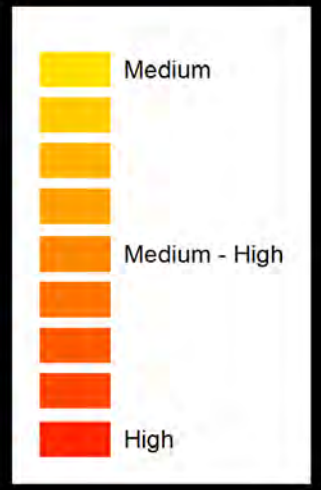


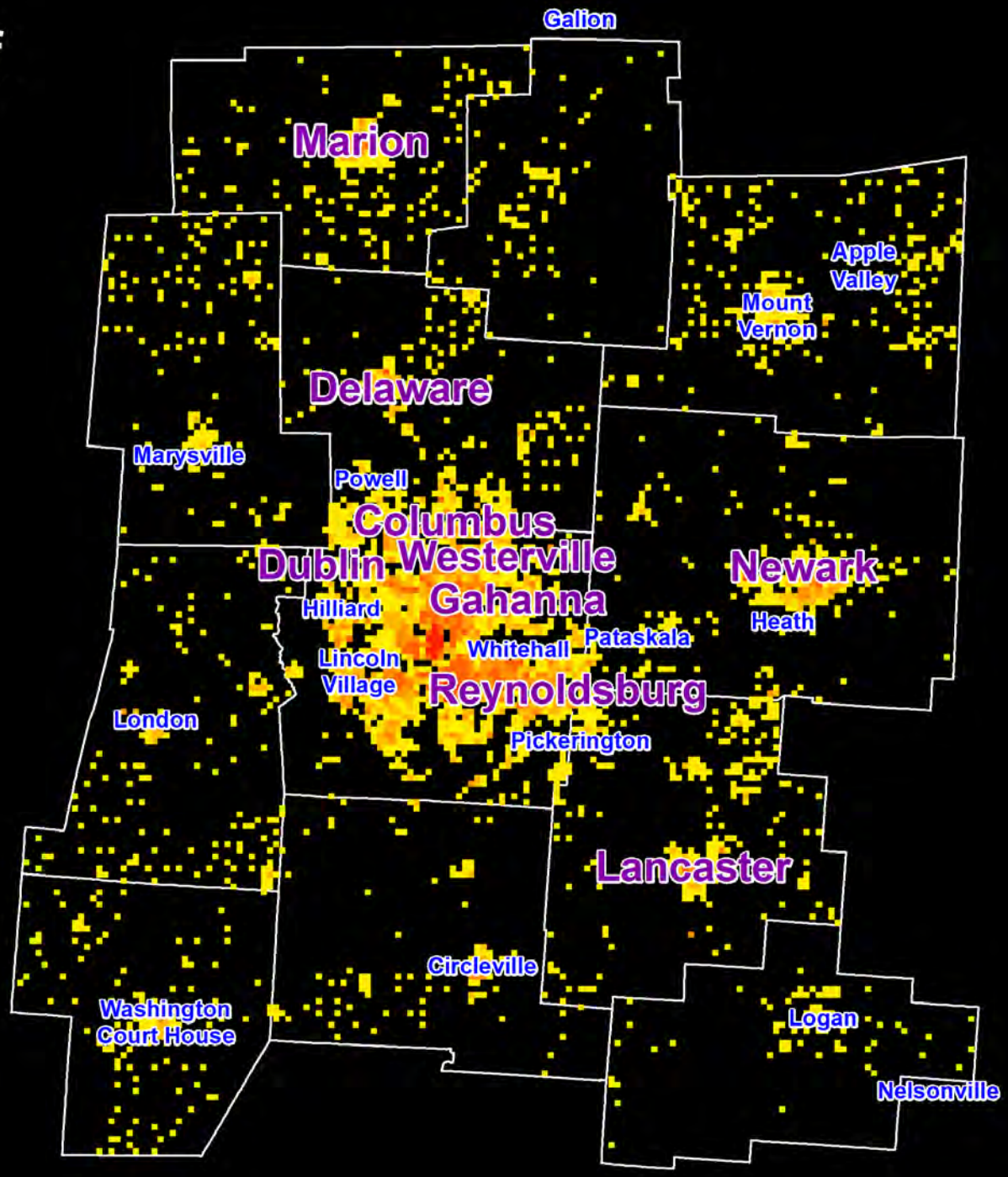
Year 2030: Probability of 25% of All Traffic at Level 4



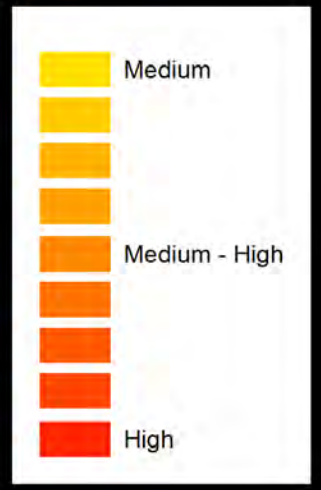


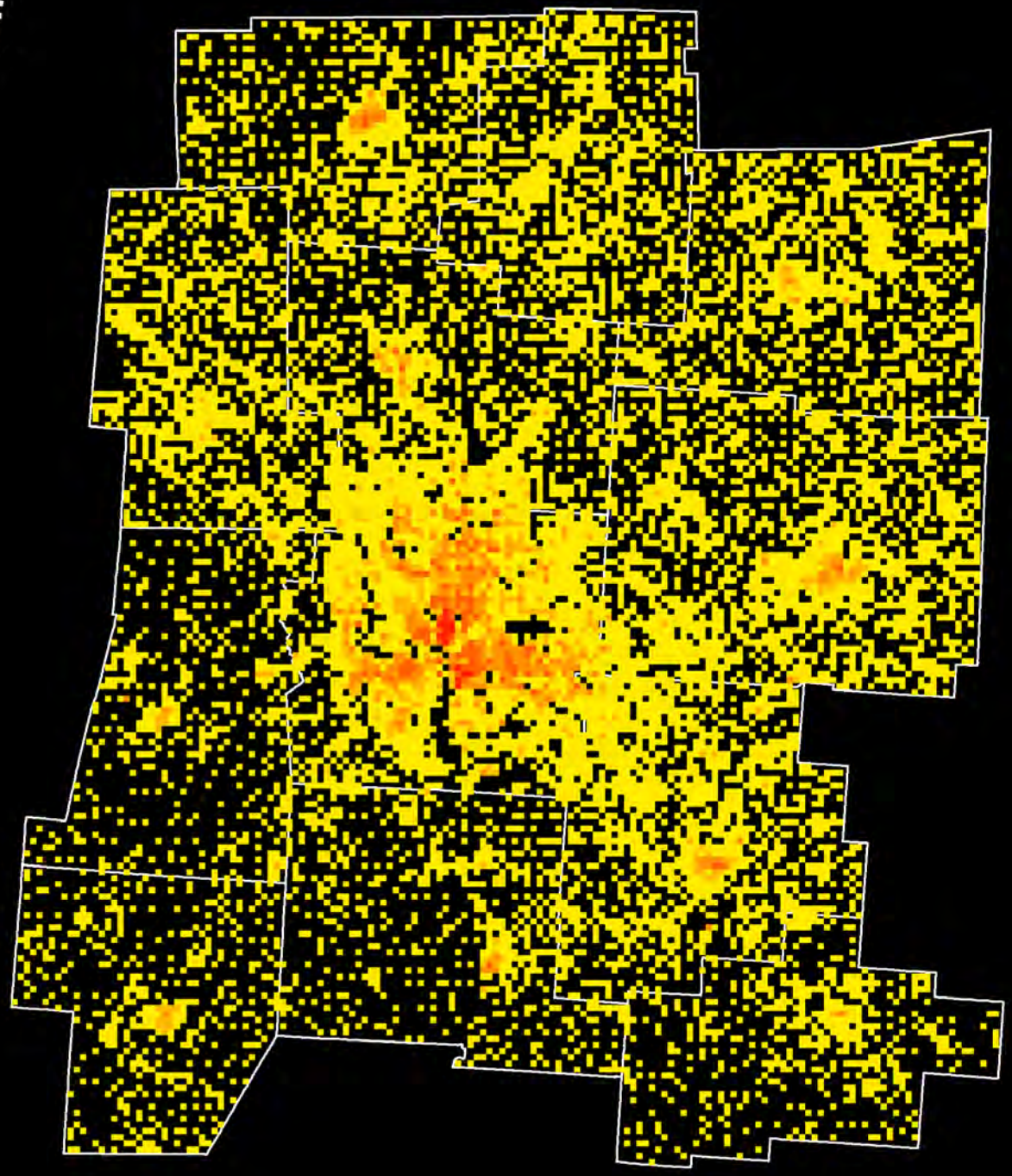
Year 2030: Probability of 25% of All Traffic at Level 4



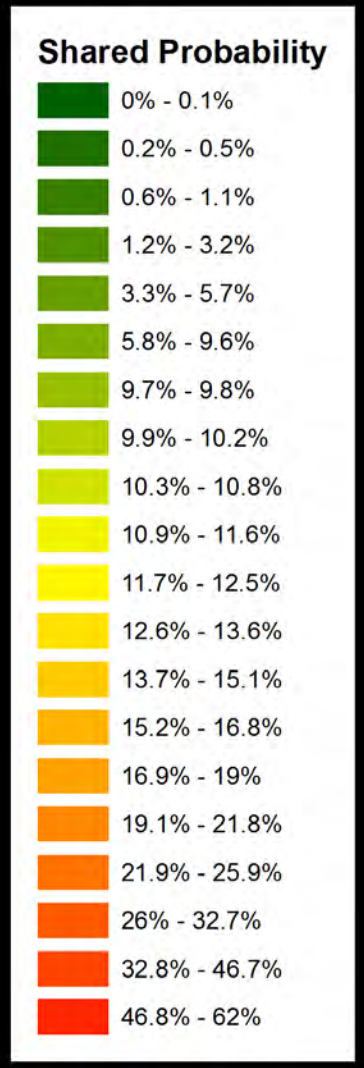


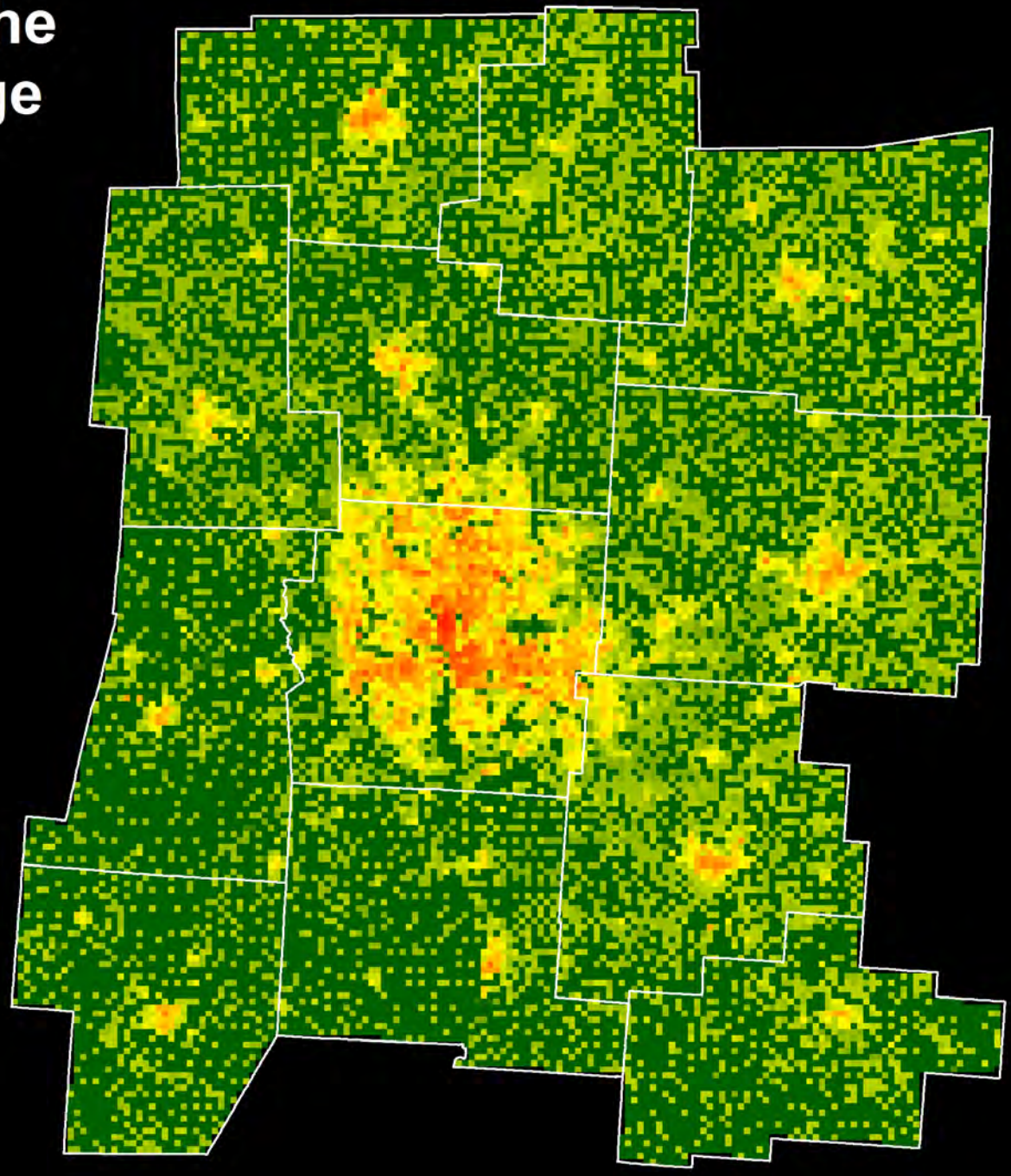
Year 2040: Probability of 65% of All Traffic at Level 4



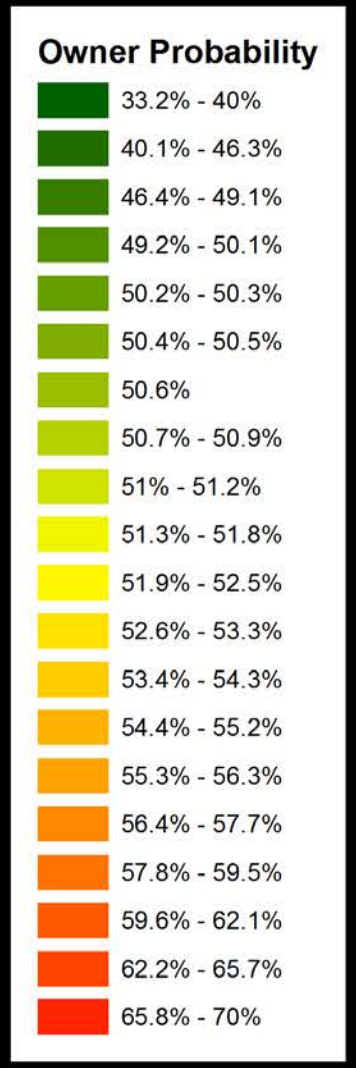


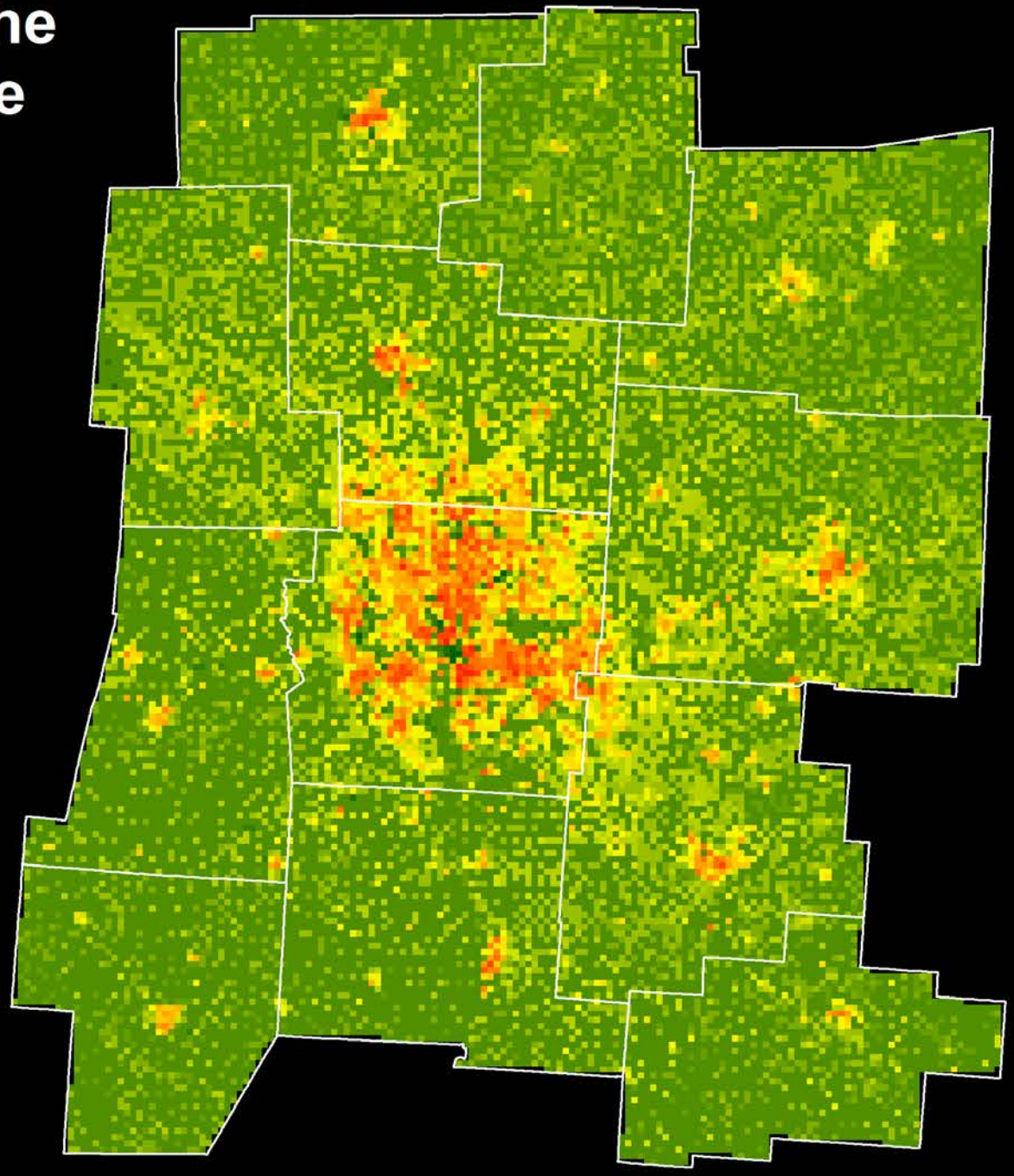
Probability of Adopting the "Shared" Model of Usage





Probability of Adopting the "Owner" Model of Usage





- Ownership Model more widely adopted on a geographic scale
- Shared Model likely to have more users (long-term)
- Hybrid of the models is most likely outcome

Impacts

Typical Development “Rules”

Typical development standards:

- 3-5 parking spaces per 1,000 square feet
- results in 40% of land needed for surface parking
- Expect to get 10,000 square feet of commercial floor area per acre.
  Other 33,000 s.f. of site area used for parking, circulation, storm, setbacks.

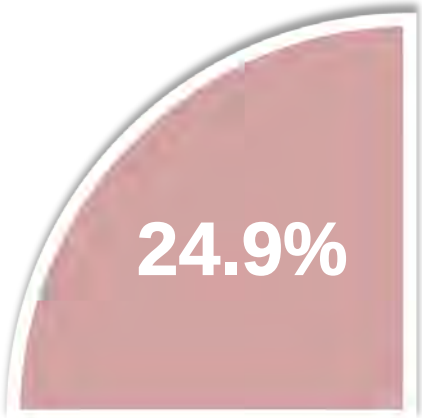
Southeast Columbus Downtown District

104 acres

Greenspace / circulation

26.3 acres

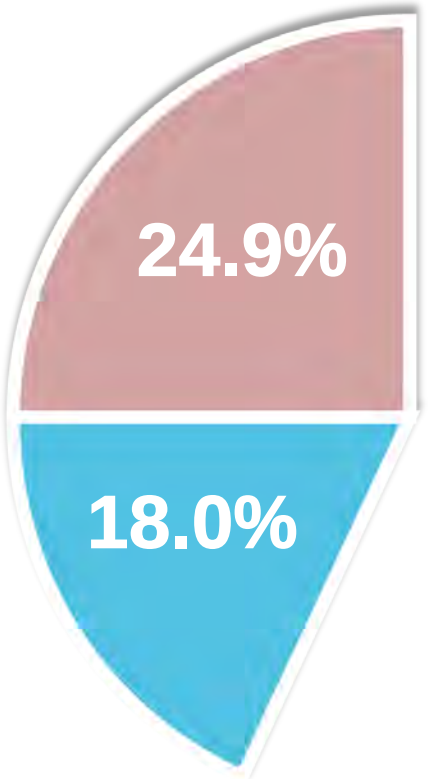
24.9% of site

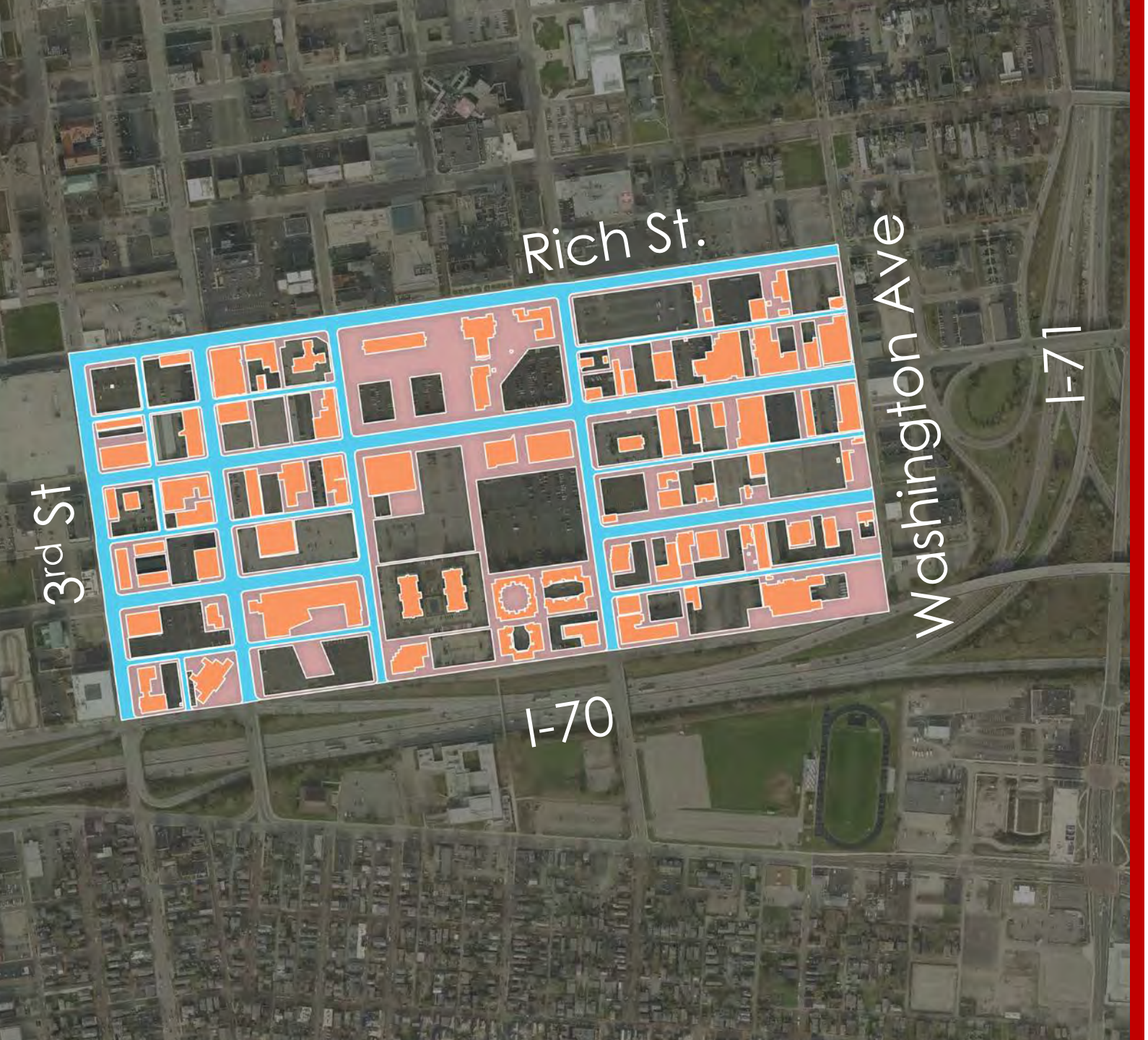


Streets & Access

19.4 acres

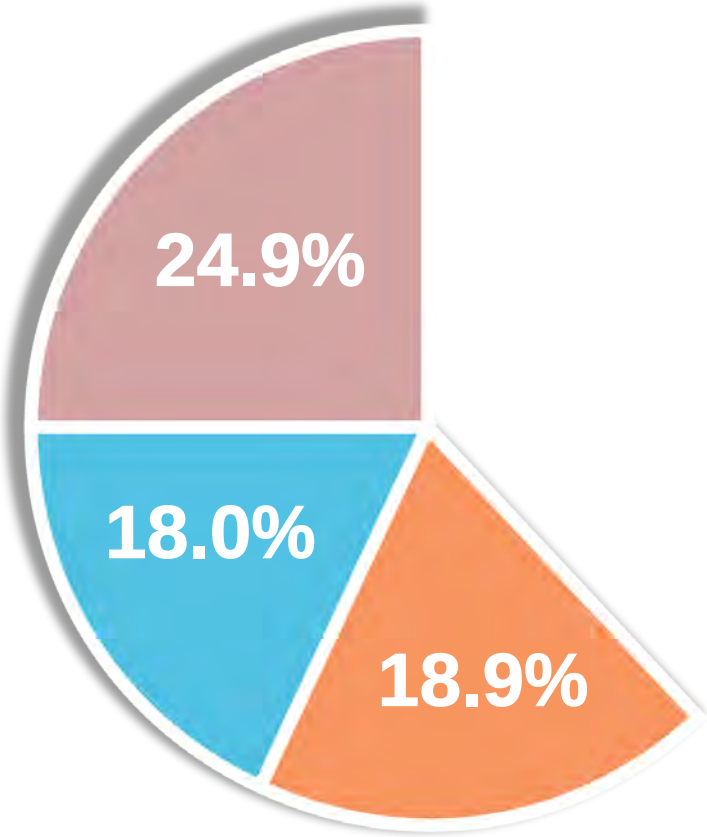
18.0% of site

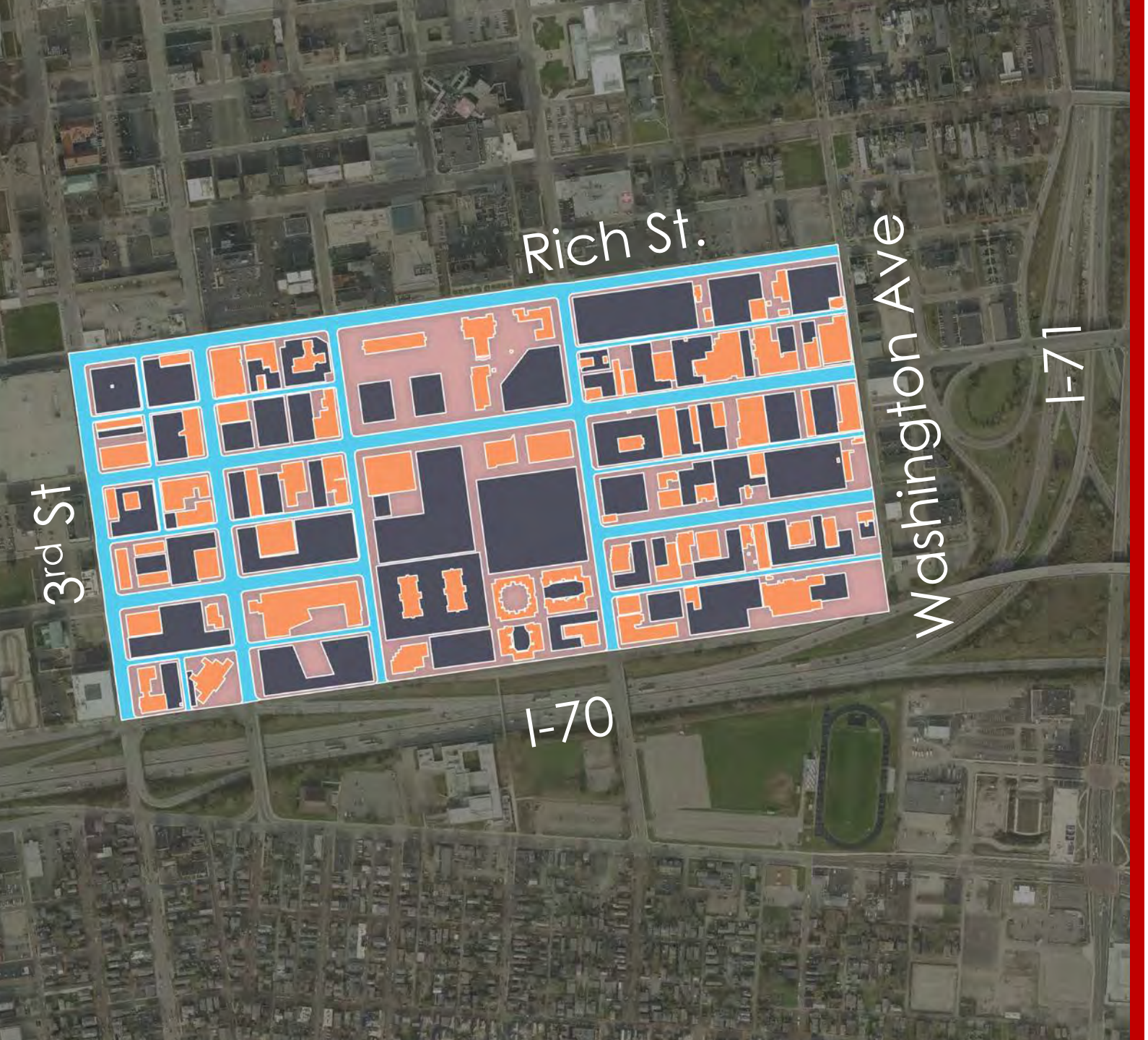




Building Footprints

19.9 acres
(2,000,000 s.f.)
18.9% of site

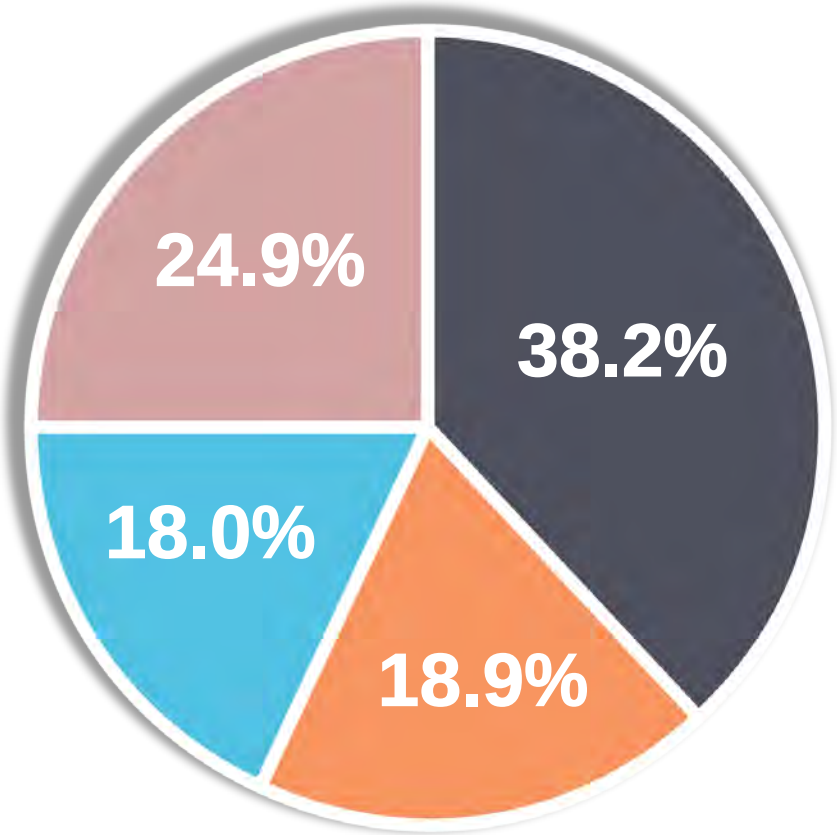




Parking

40.3 acres

38.3% of site



Downtown Districts

Parking Strategy – Development and Garages

- Typical downtown district development standards
  - No parking "requirements"
  - For Columbus: Development tends to create parking or co-locate near adequate parking under today's conditions due to driver-centric culture

- Potential investment example: Southeast Columbus Downtown
  - Several parking garages suggested to replace portion of surface parking – 41% of area
    - Approx 1,000 spaces in identified potential locations
  - Approx $20K per space
  - $20M Cost
  - When is this need obsolete? Reprioritize strategy?
  - Without parking demand, does entire density strategy change?

Downtown District

Source: Discovery District SID Southeast Gateway Framework Plan

Downtown Districts

Parking Strategy – Development and Garages

- Must consider future realities while addressing immediate needs
  - Can garages pay for themselves when the economic model flips?
  - If long-term public financing?
  - Can we locate in key areas to be compatible with high AV usage?

Source: Franklin County Convention Facilities Authority

Architecture

Development Key Points

- Parking is **THE** major constraint on development
- Development will be free from parking constraints
- The old rules of development will be obsolete
- Enormous increase in developable land
- Urban areas will become denser
- Suburban areas could expand

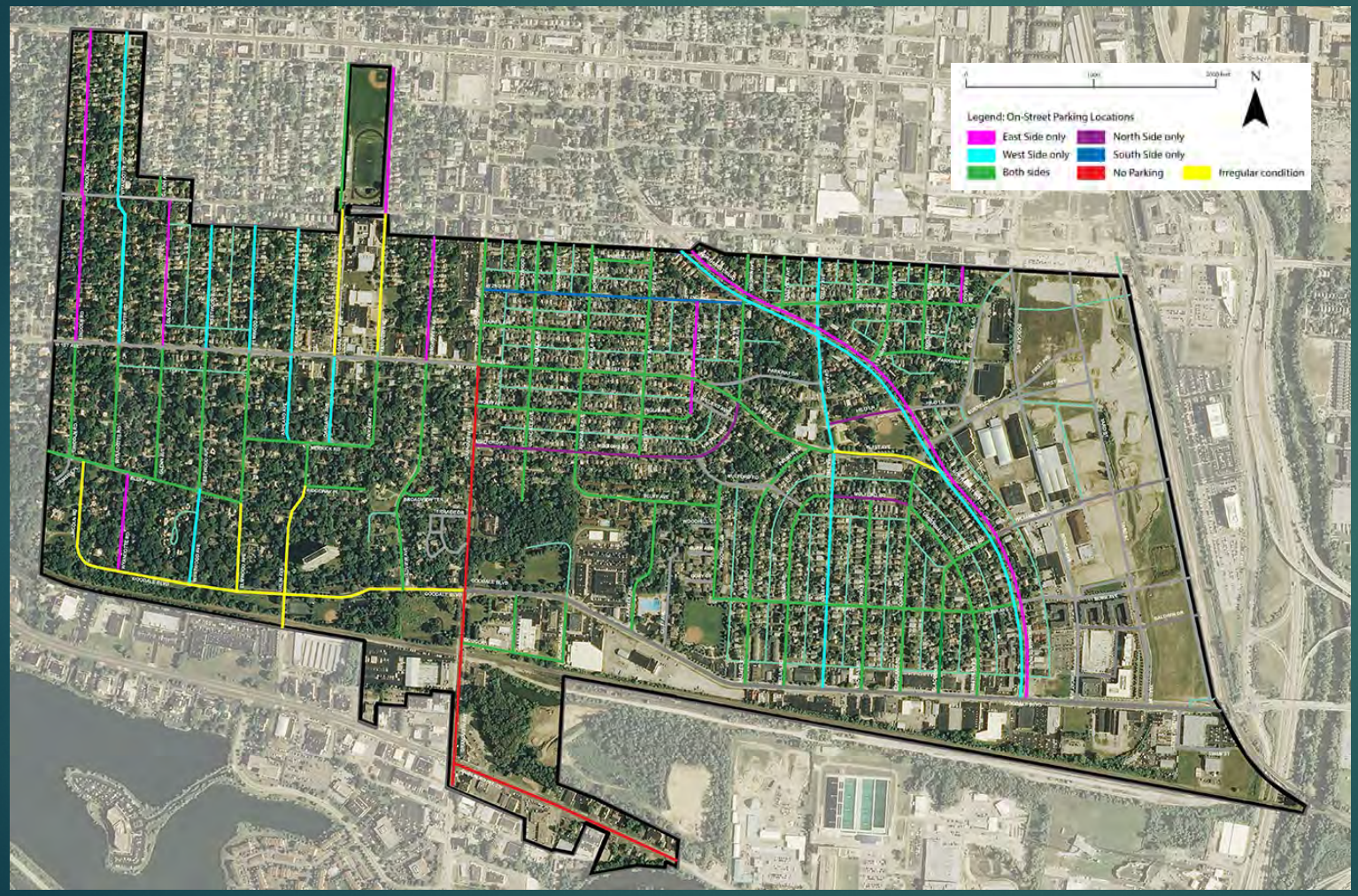
Streets

Neighborhoods

- Typical urban neighborhood street
- On-street parking spaces in 8-9 foot lane
- If little or no on-street parking needed, repurpose streets:
  - Stormwater controls
  - Recreation
  - Narrowing
  - Buildable?

Streets

Neighborhoods – Grandview Heights, Ohio

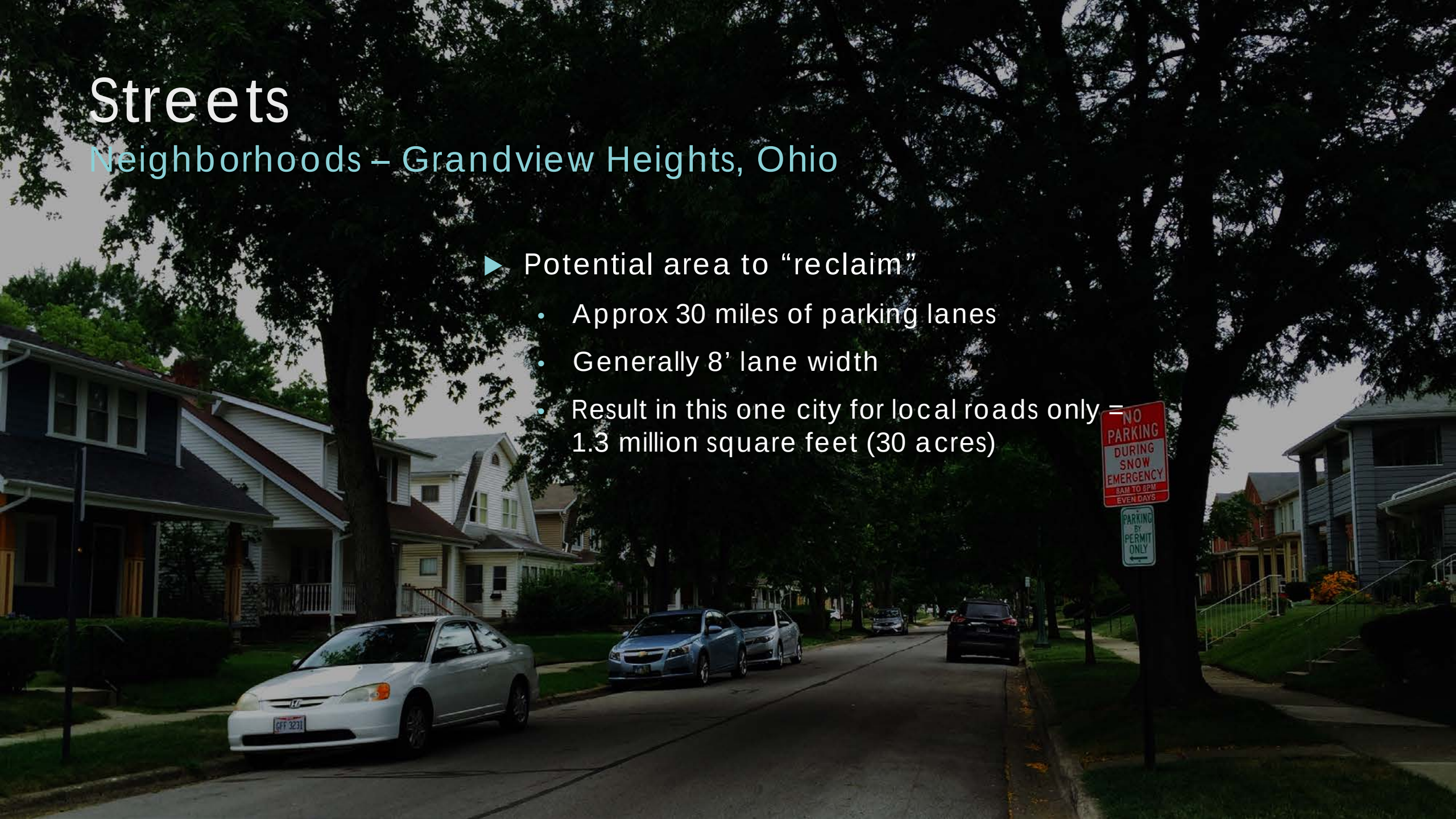


Source: City of Grandview Traffic Advisory Plan

- Typical traditional neighborhood
  - On-street parking, one or both sides of most streets

Streets

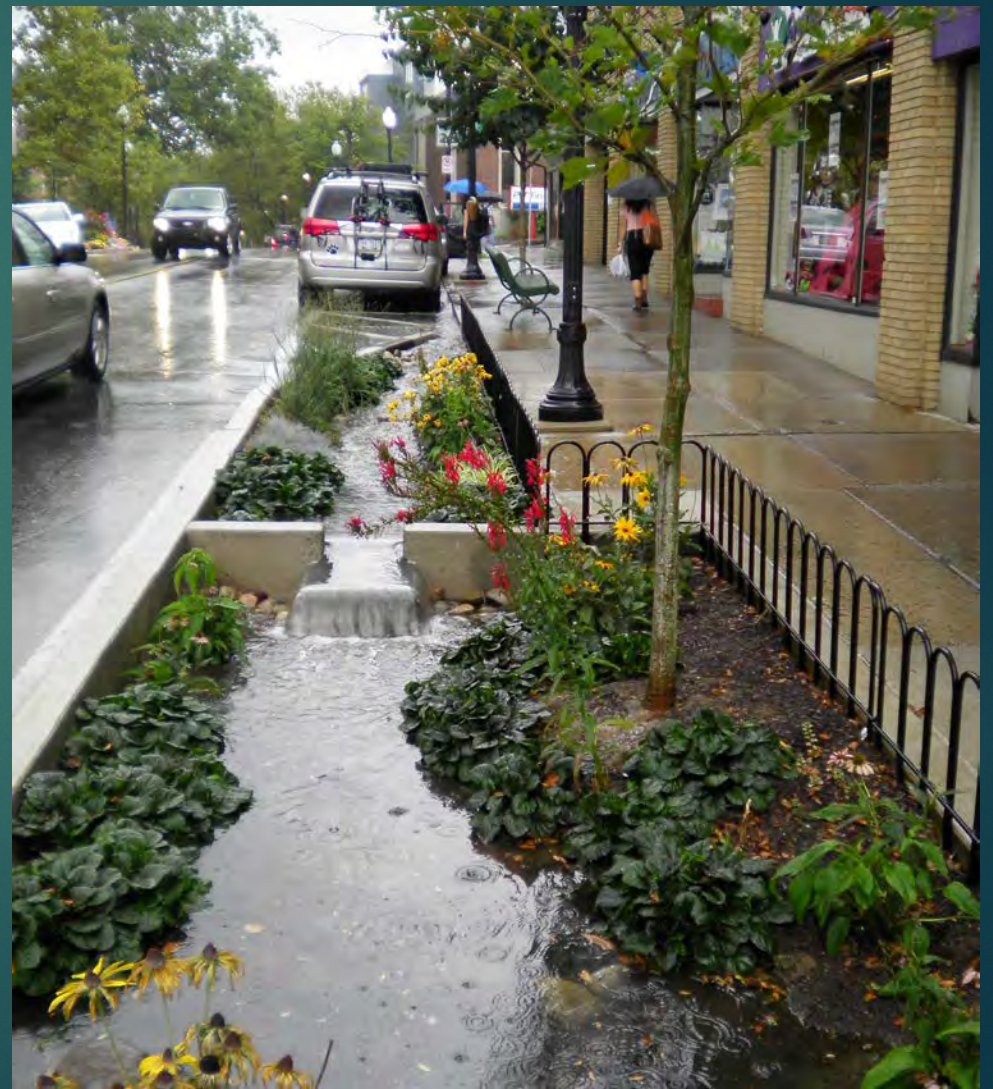
Neighborhoods – Grandview Heights, Ohio



- Potential area to “reclaim”
  - Approx 30 miles of parking lanes
  - Generally 8’ lane width
  - Result in this one city for local roads only = 1.3 million square feet (30 acres)

Streets

Neighborhoods



What should planners be doing?

PLANNING IMPERATIVES

1. Mainstream the discussion
2. Set policy objectives
3. Start planning differently
   - Site design
   - Roadway design
   - Land use
   - Neighborhood planning
   - Comprehensive planning
   - Regional infrastructure systems
   - Prioritize public investment

BIG IDEAS…

- We need to think BIG
- The Transportation Transformation is coming
- We need to be prepared.

Thank you.

Questions?