Walking and Biking into the Future: MassDOT's Next Gen Bike and Pedestrian Facilities Vision Map

Peter Sutton, MassDOT OTP
Bike and Pedestrian Program Coordinator

Dr. Pedro Hernandez, MassDOT
Senior Program Manager - Multi-modal Transportation

massDOT
Massachusetts Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

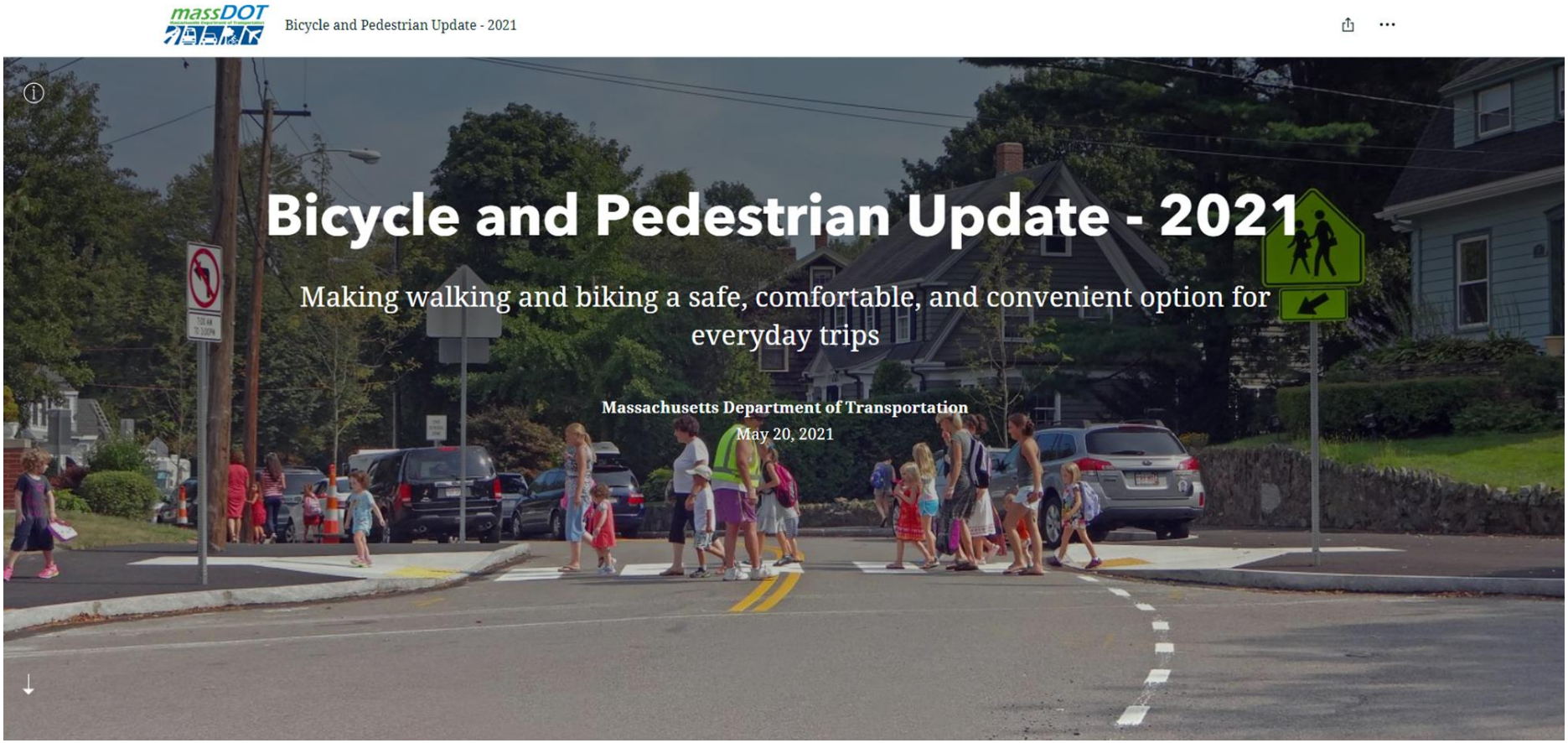
Project Goals

- This project will support MassDOT's goal in expanding a high comfort network for pedestrians and bicyclists to all applicable MassDOT jurisdictional facilities statewide that are within the range of a short walking or biking trip.

Project Scope

- Task 1 – Project Management
- Task 2 – Collection and Review of Available Data Sets
- Task 3 – Project Identification and Vision Mapping
- Task 4 – Project Prioritization Metrics

Project Building Blocks



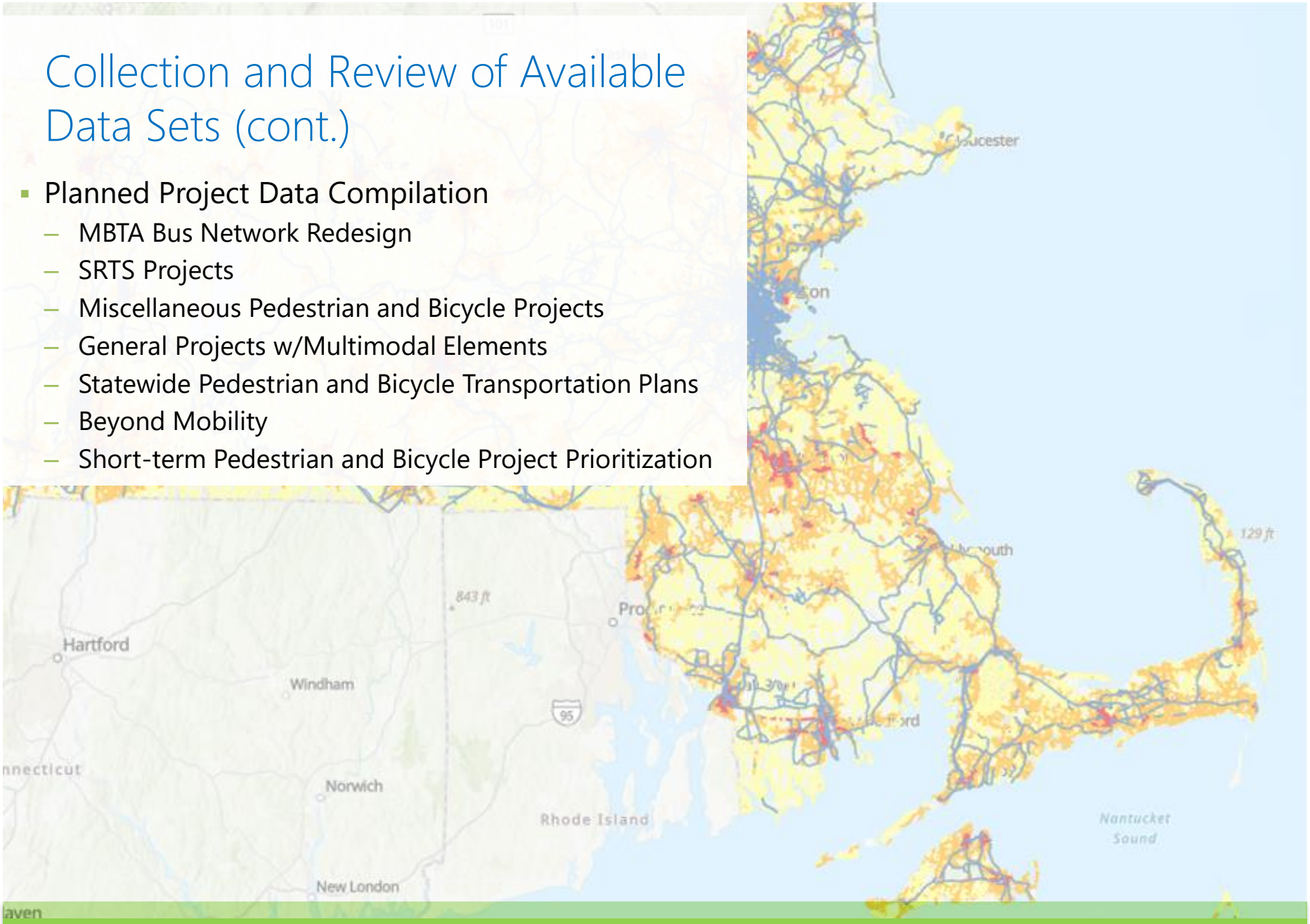
Data Compilation

Collection and Review of Available Data Sets

- GIS Data Compilation
  - REJ+ (Compilation of Data Layers)
  - Ped/Bike Crashes
  - Roadway Inventory
  - HSIP Clusters
  - Traffic Volumes
  - Posted/Prevailing Speed Limit
  - Transit Stop Presence on Road Segment (50-ft horizontal buffer)
  - Public Services
  - Parks/Open Spaces / Recreational Facilities
  - Population Density
  - Employment Density
  - Commuters that Walk, Bike and Take Transit
  - Designated Truck Route
  - Resiliency
  - Parcel and Assessing Data
  - Impact II – Bike/Ped Risk Factor (Compilation)
  - Ped/Bike Volumes
  - Statewide Bike/Ped Plan Public Wiki Map Comments
  - Potential for Everyday Walking and Biking (Compilation)

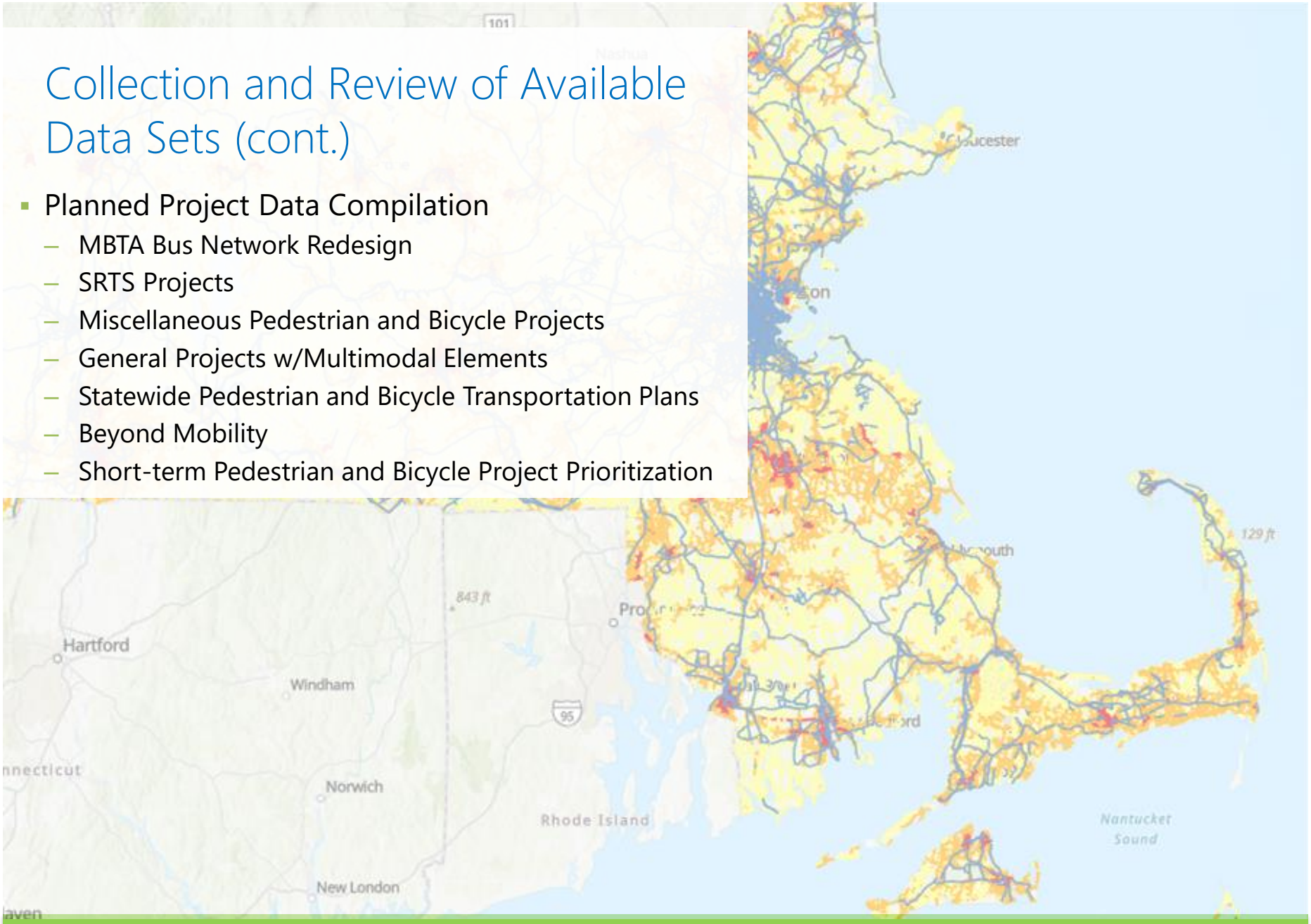
Collection and Review of Available Data Sets (cont.)

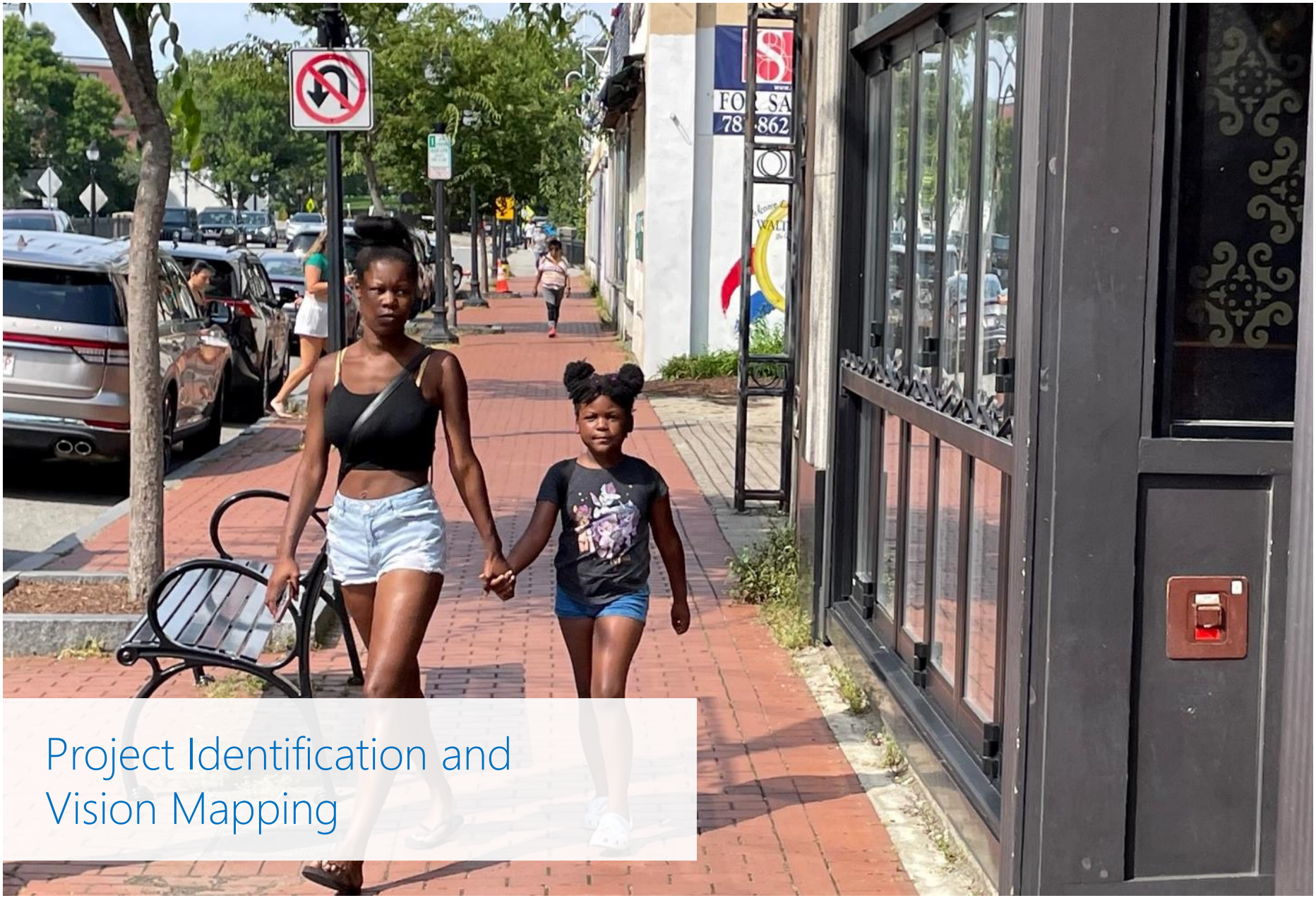
- Planned Project Data Compilation
  - MBTA Bus Network Redesign
  - SRTS Projects
  - Miscellaneous Pedestrian and Bicycle Projects
  - General Projects w/Multimodal Elements
  - Statewide Pedestrian and Bicycle Transportation Plans
  - Beyond Mobility
  - Short-term Pedestrian and Bicycle Project Prioritization



Collection and Review of Available Data Sets (cont.)

- Planned Project Data Compilation
  - MBTA Bus Network Redesign
  - SRTS Projects
  - Miscellaneous Pedestrian and Bicycle Projects
  - General Projects w/Multimodal Elements
  - Statewide Pedestrian and Bicycle Transportation Plans
  - Beyond Mobility
  - Short-term Pedestrian and Bicycle Project Prioritization

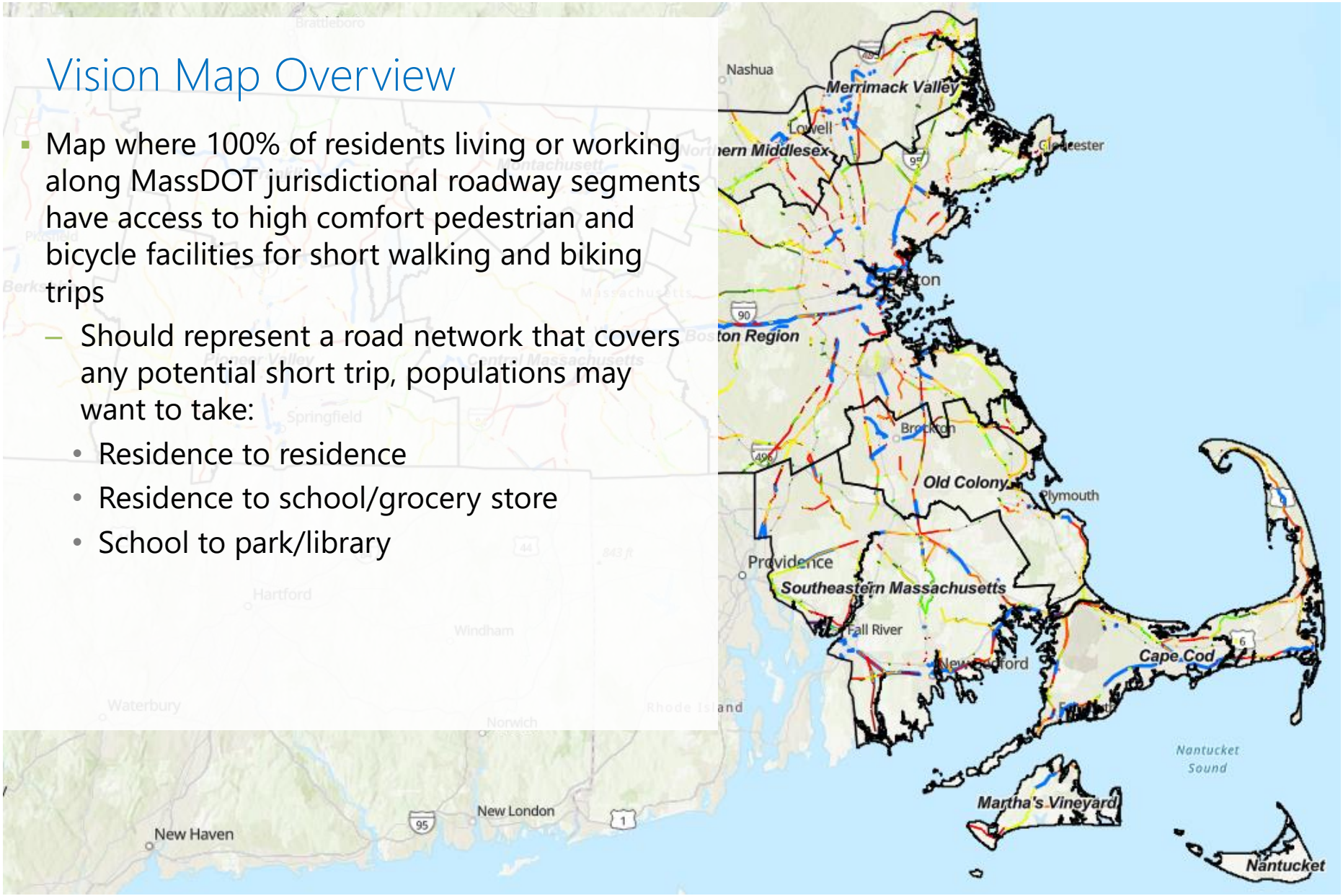




Project Identification and Vision Mapping

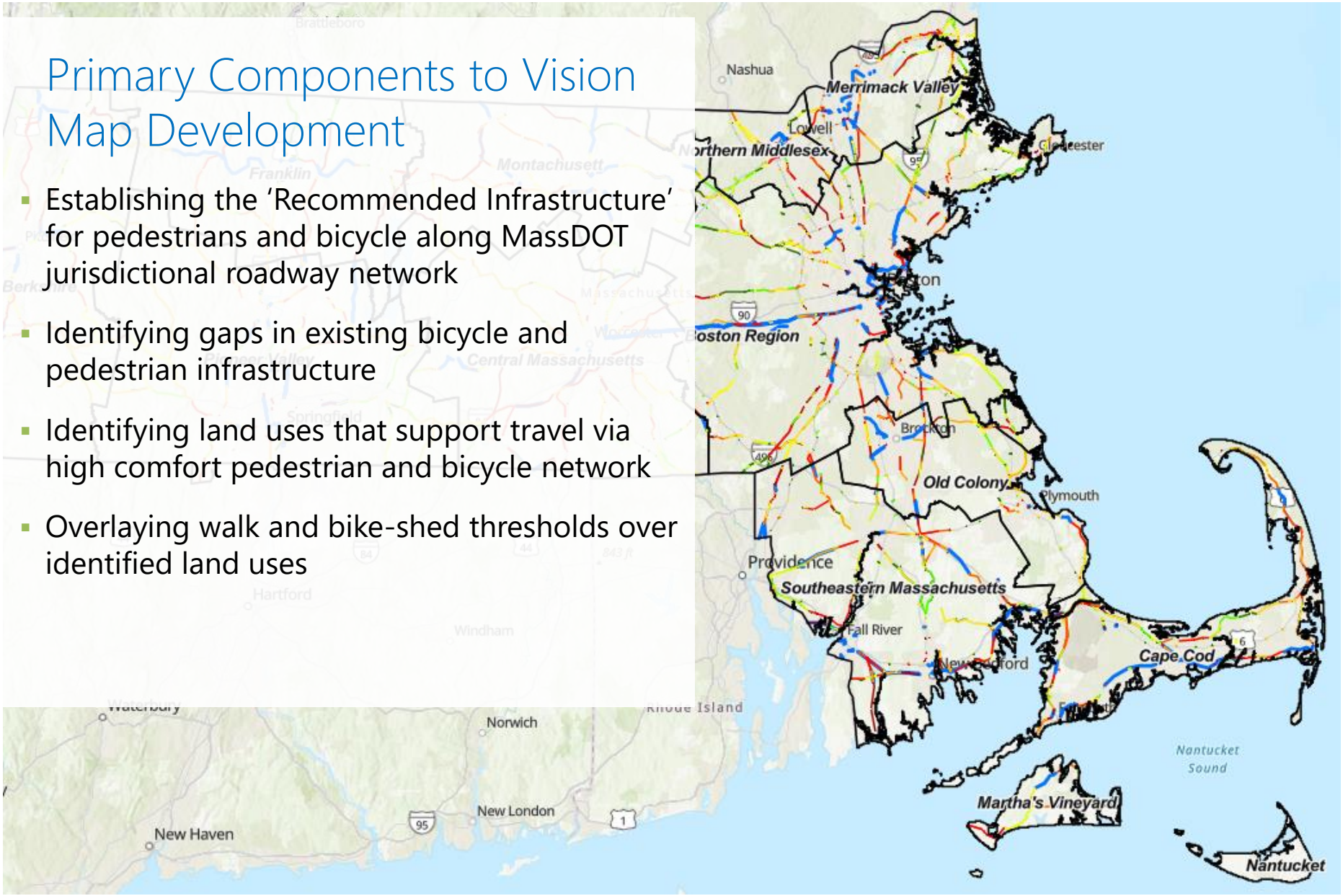
Vision Map Overview

- Map where 100% of residents living or working along MassDOT jurisdictional roadway segments have access to high comfort pedestrian and bicycle facilities for short walking and biking trips
  - Should represent a road network that covers any potential short trip, populations may want to take:
    - Residence to residence
    - Residence to school/grocery store
    - School to park/library



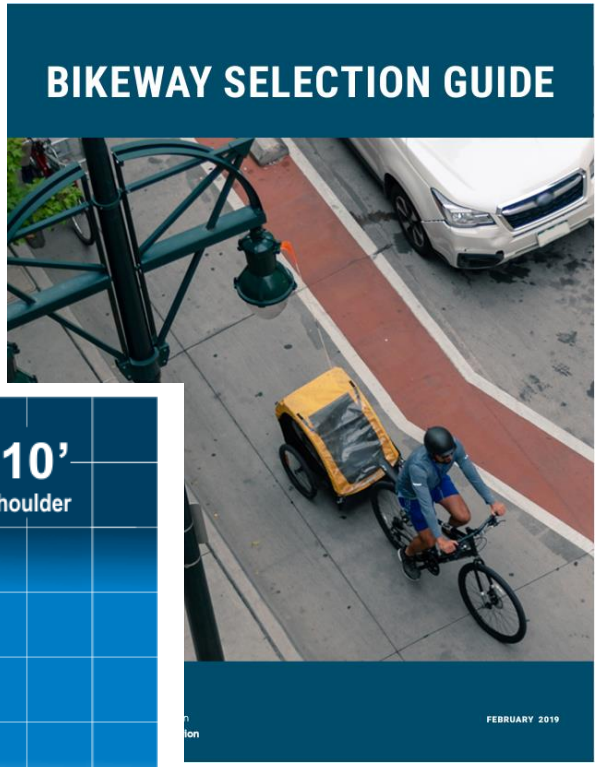
Primary Components to Vision Map Development

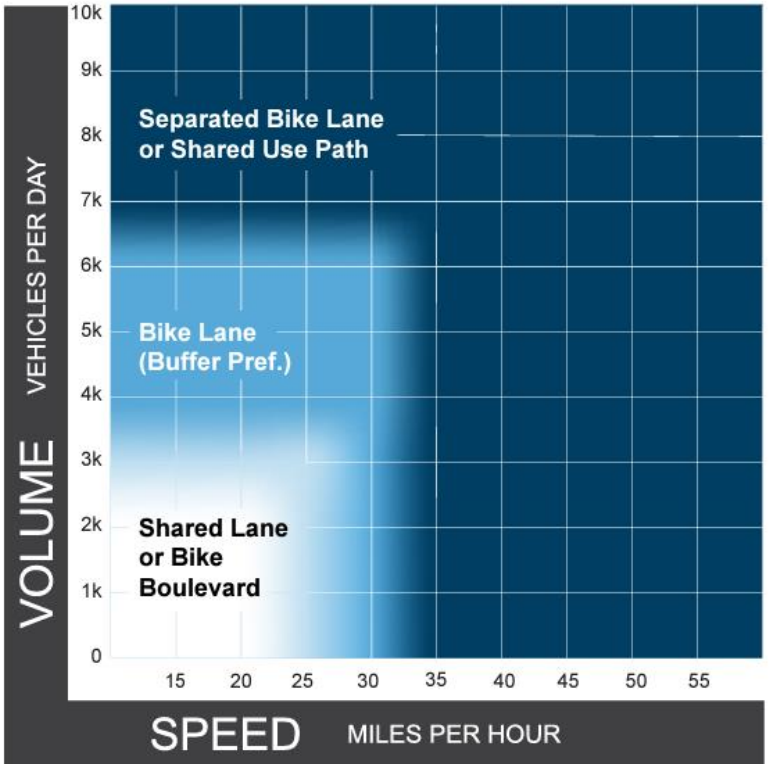
- Establishing the 'Recommended Infrastructure' for pedestrians and bicycle along MassDOT jurisdictional roadway network
- Identifying gaps in existing bicycle and pedestrian infrastructure
- Identifying land uses that support travel via high comfort pedestrian and bicycle network
- Overlaying walk and bike-shed thresholds over identified land uses



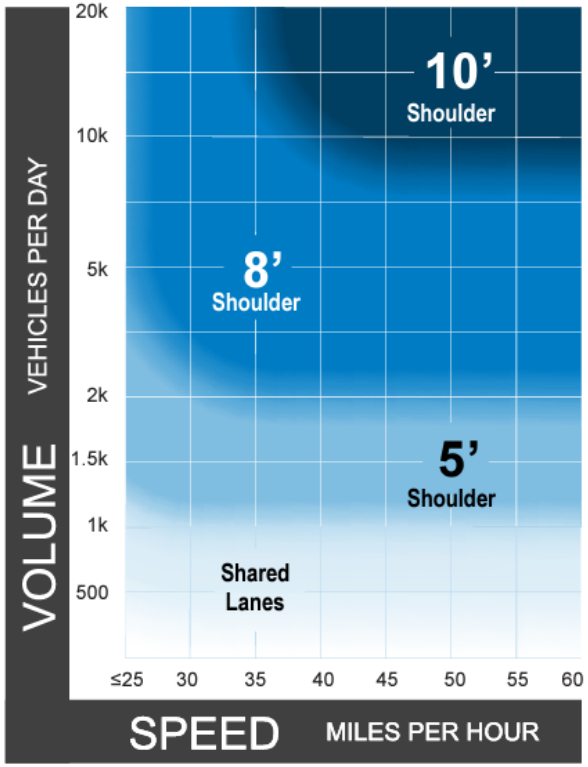
Recommended Infrastructure Identification

- Identified High Comfort Facility Screening Criteria
  - Bikes – Utilized FHWA Bikeway Selection Guide
  - Pedestrians – Utilized 5-foot Sidewalk Width





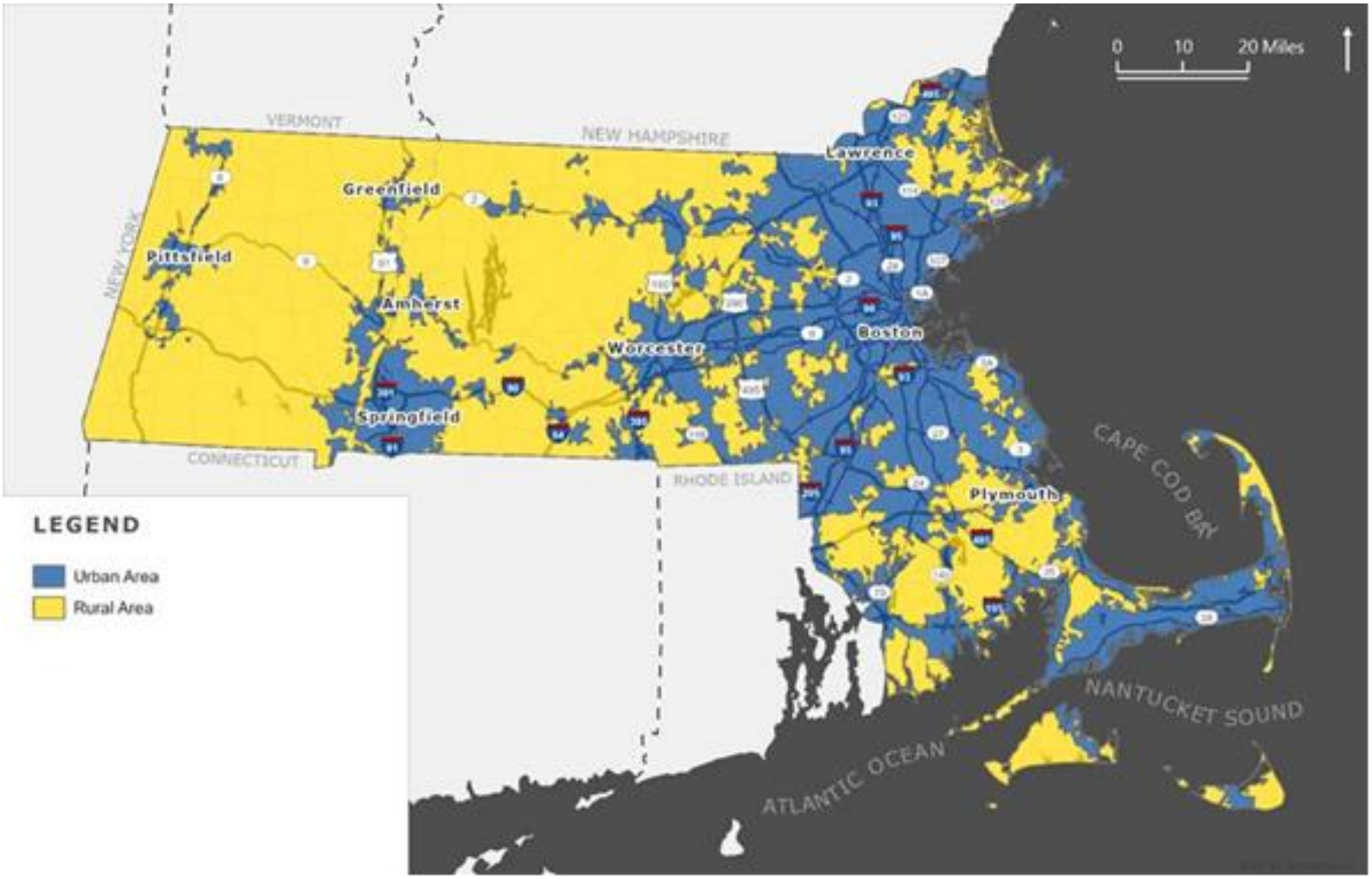
Urban/Suburban Context



Rural Context

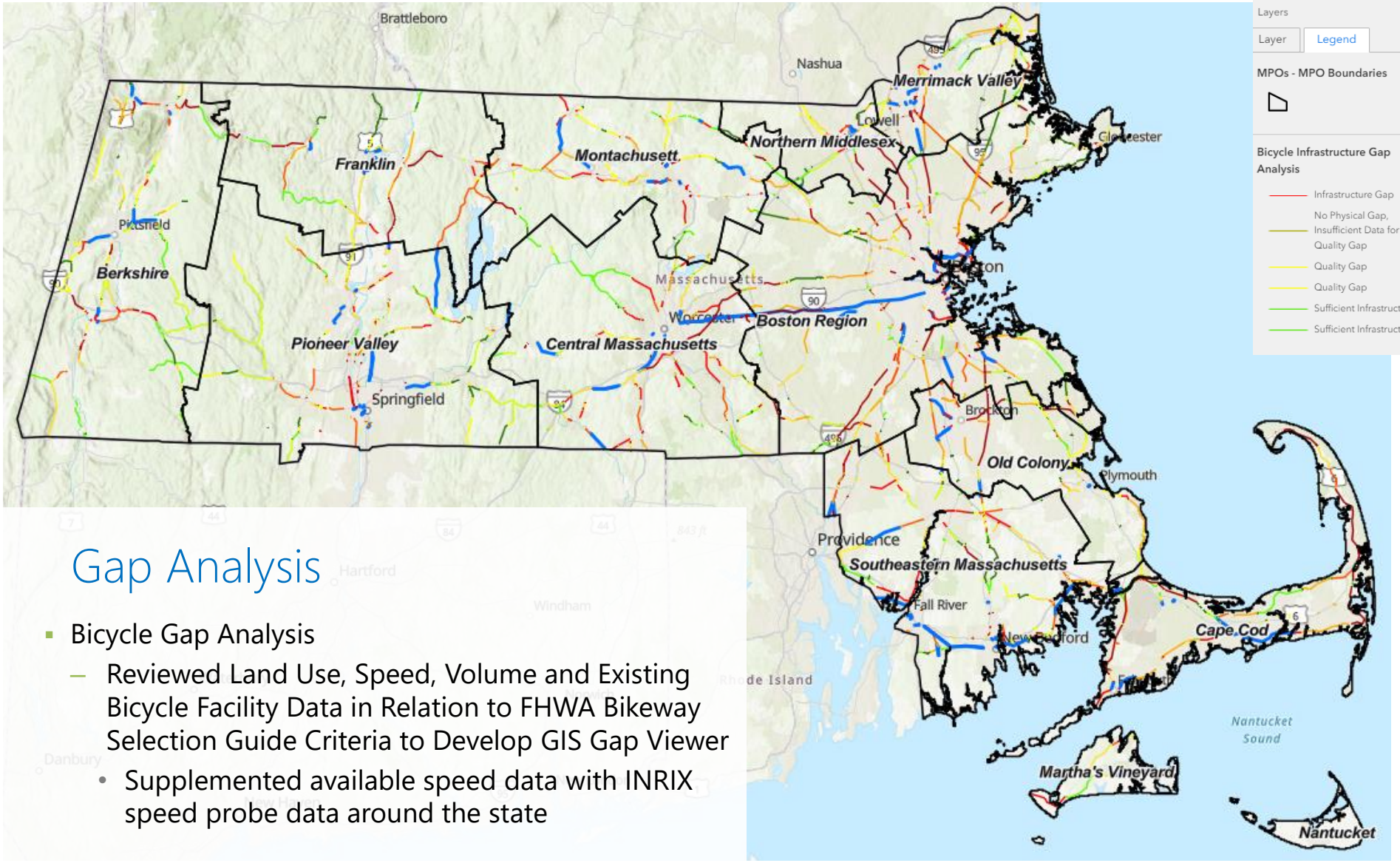
Recommended Infrastructure Identification

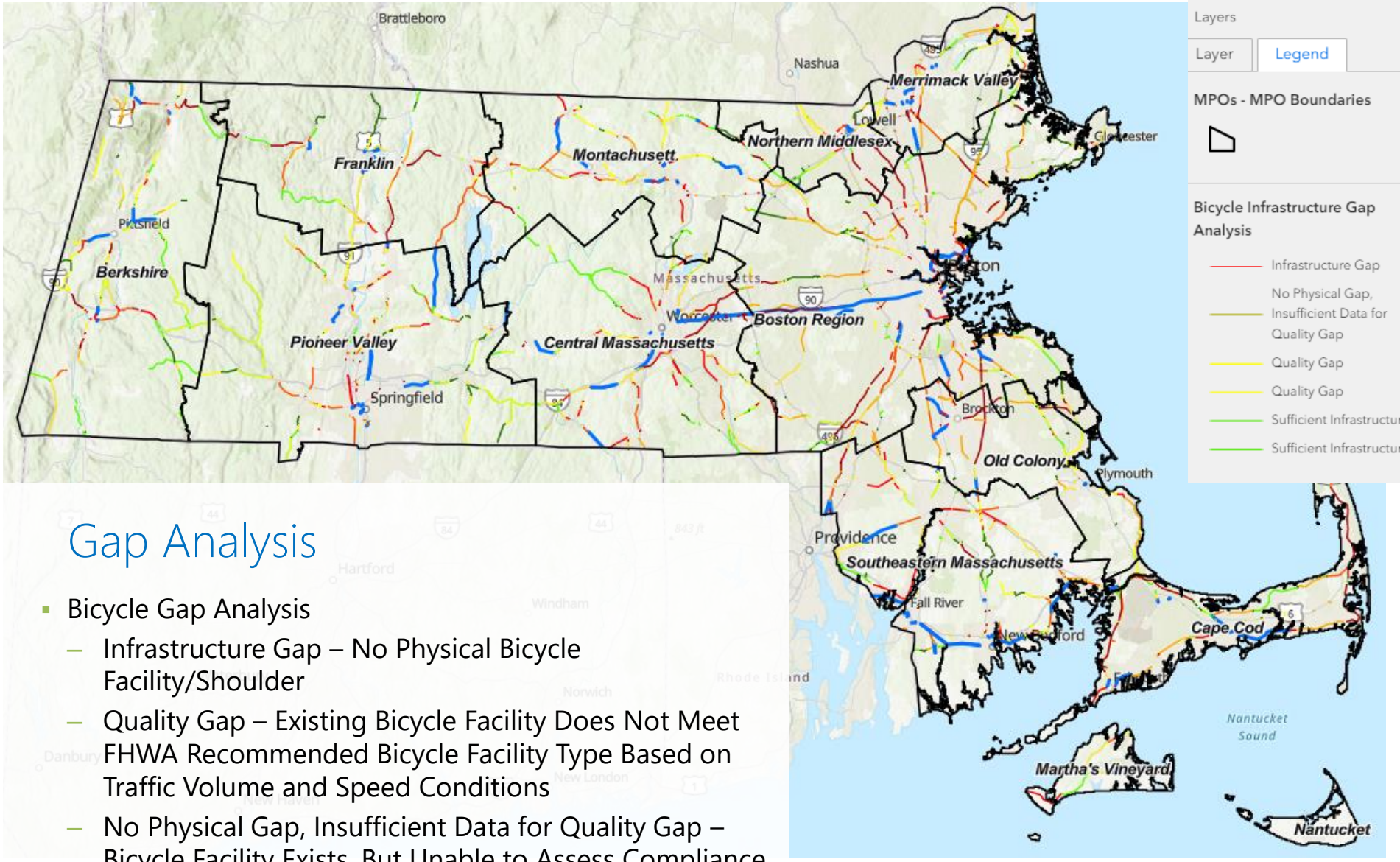
- Land Use Context Zones (2020 Census)



Gap Analysis

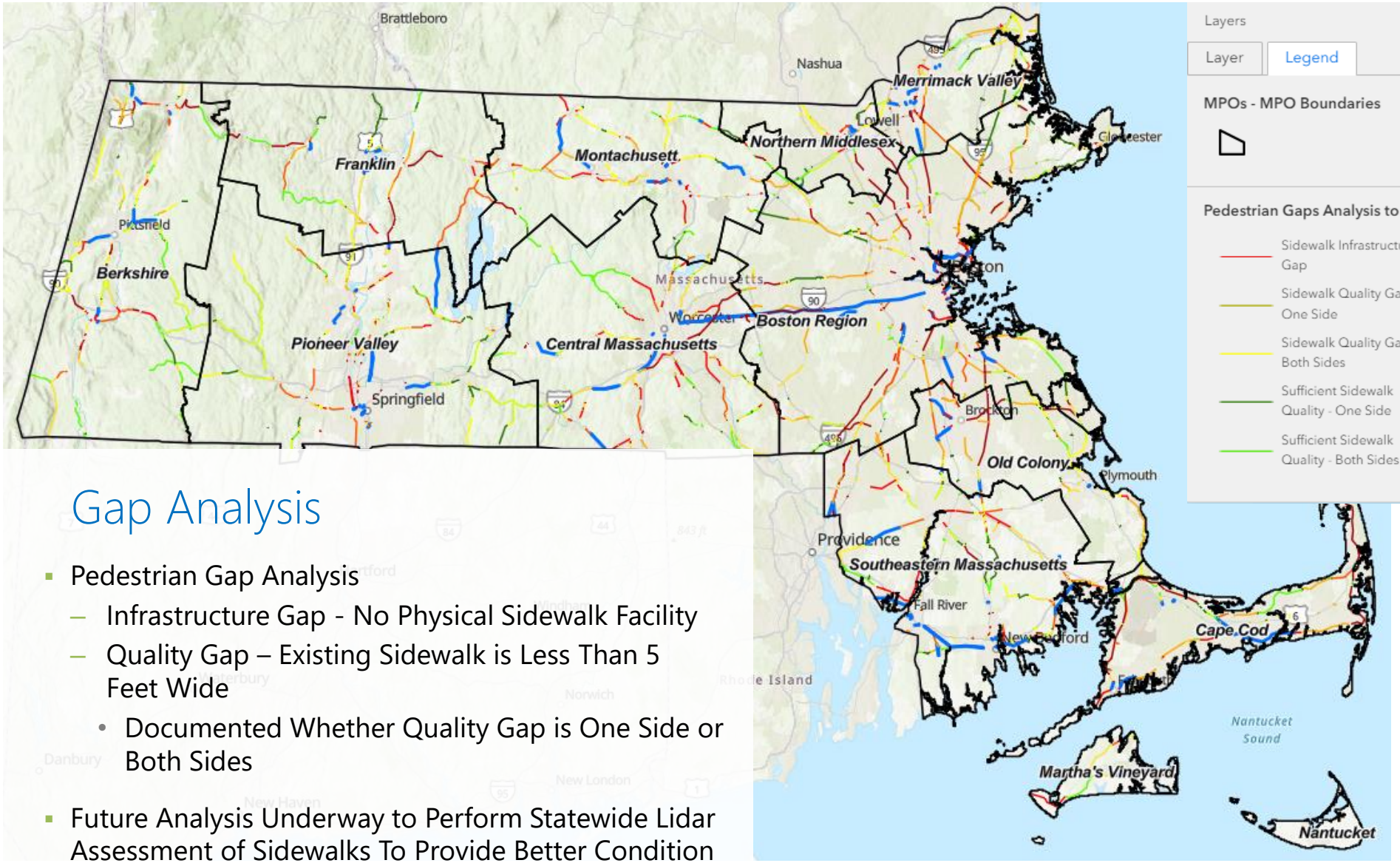
- Bicycle Gap Analysis
  - Reviewed Land Use, Speed, Volume and Existing Bicycle Facility Data in Relation to FHWA Bikeway Selection Guide Criteria to Develop GIS Gap Viewer
    - Supplemented available speed data with INRIX speed probe data around the state





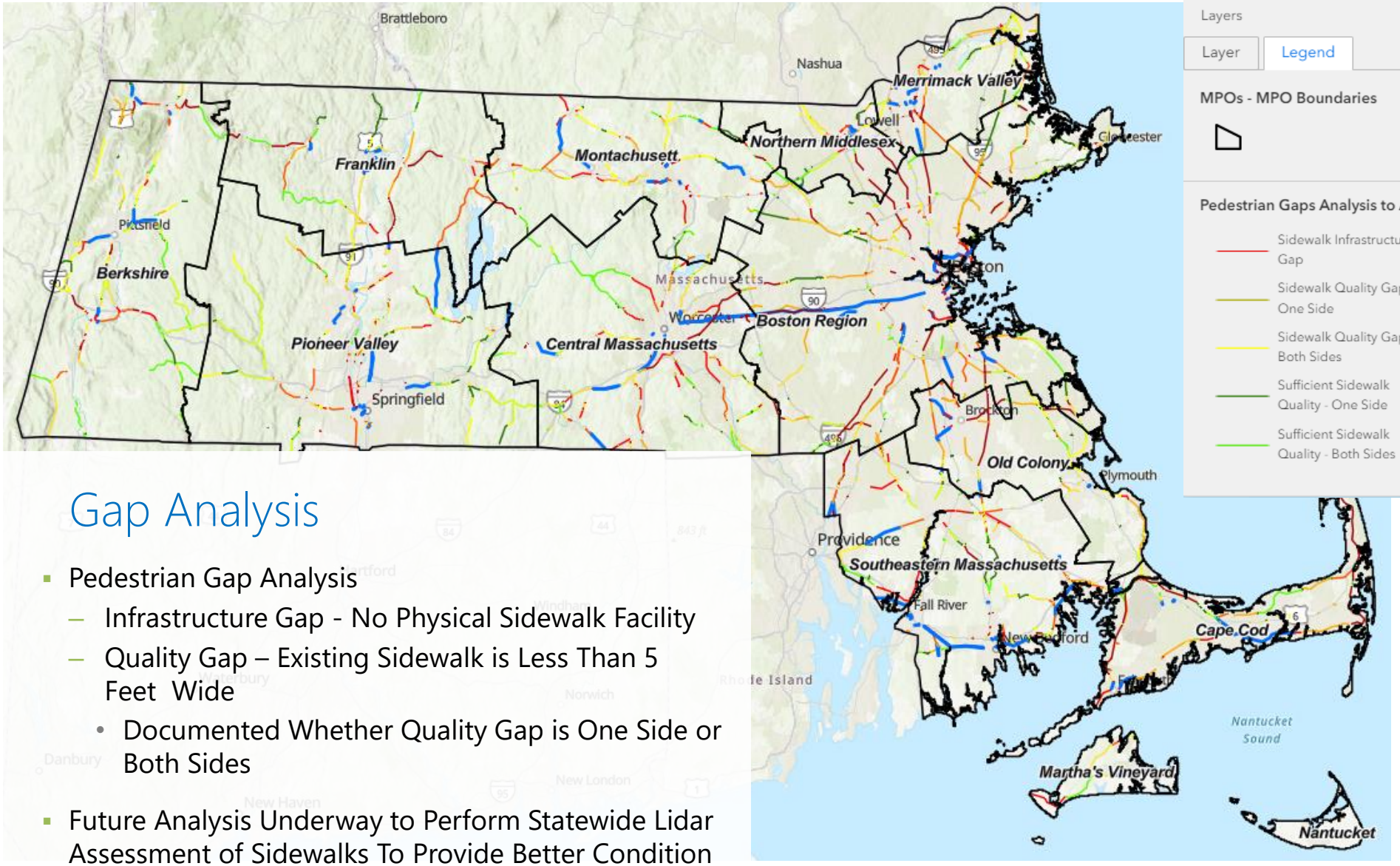
Gap Analysis

- Bicycle Gap Analysis
  - Infrastructure Gap – No Physical Bicycle Facility/Shoulder
  - Quality Gap – Existing Bicycle Facility Does Not Meet FHWA Recommended Bicycle Facility Type Based on Traffic Volume and Speed Conditions
  - No Physical Gap, Insufficient Data for Quality Gap – Bicycle Facility Exists, But Unable to Assess Compliance With FHWA Guidance Due to Insufficient Speed or Volume Data



Gap Analysis

- Pedestrian Gap Analysis
  - Infrastructure Gap - No Physical Sidewalk Facility
  - Quality Gap – Existing Sidewalk is Less Than 5 Feet Wide
    - Documented Whether Quality Gap is One Side or Both Sides
- Future Analysis Underway to Perform Statewide Lidar Assessment of Sidewalks To Provide Better Condition Assessment



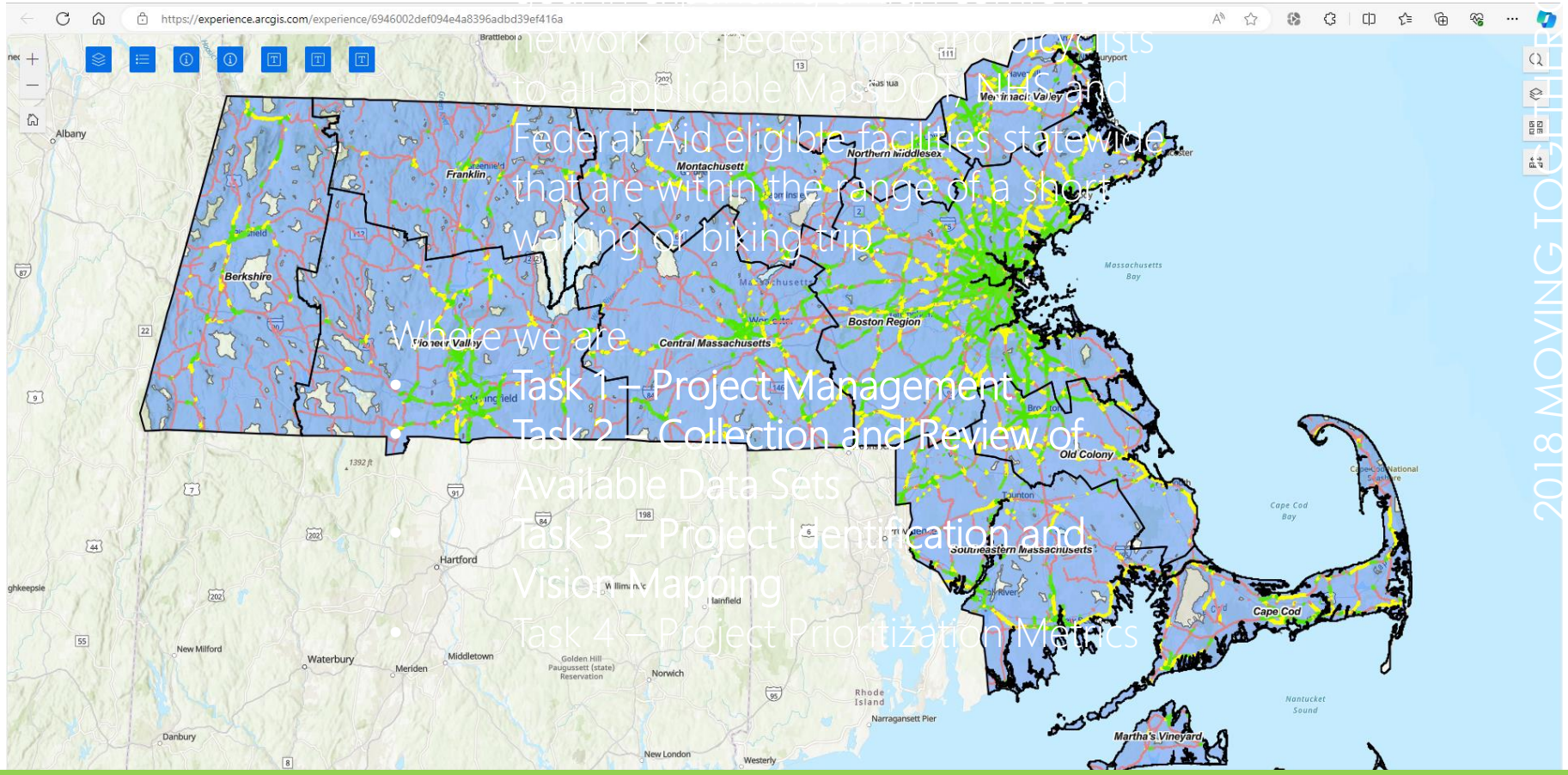
Gap Analysis

- Pedestrian Gap Analysis
  - Infrastructure Gap - No Physical Sidewalk Facility
  - Quality Gap – Existing Sidewalk is Less Than 5 Feet Wide
    - Documented Whether Quality Gap is One Side or Both Sides
- Future Analysis Underway to Perform Statewide Lidar Assessment of Sidewalks To Provide Better Condition Assessment

Vision Map Development

Considered Three Different Approaches to Vision Mapping

- Overlaying Gap Analysis with Potential for Everyday Walking and Biking
- Point of Interest Buffer Applied Walk (1/2 Mile) and Bike (3 Mile) – Shed to Gap Analysis Layer
- Land Use Based Analysis Applied to Gap Analysis Layer with (1/2 Mile) and Bike (3 Mile)



Land Use Based Approach to Vision Mapping

PROPERTY TYPE CLASSIFICATION CODES

Non-arm's Length Codes and
Sales Report Spreadsheet Specifications

Prepared by the Bureau of Local Assessment
Revised April 2019

CHANGES

- New Code: Code 434 for Telecommunication Data Centers
- Edits: Use Codes 114, 431, 717, 911,921

DLS
DIVISION OF LOCAL SERVICES
MA DEPARTMENT OF REVENUE

Revised April 2019

MULTIPLE-USE PROPERTY

CODE 0

Real property used or held for use for more than one purpose, including parcels with multiple detached or attached buildings, are considered multiple-use property for classification purposes. Any necessary related land on a multiple-use property must be allocated among the classes of property within the building.

The first digit of multiple-use property is always a zero (0). The second and third digits are the major classification of the property represented. The digits following zero (0) are listed in the order of major importance.

Examples

Since the guidelines for coding multiple-use property are unique, several specific examples of how to identify such property with these codes are listed here. These are only examples and do not represent all possible multiple use codes. Note: The mixed use code is **limited to three digits** and can only describe two classes of property.

013 Multiple-Use, primarily Residential

A building with a retail store on the first floor, apartments on the upper floors, and a major portion of the related land is reserved for tenant parking.

031 Multiple-Use, primarily Commercial

A building with retail use on the first floor, office space on the second and third floors, apartments on the fourth floor and a major portion of the related land is allocated for commercial use.

037 Multiple-Use, primarily Commercial with part of land designated under Chapter 61A use

A farm property with land and buildings predominantly used for commercial farming with part of land (at least 5 acres) designated horticulture/agricultural under Chapter 61A.

021 Multiple-Use, primarily Open Space

A single-family house with substantial acreage designated open space by the assessors.

RESIDENTIAL

CODE 1

M.G.L. Chapter 59 §2A: All real property used or held for human habitation containing one or more dwelling units including rooming houses with facilities assigned and used for living, sleeping, cooking and eating on a non-transient basis, and including a bed and breakfast home with no more than three rooms for rent. Such property includes accessory land, buildings or improvements incidental to such habitation and used exclusively by the residents of the property or their guests. Such property shall include: (i) land that is situated in a residential zone and has been subdivided into residential lots, and (ii) land used for the purpose of a manufactured housing community, as defined in Chapter 140, §32F. Such property shall not include a hotel or motel.

Incidental accessory land, buildings or improvements would include garages, sheds, in-ground swimming pools, tennis courts, etc. Non-incidental accessory land, classified and coded differently, would include mixed use properties, such as a variety store, machine shop, etc. on a residential parcel.

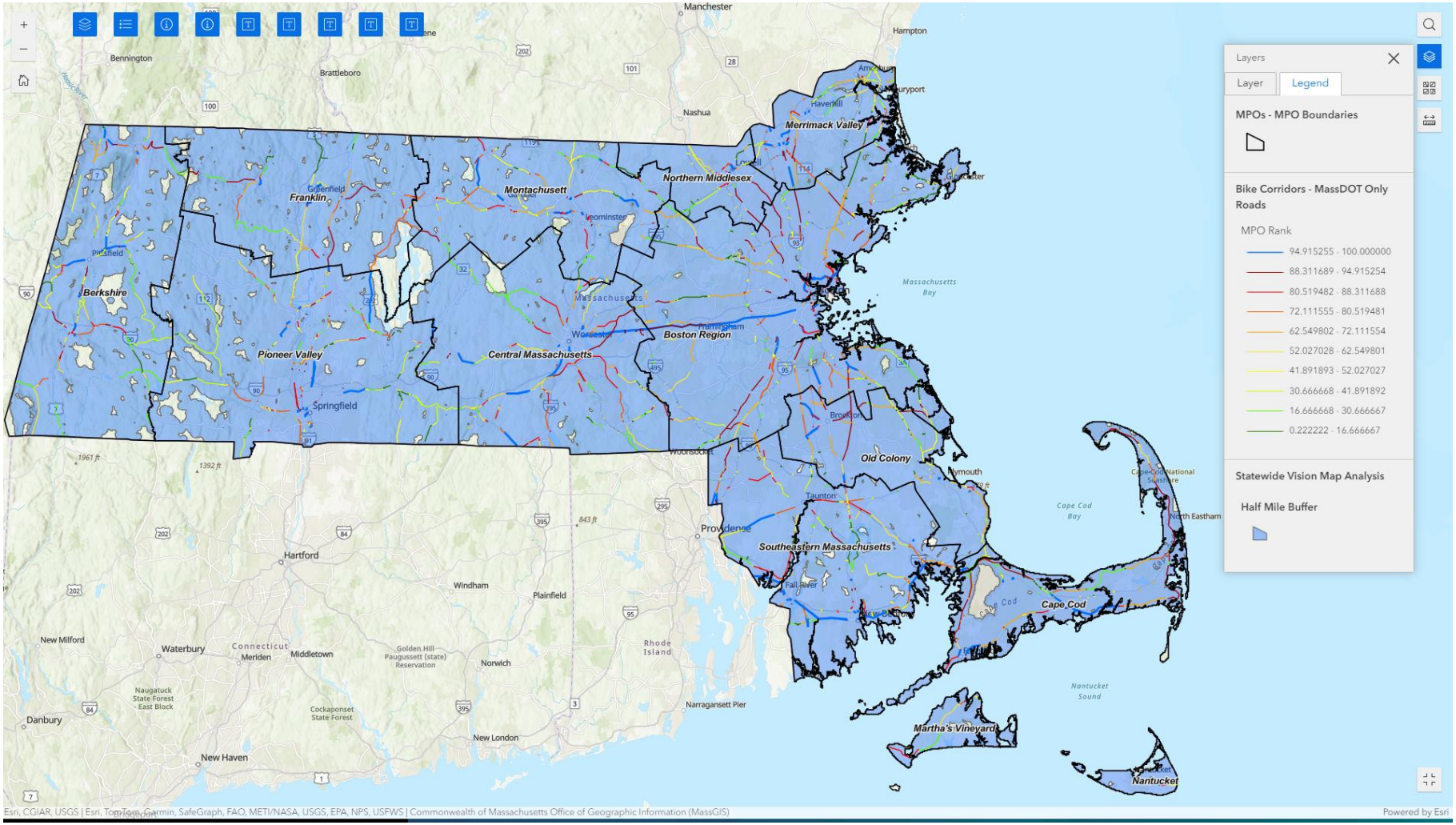
10 Residences

101 .....Single Family
102 .....Condominium
103 .....Mobile Home (includes land used for purpose of a mobile home park)
104 .....Two-Family
105 .....Three-Family
106 .....Accessory Land with Improvement - garage, etc.
107 .....(Intentionally left blank)
108 .....(Intentionally left blank)
109 .....Multiple Houses on one parcel (for example, a single and a two-family on one parcel)

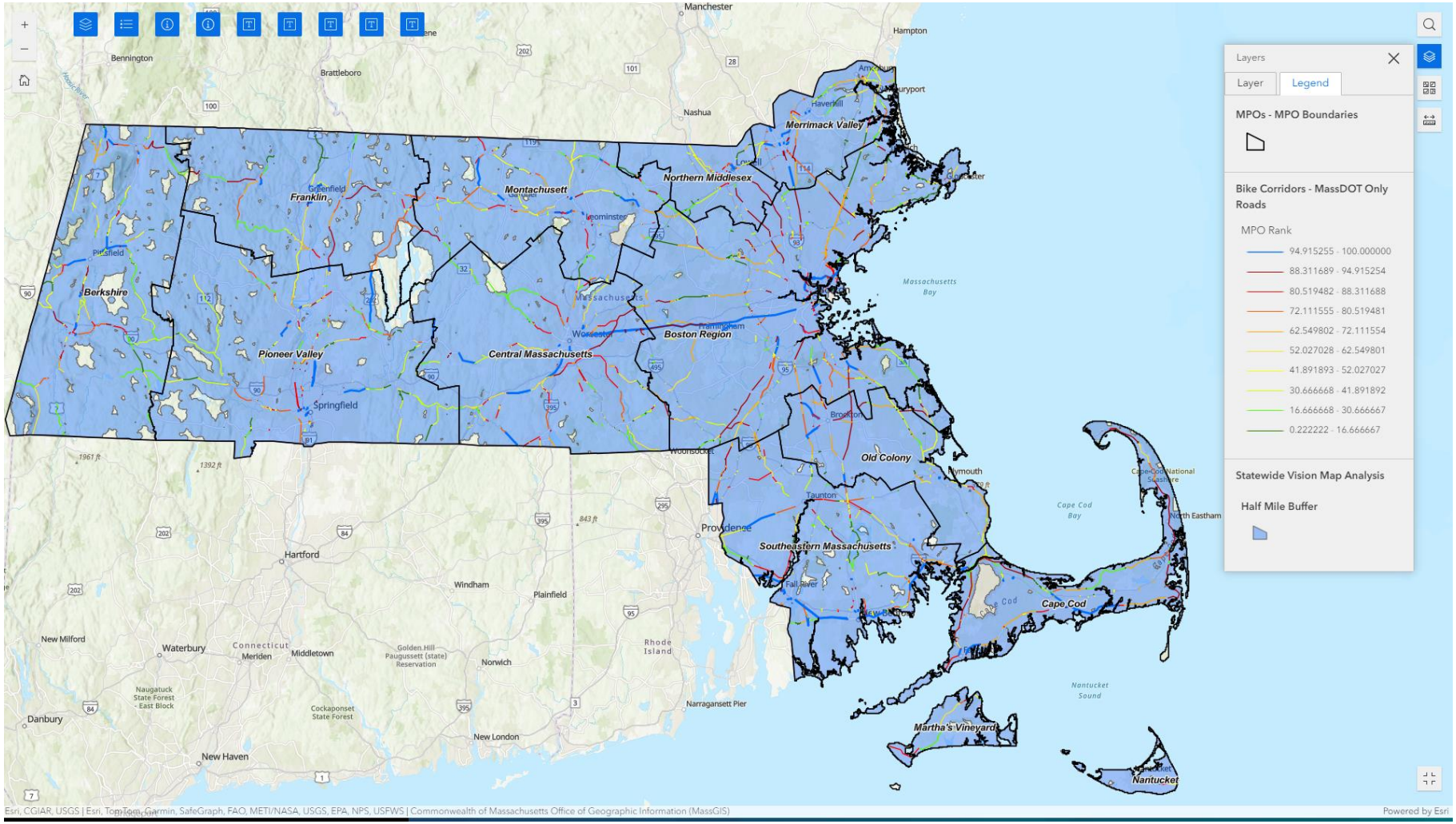
11 Apartments

111 .....Four to Eight Units
112 .....More than Eight Units
113.... (Intentionally left blank)
114.....Affordable Housing Units (Greater than 50% of the units qualify) Categorize per MGL 184, § 26, § 31 for definition of governmental body and affordable housing restriction

Bicycle Short Trips—Vision Map Analysis



Pedestrian Short Trips—Vision Map Analysis



Project Prioritization and Identification

Project Prioritization and Identification

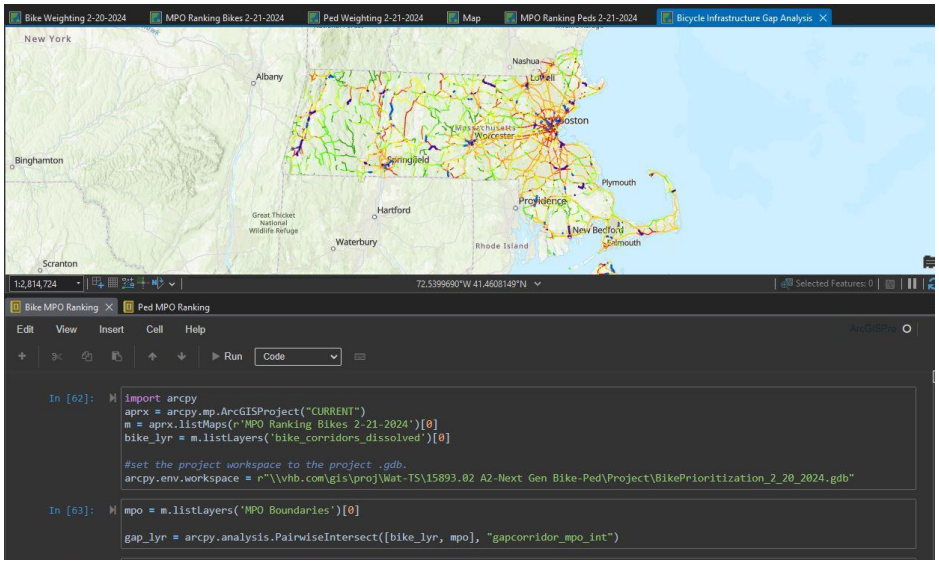
- Consistency with Beyond Mobility Project Prioritization
  - Rural vs Urban Weighting
  - Focus on Equity, Safety, Transit Connectivity, % of People Walking and Biking
  - Grouping of Projects By Regional Planning Agency Boundary
- Draft Data Layer Weighting
  - Analysis Was Run Both With and Without Weighting Applied
- Used Following Data Layers for Reality Check
  - Impact II Safety Risk Tool
  - Bike Volumes (where available)
  - Statewide Bike/Ped Transportation Plan - Public Wiki Map Comments
  - Potential for Everyday Walking and Biking

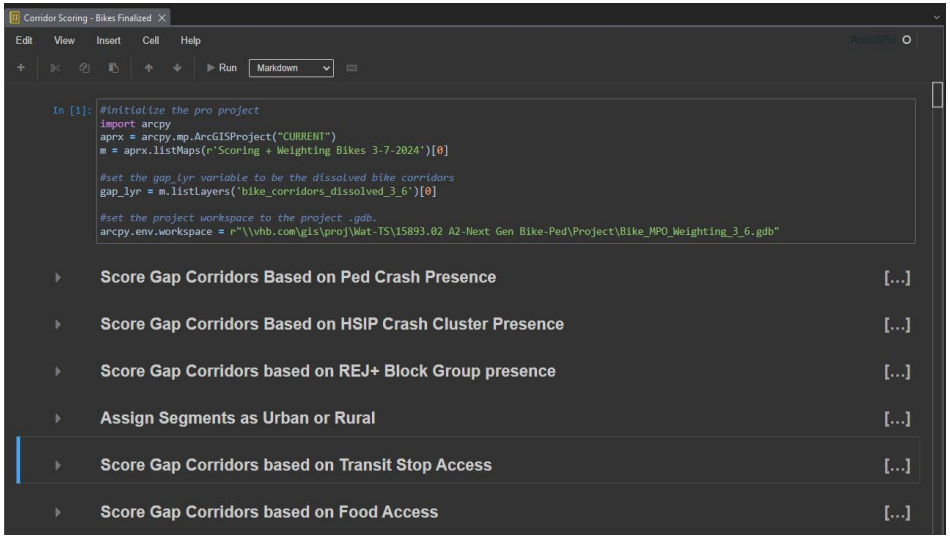
Analysis Topic	Priority (Weighting) (1-5)*	
	Urban	Rural
REJ+	5	
Ped/Bike Crashes (50-ft horizontal buffer)	5	
HSIP Clusters	5	
Transit Stop Presence on Road Segment (Urban - 0.5 Mile Walk & 1.5 Mile Bike Buffer) (Rural - 1 Mile Walk & 3 Bike Buffer)	5	
Supermarket/Access to Food	4	
Population Density	2	4
Proximity to Parks / Open Spaces / Recreational Facilities	3	1
Employment Density	2	
Proximity to Public Services	1	
Commuters that Walk, Bike and Take Transit	1	
Designated Truck Route	1	

** 1-5 weighting with 5 being more important*

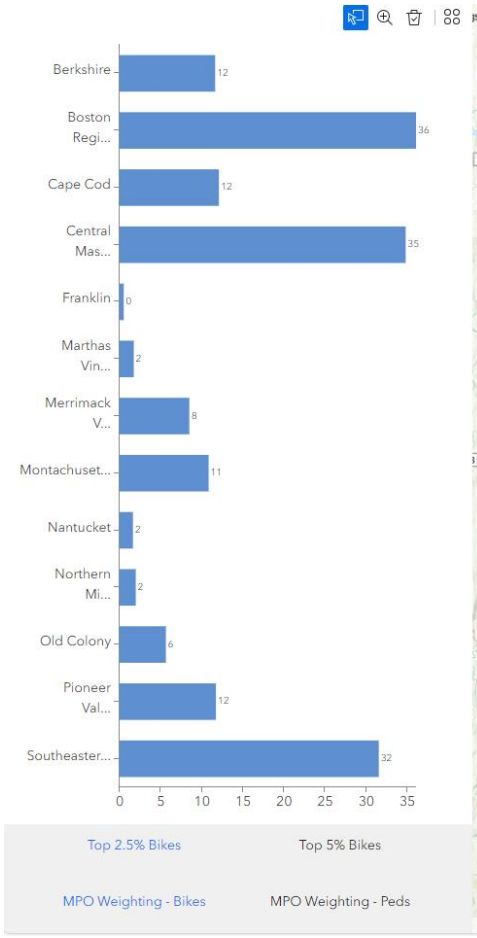
Technology Integrations: ArcGIS Notebooks

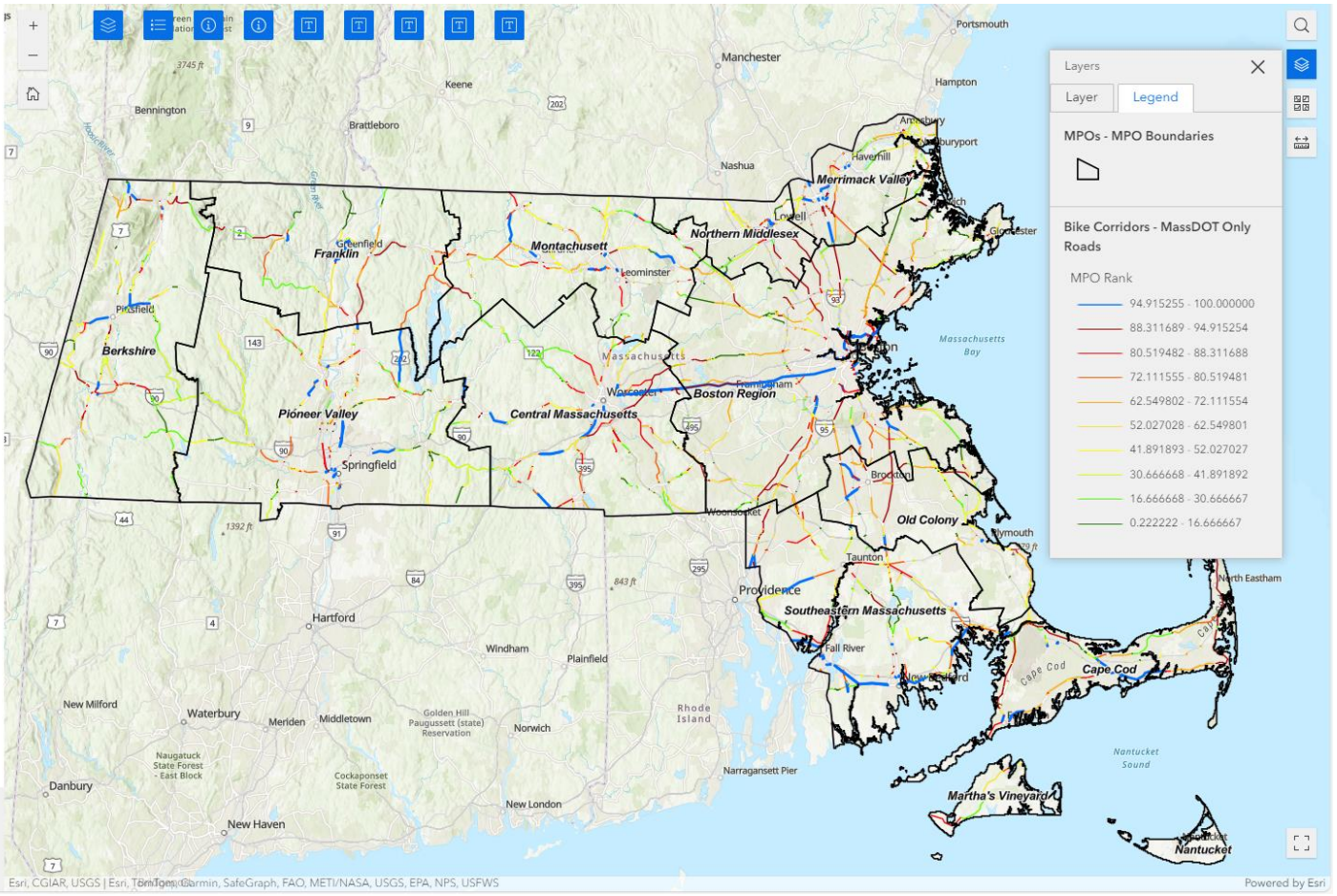
- Integrating Python into GIS Analysis
- Entire GIS Analysis contained in one place that can be easily repeated
- All NextGen GIS analyses were conducted using Notebooks
- Allowed for interactive edits with weighting/prioritization process
- Benefits:
  - Automating analysis
  - Increasing processing speed
  - Integrates into GIS map – live results
  - Organized, streamlined code





Bicycle Project Prioritization

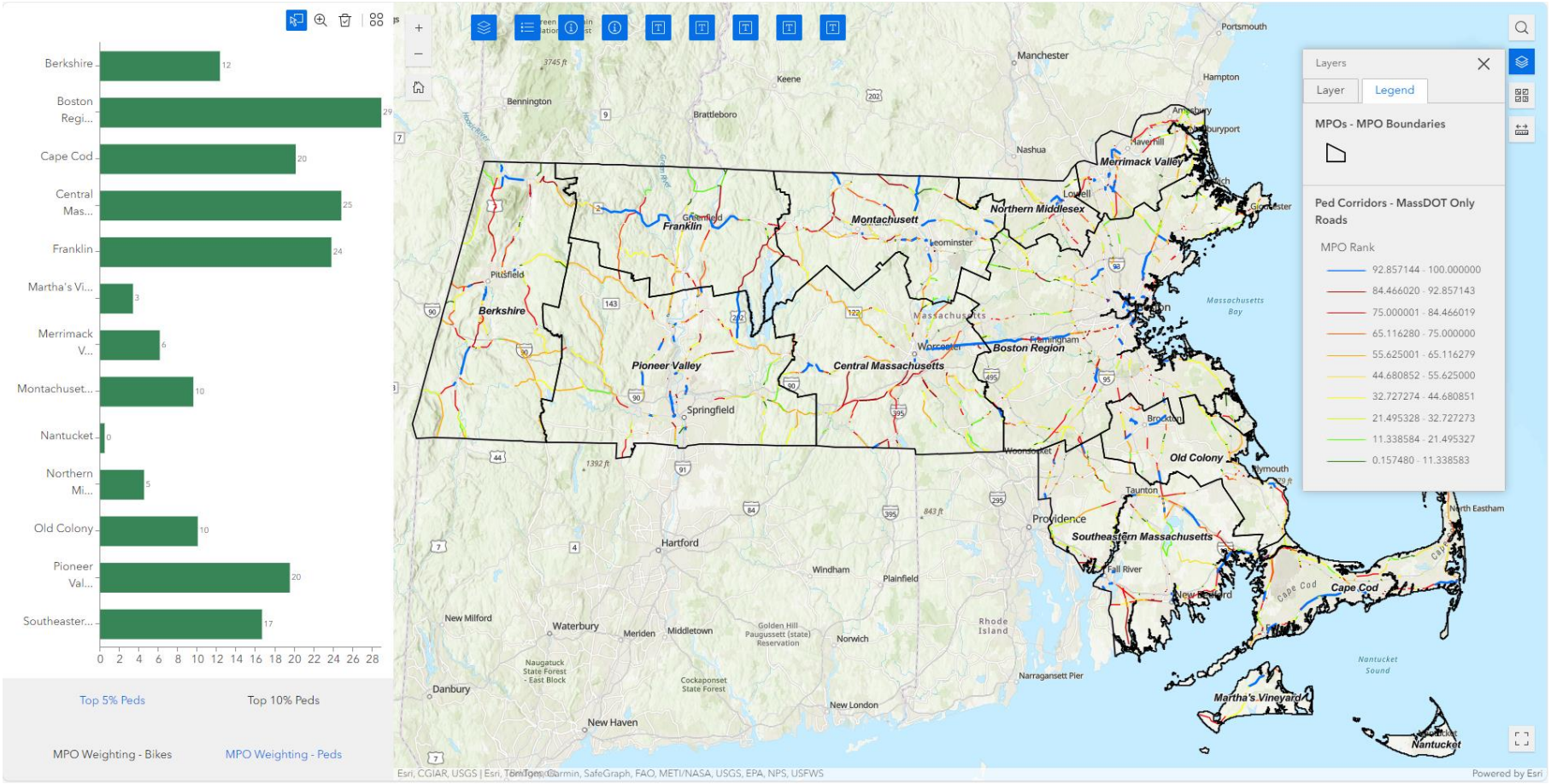




Prioritized Bicycle Project Locations – MassDOT Roads by MPO

MPO	Berkshire	Boston Region	Cape Cod	Central Massachusetts	Franklin	Martha's Vineyard	Merrimack Valley	Montachusett	Nantucket	Northern Middlesex	Old Colony	Pioneer Valley	Southeastern Massachusetts
Total Miles	235.68	524.63	161.74	254.19	149.71	35.57	110.89	146.69	6.56	64.53	102.08	251.89	240.56
Total Miles - Top 5% Projects	13.97	53.51	17.48	41.20	3.01	1.72	9.40	12.38	1.62	2.35	8.37	25.54	45.49
Total Miles - Top 2.5% Projects	11.64	36.07	12.08	34.81	0.50	1.72	8.49	10.82	1.62	1.96	5.63	11.72	31.56
Total Miles in REJ	121.50	362.03	125.05	95.02	83.25	28.56	47.26	48.01	3.94	42.12	56.83	57.70	85.06
Total Miles in REJ - Top 5% Projects	13.97	53.51	17.48	34.70	3.01	1.72	9.40	12.38	1.62	2.07	8.37	25.10	34.02
Total Miles in REJ - Top 2.5% Projects	11.64	36.07	12.08	31.30	0.50	1.72	8.49	10.82	1.62	1.68	5.63	11.28	27.97
Total Miles in Rural Communities	182.29	25.41	8.96	90.48	121.18	27.00	11.60	88.34	4.24	5.95	7.93	144.04	53.23
Total Miles in Rural Communities - Top 5% Projects	1.78	0.01	0.54	13.90	0.80	1.72	0.00	6.83	1.62	0.28	1.25	11.30	8.49
Total Miles in Rural Communities - Top 2.5% Projects	1.36	0.00	0.14	8.37	0.08	1.72	0.00	5.30	1.62	0.28	1.25	3.25	0.45
Total Miles Sufficient Infrastructure	40.33	14.89	7.41	21.61	33.61	0.52	2.22	16.31	0.19	1.66	0.04	37.37	12.03
Total Miles Sufficient Infrastructure - Top 5% Projects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Miles Sufficient Infrastructure - Top 2.5% Projects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Miles Quality Gap	88.78	36.17	12.54	43.70	49.48	0.03	17.31	44.58	0.20	3.11	5.76	67.24	23.65
Total Miles Quality Gaps - Top 5% Projects	0.77	0.86	0.75	11.26	0.52	0.00	1.44	5.50	0.00	0.20	1.39	11.34	7.24
Total Miles Quality Gaps - Top 2.5% Projects	0.42	0.84	0.38	8.10	0.00	0.00	1.36	4.66	0.00	0.20	1.39	3.23	0.36
Total Miles Physical Gap	106.57	472.09	141.79	188.88	66.62	29.25	91.30	85.17	6.17	59.76	96.28	146.99	204.35
Total Miles Physical Gaps - Top 5% Projects	13.20	52.65	16.73	29.94	2.49	1.72	7.96	6.88	1.62	2.15	6.98	14.20	38.25
Total Miles Physical Gaps - Top 2.5% Projects	11.22	35.23	11.70	26.71	0.50	1.72	7.13	6.16	1.62	1.76	4.24	8.49	31.20
Total Miles Insufficent Data	0	1.48	0	0	0	5.77	0.06	0.63	0	0	0	0.29	0.53

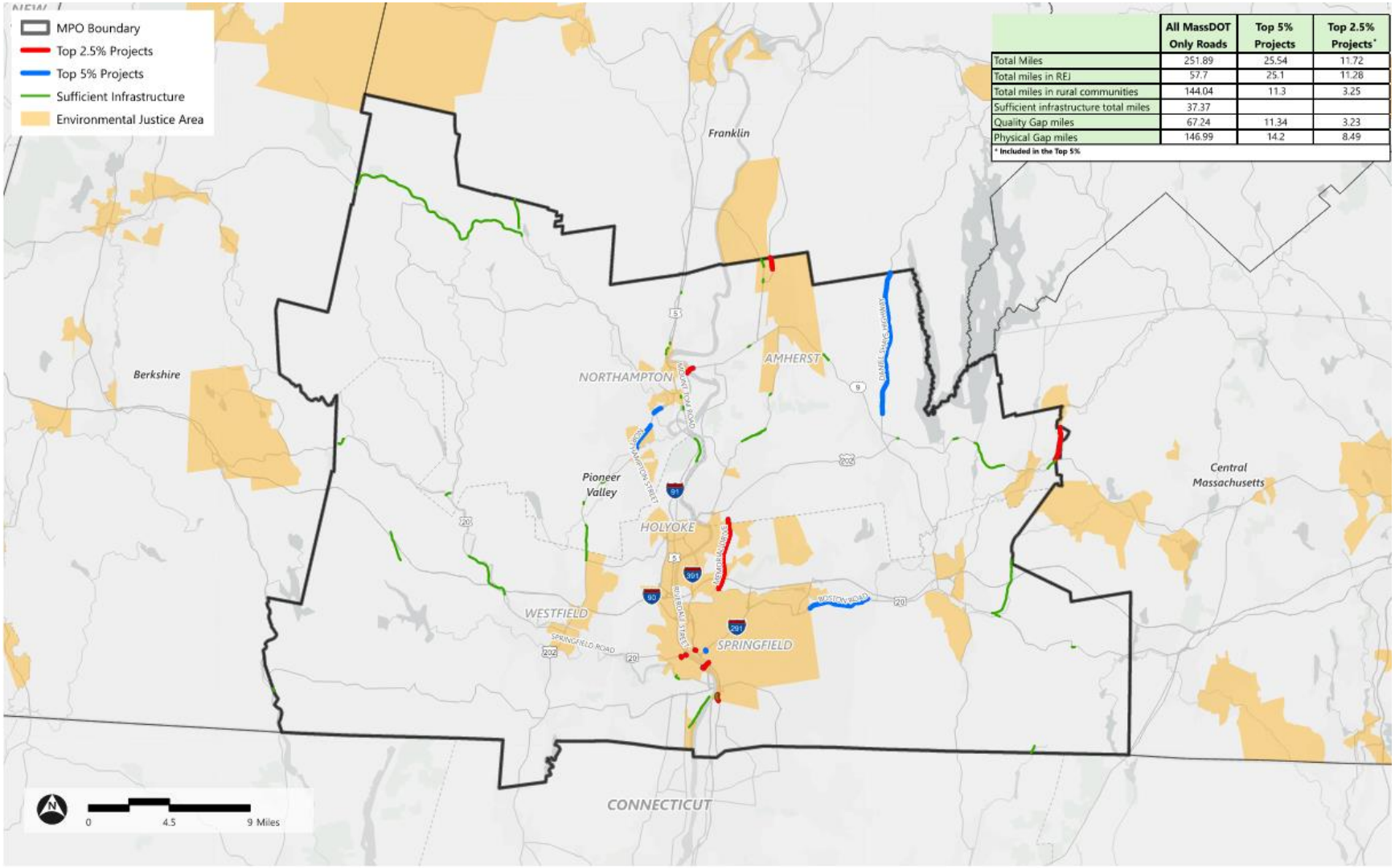
Pedestrian Project Prioritization



Prioritized Pedestrian Project Locations – MassDOT Roads by MPO

MPO	Berkshire	Boston Region	Cape Cod	Central Massachusetts	Franklin	Martha's Vineyard	Merrimack Valley	Montachusett	Nantucket	Northern Middlesex	Old Colony	Pioneer Valley	Southeastern Massachusetts
Total Miles	236.05	524.65	161.85	254.47	149.81	35.52	110.95	147.04	6.49	64.20	102.06	252.17	240.52
Total Miles - Top 5% Projects	12.32	28.91	20.12	24.80	23.79	3.37	7.56	9.58	0.45	4.51	10.02	19.49	16.65
Total Miles - Top 2.5% Projects	10.72	10.50	10.01	22.60	23.79	3.37	4.77	6.76	0.45	3.95	7.94	14.08	10.45
Total Miles in REJ	140.51	286.23	109.73	92.99	86.16	24.16	44.73	58.18	3.86	33.88	42.57	48.45	82.32
Total Miles in REJ - Top 5% Projects	12.32	28.89	20.12	24.80	23.79	3.37	7.56	9.58	0.00	4.23	8.47	14.30	11.13
Total Miles in REJ - Top 2.5% Projects	10.72	10.48	10.01	22.60	23.79	3.37	4.77	6.76	0.00	3.67	6.39	13.64	10.45
Total Miles in Rural Communities	182.41	25.62	9.01	90.54	121.11	26.94	11.66	88.37	4.25	5.95	7.94	144.04	53.31
Total Miles in Rural Communities - Top 5% Projects	6.97	0.02	2.45	4.30	23.16	3.07	0.00	4.78	0.45	0.28	3.43	13.90	5.37
Total Miles in Rural Communities - Top 2.5% Projects	6.97	0.02	2.45	4.15	23.16	3.07	0.00	4.68	0.45	0.28	3.43	8.49	0.00
Total Miles Sufficient Infrastructure	16.04	202.19	25.92	38.29	11.72	5.81	24.64	10.68	4.98	17.56	25.90	35.14	43.46
Total Miles Sufficient Infrastructure - Top 5% Projects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Miles Sufficient Infrastructure - Top 2.5% Projects	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Miles Quality Gap	23.48	114.72	38.07	26.58	6.84	0.92	27.28	17.40	0.00	13.46	24.59	27.79	53.18
Total Miles Quality Gaps - Top 5% Projects	6.61	14.31	7.98	1.25	0.32	0.30	5.70	2.18	0.00	2.04	4.14	3.53	8.78
Total Miles Quality Gaps - Top 2.5% Projects	5.01	2.33	6.58	0.95	0.32	0.30	4.77	2.08	0.00	2.04	4.14	3.53	8.69
Total Miles Physical Gap	196.53	207.74	97.86	189.60	131.25	28.79	59.03	118.96	1.51	33.18	51.57	189.24	143.88
Total Miles Physical Gaps - Top 5% Projects	5.71	14.60	12.14	23.55	23.47	3.07	1.86	7.40	0.45	2.47	5.88	15.96	7.87
Total Miles Physical Gaps - Top 2.5% Projects	5.71	8.17	3.43	21.65	23.47	3.07	0.00	4.68	0.45	1.91	3.80	10.55	1.76

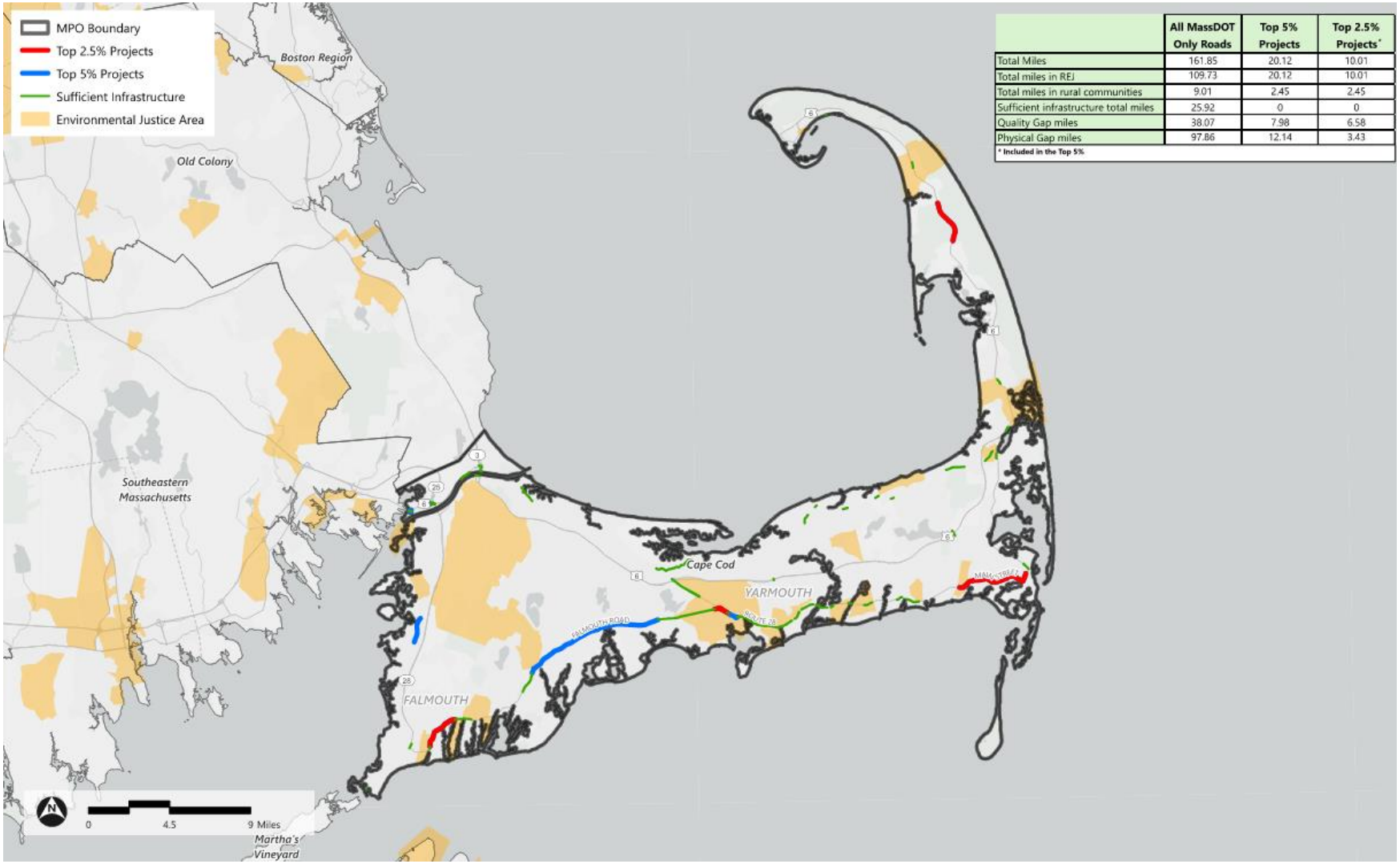
Prioritized Bicycle Project Locations – MassDOT Roads – Pioneer Valley MPO



	All MassDOT Only Roads	Top 5% Projects	Top 2.5% Projects*
Total Miles	251.89	25.54	11.72
Total miles in REJ	57.7	25.1	11.28
Total miles in rural communities	144.04	11.3	3.25
Sufficient infrastructure total miles	37.37		
Quality Gap miles	67.24	11.34	3.23
Physical Gap miles	146.99	14.2	8.49

* Included in the Top 5%

Prioritized Pedestrian Project Locations – MassDOT Roads – Cape Cod MPO



	All MassDOT Only Roads	Top 5% Projects	Top 2.5% Projects*
Total Miles	161.85	20.12	10.01
Total miles in REJ	109.73	20.12	10.01
Total miles in rural communities	9.01	2.45	2.45
Sufficient infrastructure total miles	25.92	0	0
Quality Gap miles	38.07	7.98	6.58
Physical Gap miles	97.86	12.14	3.43

* Included in the Top 5%

Use Case Studies—How Will MassDOT Utilize This Data?

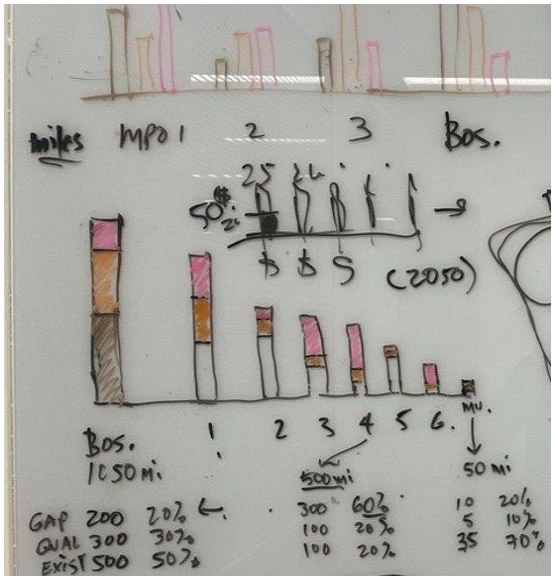
- Bike and Pedestrian Network Planning
  - Data driven project identification
  - Identify priority corridors
  - Coordination with Municipalities / Districts / MPOs
- Funding
  - Annual / 5-year funding level
  - Regional goals being met?
  - Equitable funding allocation – District / MPO / State
- Annual reporting and performance metrics
  - Number of gap miles closed
  - Amount of investment and population served
    - Urban/rural
    - REJ+
    - District/MPO/State level

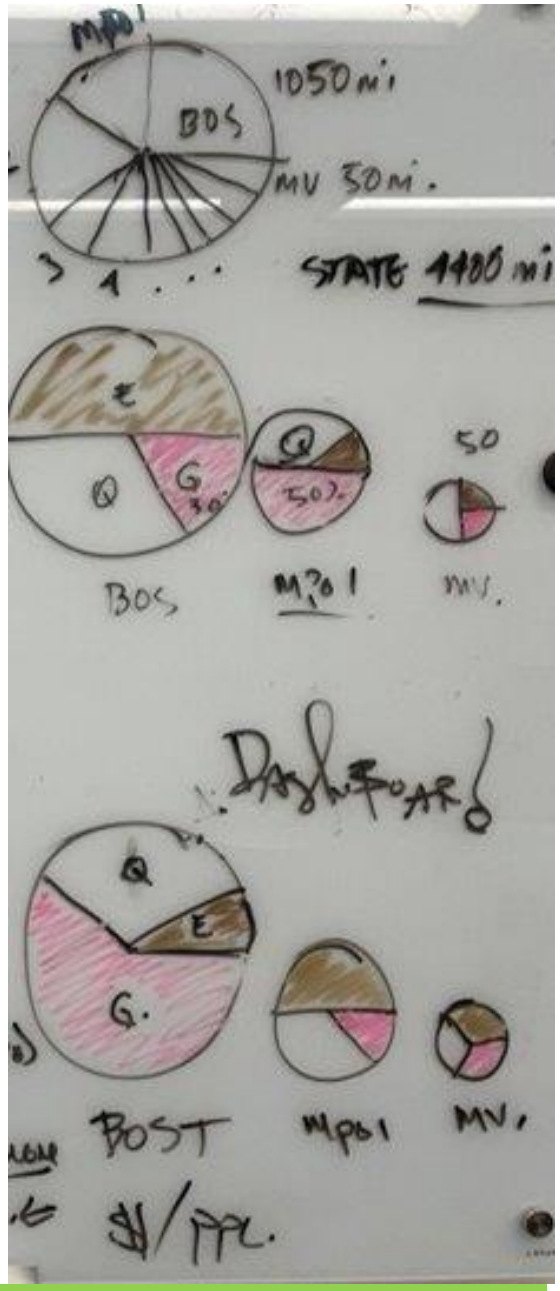
Use Case Studies—How Will MassDOT Utilize This Data?

- District / MPO initiated projects
  - Analyze where locations fall within the priority map
- Complete Streets
  - Assist in coordination of municipal planning for redundancy or collaboration
- Complement road inventory facilities
  - Support prioritization of sidewalk inventory Currently being assessed as a separate study
  - Support creation and prioritization of Massachusetts ADA Compliance Plan

Future Dashboard

- Policy Implementation
- Investment Allocation
  - Urban/rural
  - REJ+
- District/MPO/State level comparison
- Updated Network
  - Sufficient – Quality – Physical gap
- Comparative Illustration
  - MPOs / State
- Success metrics
  - Miles built
  - Millions spent
  - % improvements





Questions?

Acknowledgements

Office of Transportation Planning
MassDOT GIS
Chief Engineer's Office
VHB