Baltimore Metropolitan Council

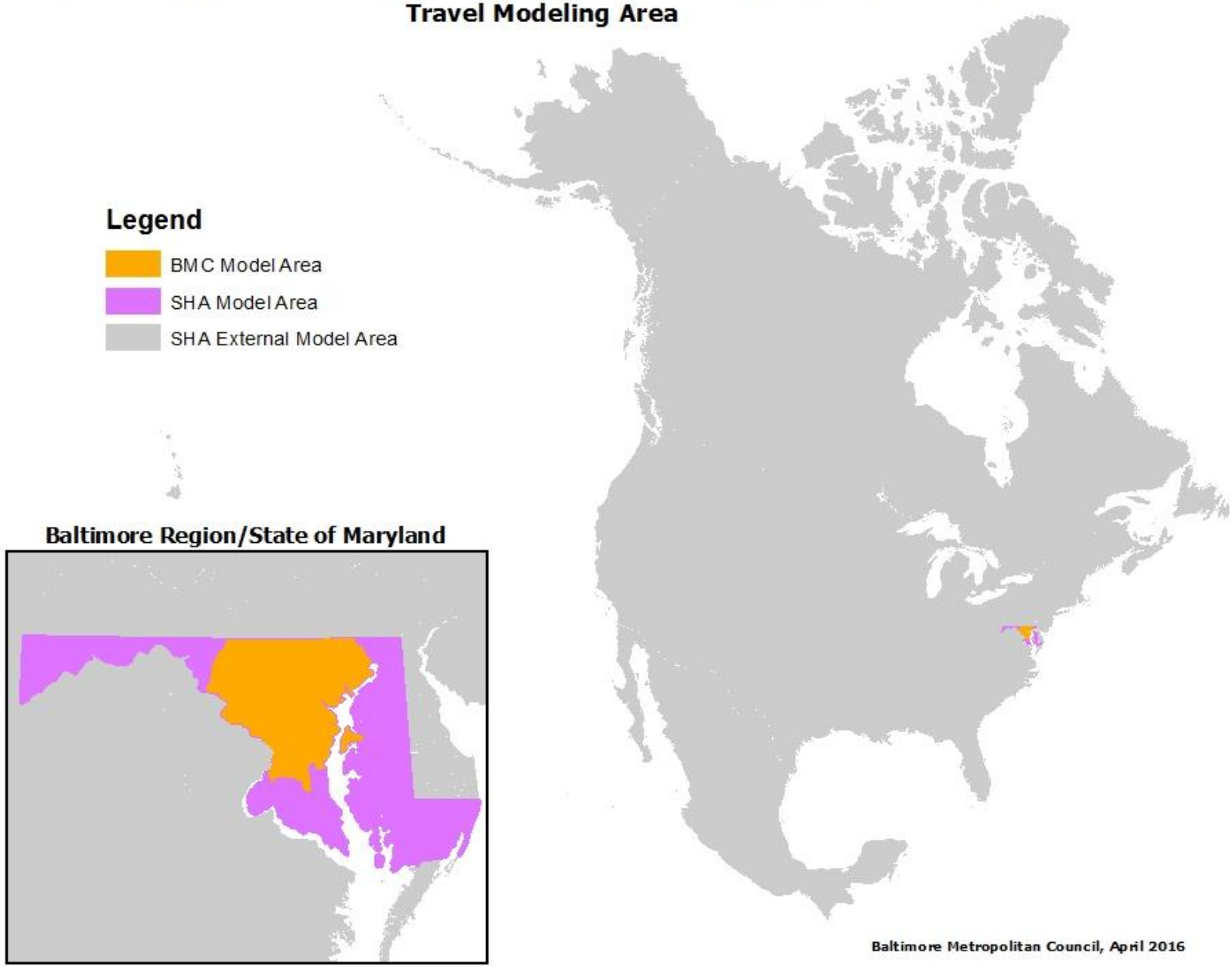
SHA State Highway Administration
Maryland Department of Transportation

# SHRP2 C20 Maryland Behavior Based Freight Model: Update

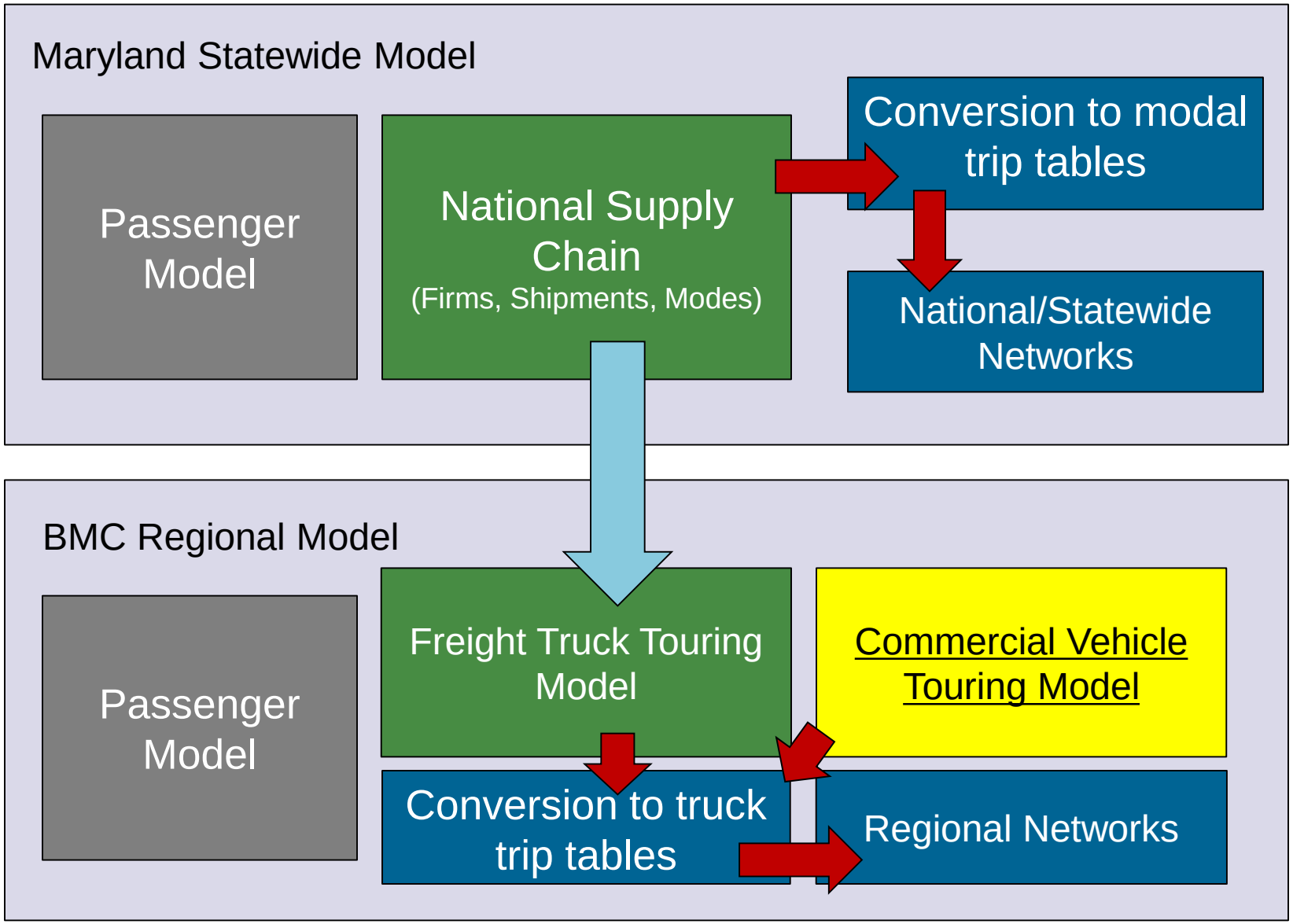
## Freight Movement Task Force Meeting

June 7, 2016

# Baltimore Metropolitan Council & Maryland State Highway Administration
# Travel Modeling Area



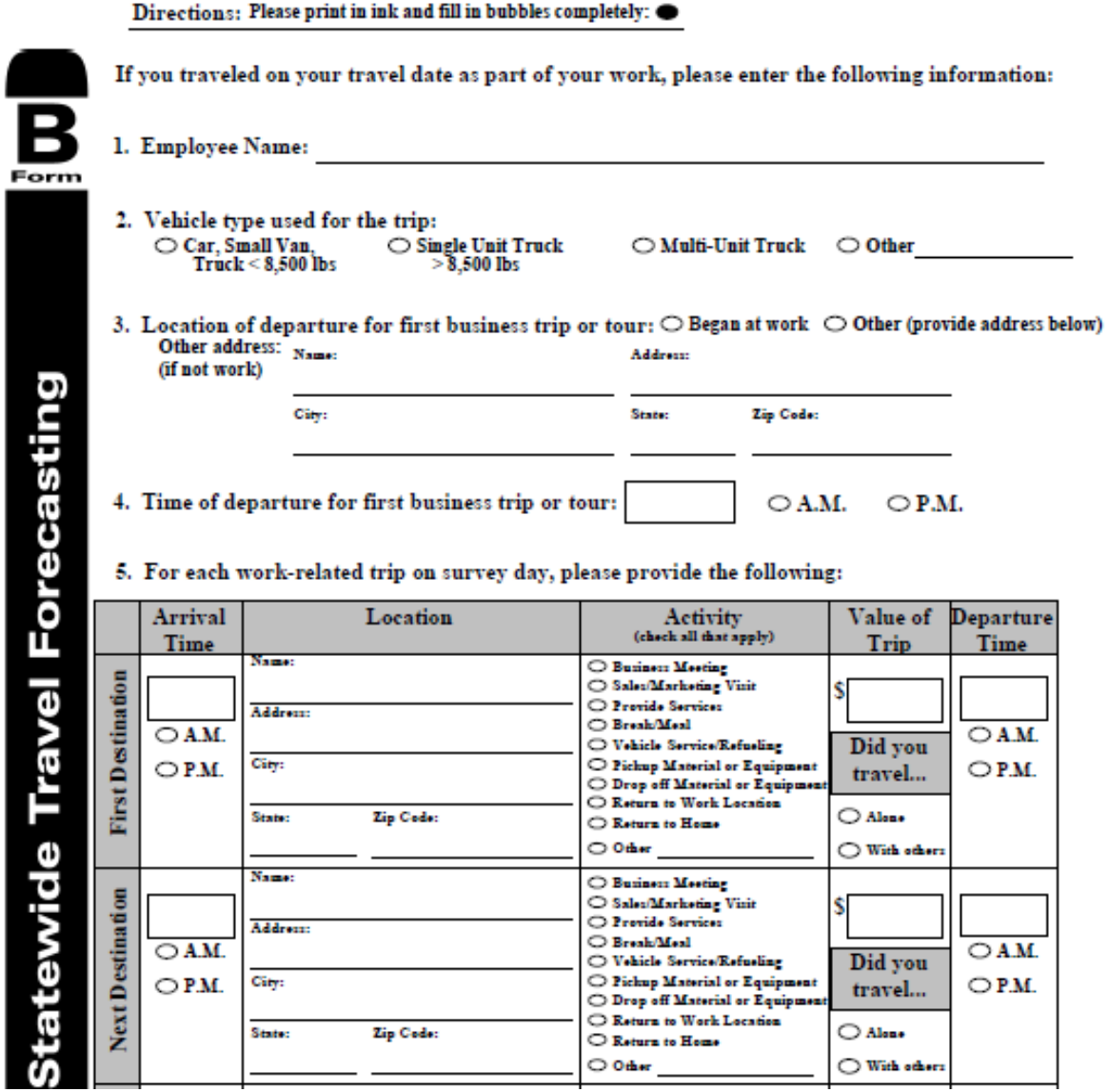
# Freight Model: Model Design



# Freight Model: Data

- **Business Data**
  - Establishment Survey: 2003 Ohio Statewide General Establishment Survey
  - Logistics Nodes: Intermodal facilities, warehouses and distribution center locations / Leonard's Guide, Bureau of Transportation Statistics (BTS), Center for Transportation Analysis (CTA) & Maryland county planning departments
  - Employment: Longitudinal Employer-Household Dynamics (LEHD) / US Census
- **Freight Flow Data**
  - Goods Movement: 2012 Freight Analysis Framework (FAF) / FHWA & BTS
- **Modal Data**
  - Truck - Traffic Counts: SHA, MdTA & BMC
  - Truck - GPS: American Transportation Research Institute (ATRI)
  - Port: 2012 State and Port Cargo Movement Data / US Army Corps of Engineers
  - Air: 2012 Air Freight Data (T100) / BTS

# Ohio GES Form B: Travel Diaries



Directions: Please print in ink and fill in bubbles completely: ●

Form B

Statewide Travel Forecasting

If you traveled on your travel date as part of your work, please enter the following information:

1. Employee Name: _____

2. Vehicle type used for the trip:
   ○ Car, Small Van, Truck < 8,500 lbs ○ Single Unit Truck > 8,500 lbs ○ Multi-Unit Truck ○ Other _____

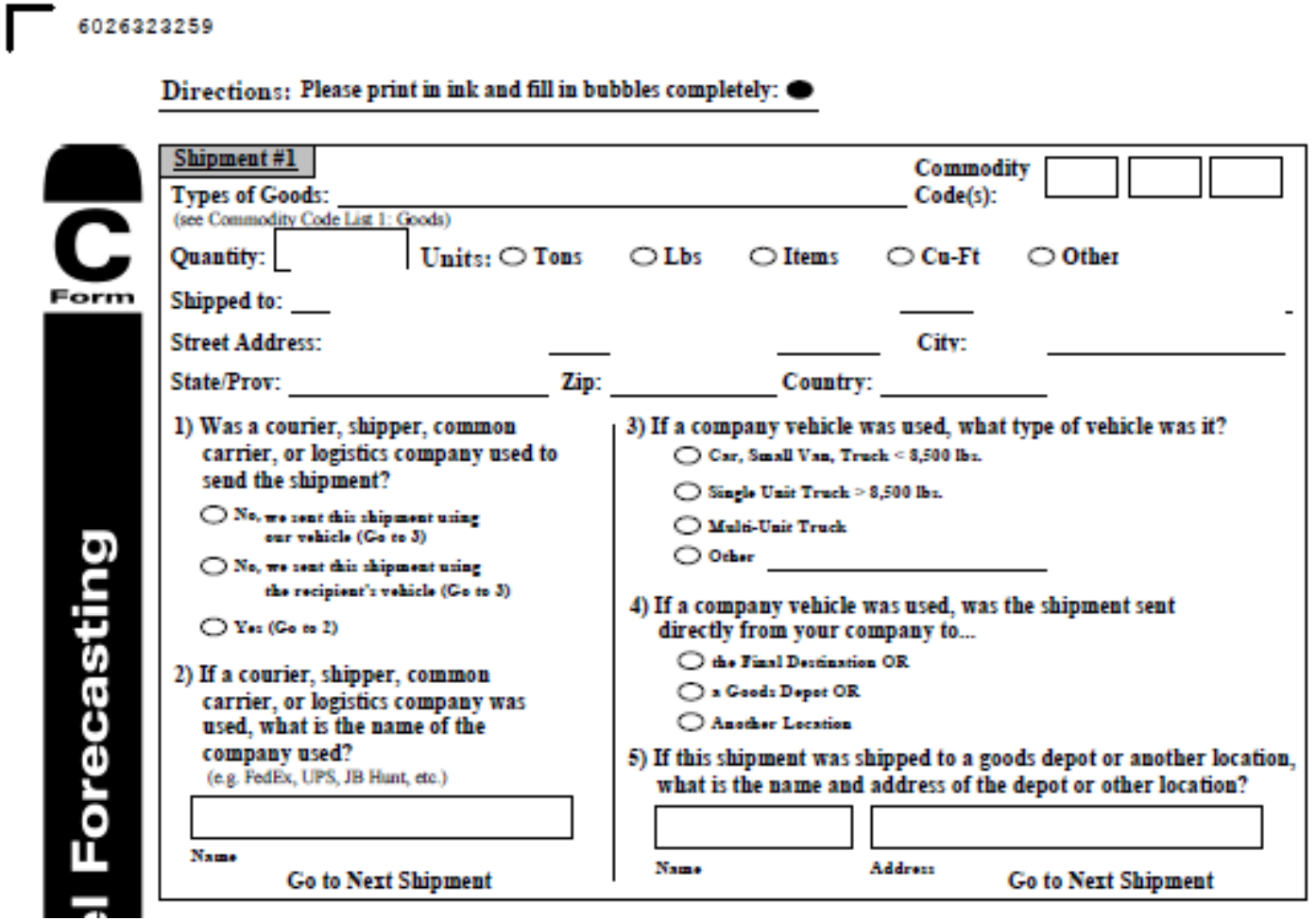
3. Location of departure for first business trip or tour: ○ Began at work ○ Other (provide address below)
   Other address: (if not work) Name: Address: City: State: Zip Code:

4. Time of departure for first business trip or tour: ____ ○ A.M. ○ P.M.

5. For each work-related trip on survey day, please provide the following:

| | Arrival Time | Location | Activity (check all that apply) | Value of Trip | Departure Time |
|---|---|---|---|---|---|
| First Destination | ____ ○ A.M. ○ P.M. | Name: Address: City: State: Zip Code: | ○ Business Meeting ○ Sales/Marketing Visit ○ Provide Services ○ Break/Meal ○ Vehicle Service/Refueling ○ Pickup Material or Equipment ○ Drop off Material or Equipment ○ Return to Work Location ○ Return to Home ○ Other _____ | $ ____ Did you travel... ○ Alone ○ With others: | ____ ○ A.M. ○ P.M. |
| Next Destination | ____ ○ A.M. ○ P.M. | Name: Address: City: State: Zip Code: | ○ Business Meeting ○ Sales/Marketing Visit ○ Provide Services ○ Break/Meal ○ Vehicle Service/Refueling ○ Pickup Material or Equipment ○ Drop off Material or Equipment ○ Return to Work Location ○ Return to Home ○ Other _____ | $ ____ Did you travel... ○ Alone ○ With others: | ____ ○ A.M. ○ P.M. |

# Ohio GES Form C and D: Outgoing / Incoming Shipment Information



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Directions: Please print in ink and fill in bubbles completely: ●

Form C

Forecasting

**Shipment #1**

Types of Goods: _____ Commodity Code(s): ☐☐☐

(see Commodity Code List 1: Goods)

Quantity: ☐ Units: ○ Tons ○ Lbs ○ Items ○ Cu-Ft ○ Other

Shipped to: ___ _____ -

Street Address: ____ _____ City: _____

State/Prov: _____ Zip: _____ Country: _____

1) Was a courier, shipper, common carrier, or logistics company used to send the shipment?

- ○ No, we sent this shipment using our vehicle (Go to 3)
- ○ No, we sent this shipment using the recipient's vehicle (Go to 3)
- ○ Yes (Go to 2)

2) If a courier, shipper, common carrier, or logistics company was used, what is the name of the company used?

(e.g. FedEx, UPS, JB Hunt, etc.)

☐

Name

Go to Next Shipment

3) If a company vehicle was used, what type of vehicle was it?

- ○ Car, Small Van, Truck < 8,500 lbs.
- ○ Single Unit Truck > 8,500 lbs.
- ○ Multi-Unit Truck
- ○ Other _____

4) If a company vehicle was used, was the shipment sent directly from your company to...

- ○ the Final Destination OR
- ○ a Goods Depot OR
- ○ Another Location

5) If this shipment was shipped to a goods depot or another location, what is the name and address of the depot or other location?

☐ ☐

Name Address

Go to Next Shipment

# Firm-to-Stop Zone Distances (miles)

### All Activities

| | Simulation | | | Ohio GES | | | R = 0.97 |
|---|---|---|---|---|---|---|---|
| | *N* | *Mean* | *Std. Dev.* | *N* | *Mean* | *Std. Dev.* | *% Diff* |
| Agriculture | 2,520 | 10.4 | 15.1 | 1,008 | 10.0 | 570.1 | 3% |
| Construction | 173,389 | 6.7 | 10.8 | 606 | 6.5 | 3,445.4 | 3% |
| Government | 331,733 | 6.7 | 10.1 | 1,112 | 5.4 | 4,804.4 | 24% |
| Health | 156,346 | 5.6 | 8.9 | 302 | 4.8 | 2,139.8 | 16% |
| Hotel & Real Estate | 102,093 | 5.8 | 10.0 | 130 | 5.8 | 2,152.8 | 1% |
| Manufacturing | 11,485 | 7.0 | 12.1 | 211 | 7.9 | 1,114.0 | -12% |
| Other Services | 817,756 | 6.0 | 9.7 | 629 | 5.1 | 6,257.1 | 18% |
| Retail | 382,877 | 7.9 | 13.4 | 320 | 9.7 | 7,119.3 | -19% |
| Transportation Handling | 179,650 | 10.9 | 15.7 | 349 | 11.5 | 5,875.3 | -5% |
| Wholesale | 277,649 | 15.0 | 20.2 | 2,754 | 16.1 | 7,267.5 | -7% |
| **Overall** | **2,435,498** | **7.8** | **12.5** | **7,421** | **7.7** | **5,845.0** | 1% |

### All Industries

| | Simulation | | | Ohio GES | | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *Std. Dev.* | *N* | *Mean* | *Std. Dev.* |
| Goods | 458,435 | 10.8 | 9.1 | 3,643 | 11.8 | 12.3 |
| Service | 931,637 | 7.1 | 6.7 | 2,757 | 7.9 | 9.0 |
| Meeting | 1,045,426 | 7.1 | 6.7 | 1,021 | 5.7 | 8.6 |
| **Overall** | **2,435,498** | **7.8** | **7.2** | **7,421** | **7.7** | **9.6** |

### Goods

| | Simulation | | | Ohio GES | | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *Std. Dev.* | *N* | *Mean* | *Std. Dev.* |
| Agriculture | 133 | 11.8 | 8.9 | 142 | 8.2 | 12.1 |
| Construction | 22,606 | 7.5 | 6.6 | 218 | 7.9 | 8.4 |
| Government | 39,119 | 7.1 | 6.1 | 522 | 10.1 | 10.7 |
| Health | 4,139 | 6.1 | 5.3 | 77 | 3.6 | 4.8 |
| Hotel & Real Estate | 9,435 | 6.9 | 6.3 | 35 | 4.0 | 4.4 |
| Manufacturing | 3,018 | 8.4 | 7.4 | 156 | 11.2 | 15.5 |
| Other Services | 79,768 | 6.8 | 6.0 | 188 | 6.4 | 8.9 |
| Retail | 108,392 | 9.2 | 8.2 | 176 | 8.4 | 9.7 |
| Transportation Handling | 85,636 | 13.1 | 10.2 | 331 | 18.6 | 16.4 |
| Wholesale | 106,189 | 16.5 | 12.3 | 1,798 | 16.5 | 14.6 |
| **Overall** | **458,435** | **10.8** | **9.1** | **3,643** | **11.8** | **12.3** |

### Service

| | Simulation | | | Ohio GES | | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *Std. Dev.* | *N* | *Mean* | *Std. Dev.* |
| | 1,146 | 9.8 | 8.3 | 774 | 9.3 | 9.3 |
| | 73,732 | 6.5 | 6.1 | 272 | 5.8 | 7.4 |
| | 139,999 | 6.6 | 5.7 | 494 | 6.2 | 9.7 |
| | 70,600 | 5.5 | 5.0 | 195 | 4.4 | 5.3 |
| | 42,403 | 5.7 | 5.5 | 74 | 5.0 | 4.4 |
| | 4,227 | 6.4 | 6.8 | 41 | 7.3 | 6.0 |
| | 358,475 | 5.9 | 5.4 | 363 | 6.6 | 6.9 |
| | 113,092 | 7.3 | 7.5 | 100 | 10.2 | 9.9 |
| | 42,408 | 8.9 | 8.5 | 18 | 11.1 | 16.4 |
| | 85,555 | 14.1 | 11.4 | 426 | 17.3 | 13.9 |
| **Overall** | **931,637** | **7.1** | **6.7** | **2,757** | **7.9** | **9.0** |

### Meeting

| | Simulation | | | Ohio GES | | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *Std. Dev.* | *N* | *Mean* | *Std. Dev.* |
| | 1,241 | 10.7 | 9.0 | 92 | 10.9 | 12.9 |
| | 77,051 | 6.5 | 6.1 | 116 | 6.7 | 9.0 |
| | 152,615 | 6.7 | 5.7 | 96 | 3.4 | 6.0 |
| | 81,607 | 5.5 | 5.0 | 30 | 5.2 | 5.5 |
| | 50,255 | 5.7 | 5.5 | 21 | 6.7 | 8.5 |
| | 4,240 | 6.5 | 6.7 | 14 | 6.2 | 9.2 |
| | 379,513 | 5.9 | 5.4 | 78 | 3.4 | 6.5 |
| | 161,393 | 7.4 | 7.5 | 44 | 10.1 | 13.5 |
| | 51,606 | 8.9 | 8.4 | - | - | - |
| | 85,905 | 14.2 | 11.4 | 530 | 14.5 | 12.5 |
| **Overall** | **1,045,426** | **7.1** | **6.7** | **1,021** | **5.7** | **8.6** |

# Average Daily Stops per Employee

### All Activities

| | Simulation | | Ohio GES | | R = 0.94 |
|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *% Diff* |
| Agriculture | 254 | 1.0 | 87 | 0.9 | 5% |
| Construction | 27,512 | 0.5 | 106 | 0.5 | 0% |
| Government | 25,593 | 1.0 | 84 | 1.0 | 2% |
| Health | 31,011 | 0.4 | 56 | 0.4 | 1% |
| Hotel & Real Estate | 16,894 | 0.5 | 25 | 0.5 | -2% |
| Manufacturing | 2,211 | 0.4 | 32 | 0.4 | -4% |
| Other Services | 118,019 | 0.6 | 81 | 0.6 | -1% |
| Retail | 33,812 | 0.9 | 54 | 0.8 | 1% |
| Transportation Handling | 6,067 | 2.2 | 13 | 2.2 | 2% |
| Wholesale | 9,424 | 2.5 | 84 | 1.5 | 60% |
| **Overall** | **270,797** | **0.7** | **72** | **0.7** | 4% |

# Average Zones Visited

### All Activities

| | Simulation | | Ohio GES | | R = 1. |
|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *% Diff* |
| | 107 | 19.3 | 50 | 20.1 | -4% |
| | 11,237 | 13.1 | 49 | 12.4 | 6% |
| | 10,435 | 24.7 | 47 | 23.7 | 5% |
| | 15,419 | 9.4 | 34 | 8.9 | 5% |
| | 8,231 | 7.6 | 18 | 7.2 | 5% |
| | 817 | 8.3 | 26 | 8.1 | 2% |
| | 50,745 | 12.6 | 53 | 11.9 | 6% |
| | 15,106 | 9.9 | 34 | 9.4 | 5% |
| | 2,637 | 32.9 | 11 | 31.7 | 4% |
| | 3,286 | 53.1 | 51 | 54.0 | -2% |
| **Overall** | **118,020** | **14.2** | **373** | **13.5** | 5% |

# Vehicle Share (of Stops)

## All Activities

| | Simulation | | | | Ohio GES | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Light | Medium | Heavy | N | Light | Medium | Heavy |
| Agriculture | 2,520 | 66% | 30% | 4% | 1,008 | 40% | 52% | 8% |
| Construction | 173,389 | 86% | 12% | 3% | 606 | 71% | 22% | 8% |
| Government | 331,733 | 97% | 3% | 0% | 1,112 | 90% | 7% | 3% |
| Health | 156,346 | 76% | 17% | 7% | 302 | 96% | 4% | 0% |
| Hotel & Real Estate | 102,093 | 73% | 18% | 9% | 130 | 93% | 7% | 0% |
| Manufacturing | 11,485 | 47% | 33% | 21% | 211 | 36% | 35% | 29% |
| Other Services | 817,756 | 96% | 3% | 1% | 629 | 89% | 9% | 2% |
| Retail | 382,877 | 84% | 11% | 5% | 320 | 68% | 21% | 11% |
| Transportation Handling | 179,650 | 26% | 23% | 50% | 349 | 4% | 22% | 74% |
| Wholesale | 277,649 | 53% | 25% | 22% | 2,754 | 29% | 46% | 25% |
| **Overall** | **2,435,498** | **81%** | **11%** | **9%** | **7,421** | **72%** | **16%** | **12%** |

## All Industries

| | Simulation | | | | Ohio GES | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Light | Medium | Heavy | N | Light | Medium | Heavy |
| Goods | 458,435 | 48% | 21% | 30% | 3,643 | 50% | 30% | 21% |
| Service | 931,637 | 79% | 15% | 7% | 2,757 | 72% | 12% | 17% |
| Meeting | 1,045,426 | 97% | 2% | 1% | 1,021 | 91% | 4% | 1% |
| **Overall** | **2,435,498** | **81%** | **11%** | **9%** | **7,421** | **76%** | **12%** | **10%** |

## Goods

| | Simulation | | | | Ohio GES | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Light | Medium | Heavy | N | Light | Medium | Heavy |
| Agriculture | 133 | 22% | 58% | 20% | 142 | 47% | 46% | 7% |
| Construction | 22,606 | 63% | 27% | 10% | 218 | 67% | 26% | 8% |
| Government | 39,119 | 91% | 7% | 2% | 522 | 93% | 6% | 1% |
| Health | 4,139 | 34% | 33% | 34% | 77 | 97% | 3% | 0% |
| Hotel & Real Estate | 9,435 | 32% | 33% | 35% | 35 | 89% | 11% | 0% |
| Manufacturing | 3,018 | 14% | 41% | 45% | 156 | 36% | 25% | 39% |
| Other Services | 79,768 | 86% | 9% | 5% | 188 | 90% | 6% | 4% |
| Retail | 108,392 | 64% | 23% | 13% | 176 | 70% | 27% | 2% |
| Transportation Handling | 85,636 | 4% | 21% | 76% | 331 | 4% | 23% | 73% |
| Wholesale | 106,189 | 24% | 32% | 43% | 1,798 | 10% | 68% | 22% |
| **Overall** | **458,435** | **48%** | **21%** | **30%** | **3,643** | **50%** | **30%** | **21%** |

## Service

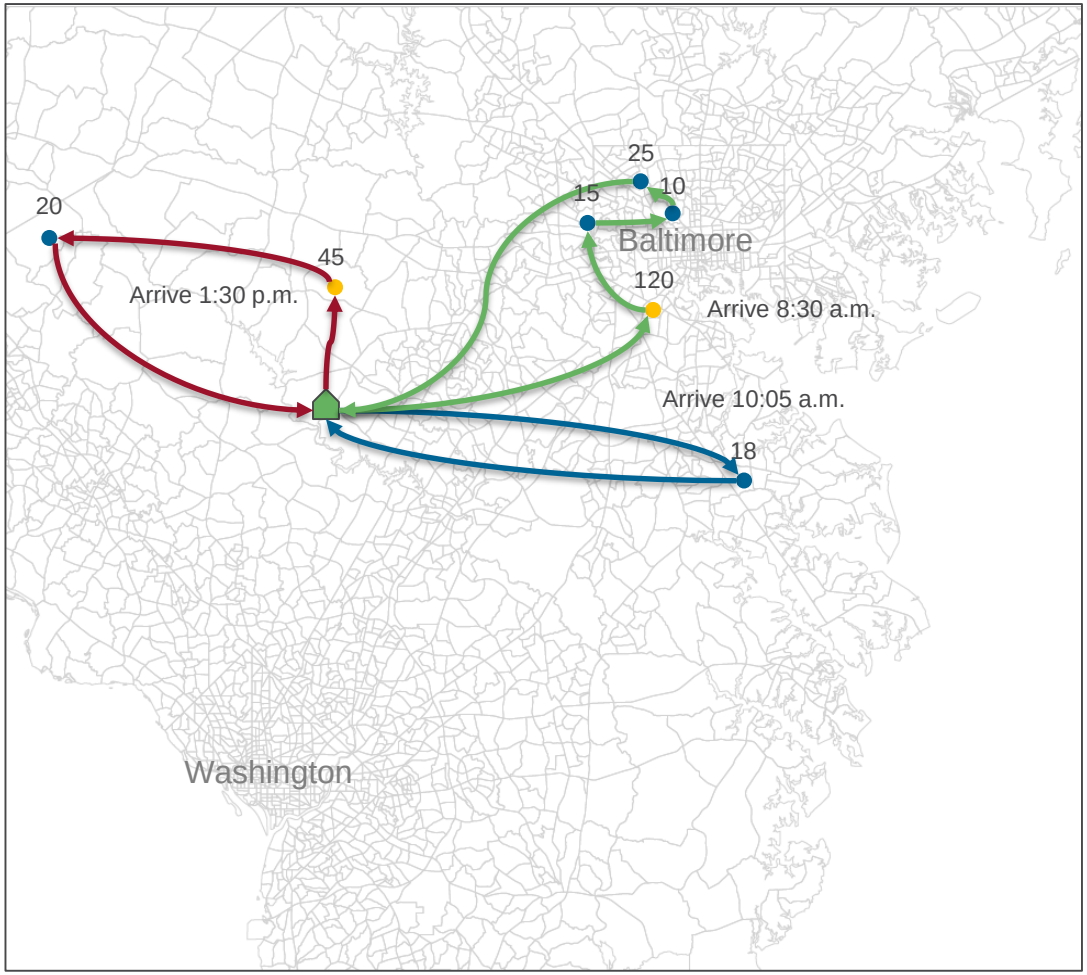
| | Simulation | | | | Ohio GES | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Light | Medium | Heavy | N | Light | Medium | Heavy |
| Agriculture | 1,146 | 43% | 51% | 6% | 774 | 36% | 56% | 8% |
| Construction | 73,732 | 80% | 18% | 3% | 272 | 67% | 22% | 11% |
| Government | 139,999 | 95% | 4% | 0% | 494 | 86% | 8% | 6% |
| Health | 70,600 | 57% | 31% | 13% | 195 | 95% | 5% | 0% |
| Hotel & Real Estate | 42,403 | 57% | 30% | 13% | 74 | 95% | 5% | 0% |
| Manufacturing | 4,227 | 30% | 48% | 22% | 41 | 17% | 83% | 0% |
| Other Services | 358,475 | 94% | 5% | 1% | 363 | 86% | 12% | 1% |
| Retail | 113,092 | 82% | 15% | 3% | 100 | 53% | 18% | 29% |
| Transportation Handling | 42,408 | 13% | 36% | 51% | 18 | 0% | 0% | 100% |
| Wholesale | 85,555 | 48% | 34% | 18% | 426 | 24% | 8% | 68% |
| **Overall** | **931,637** | **79%** | **15%** | **7%** | **2,757** | **72%** | **12%** | **17%** |

## Meeting

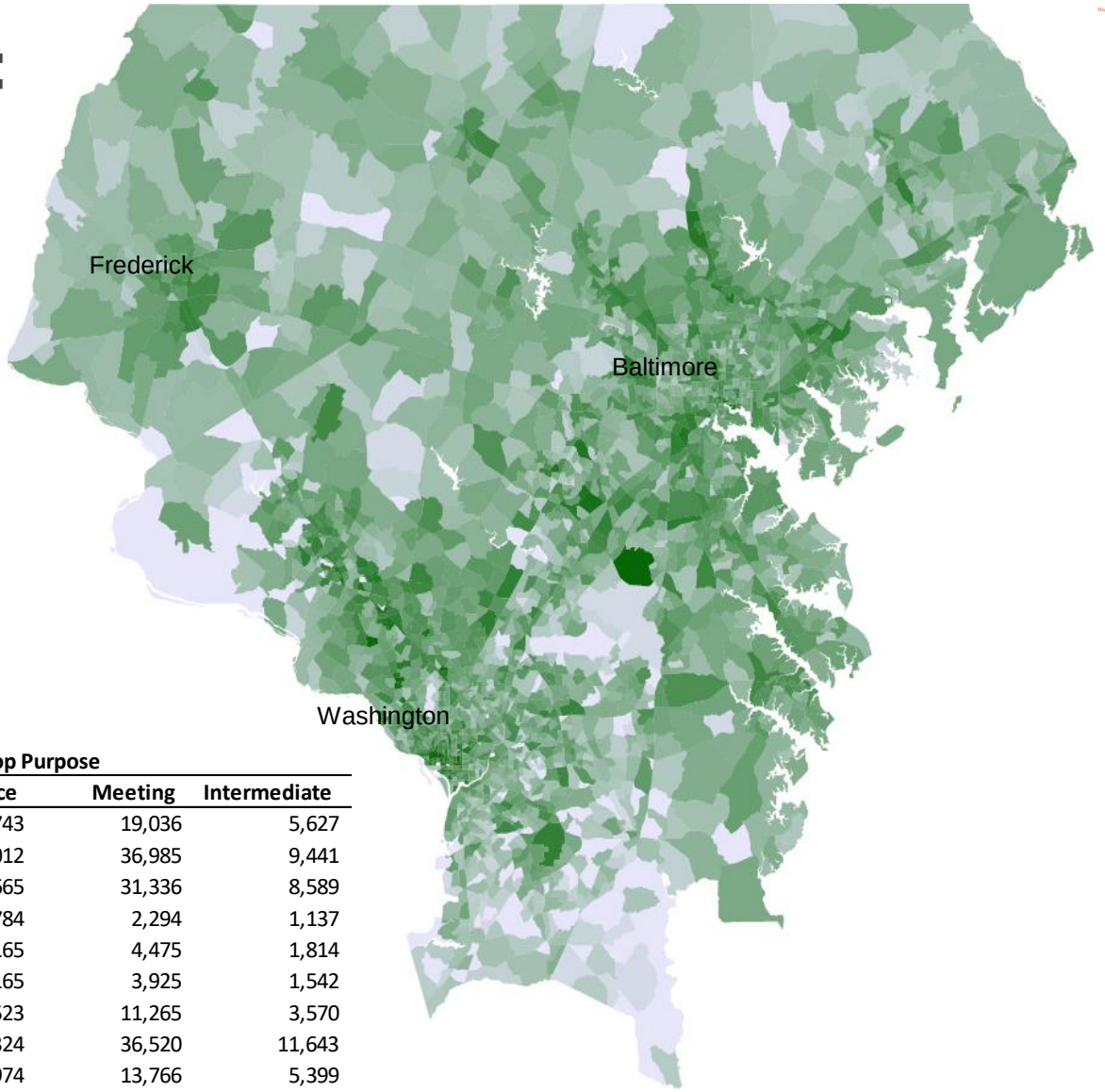
| | Simulation | | | | Ohio GES | | | |
|---|---|---|---|---|---|---|---|---|
| | N | Light | Medium | Heavy | N | Light | Medium | Heavy |
| Agriculture | 1,241 | 92% | 8% | 0% | 92 | 66% | 24% | 10% |
| Construction | 77,051 | 98% | 2% | 0% | 116 | 88% | 12% | 0% |
| Government | 152,615 | 100% | 0% | 0% | 96 | 93% | 6% | 1% |
| Health | 81,607 | 95% | 4% | 1% | 30 | 100% | 0% | 0% |
| Hotel & Real Estate | 50,255 | 95% | 4% | 1% | 21 | 95% | 5% | 0% |
| Manufacturing | 4,240 | 87% | 12% | 1% | 14 | 100% | 0% | 0% |
| Other Services | 379,513 | 100% | 0% | 0% | 78 | 96% | 4% | 0% |
| Retail | 161,393 | 99% | 1% | 0% | 44 | 95% | 2% | 2% |
| Transportation Handling | 51,606 | 75% | 18% | 8% | - | 0% | 0% | 0% |
| Wholesale | 85,905 | 94% | 6% | 1% | 530 | 99% | 1% | 0% |
| **Overall** | **1,045,426** | **97%** | **2%** | **1%** | **1,021** | **91%** | **4%** | **1%** |

# BMC Commercial Vehicle Component

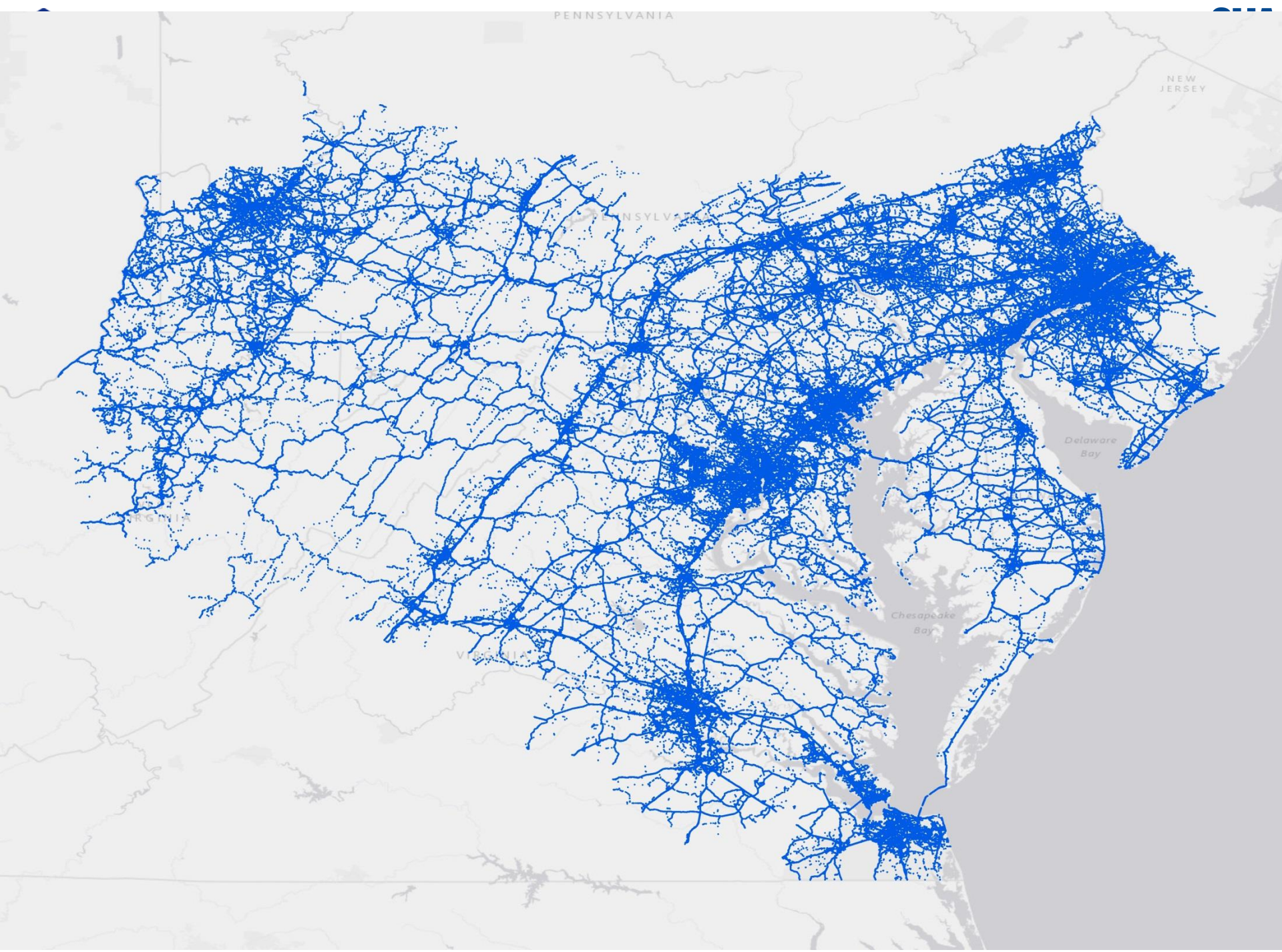
*A portion of the model area*



# Freight Model: Outputs



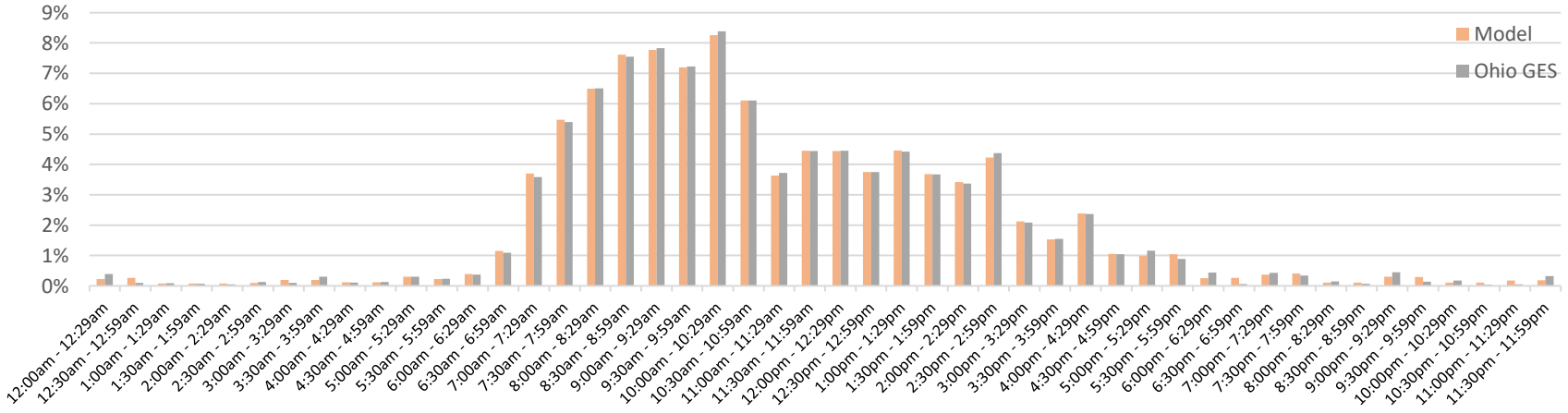

| | Stop Purpose | | | |
|---|---|---|---|---|
| **County** | **Goods** | **Service** | **Meeting** | **Intermediate** |
| Anne Arundel County, MD | 28,972 | 30,743 | 19,036 | 5,627 |
| Baltimore City, MD | 29,781 | 57,012 | 36,985 | 9,441 |
| Baltimore County, MD | 40,935 | 58,665 | 31,336 | 8,589 |
| Carroll County, MD | 3,467 | 6,784 | 2,294 | 1,137 |
| Frederick County, MD | 5,802 | 11,165 | 4,475 | 1,814 |
| Harford County, MD | 4,124 | 10,165 | 3,925 | 1,542 |
| Howard County, MD | 17,811 | 21,523 | 11,265 | 3,570 |
| Montgomery County, MD | 56,734 | 83,324 | 36,520 | 11,643 |
| Prince George's County, MD | 19,881 | 31,974 | 13,766 | 5,399 |
| District of Columbia | 52,629 | 143,370 | 70,374 | 19,004 |
| **Total** | **260,136** | **454,725** | **229,976** | **67,766** |


PENNSYLVANIA
NEW JERSEY
Delaware Bay
Chesapeake Bay

# Freight Model: Outputs

**Vehicle Shares (All Activities)**

| | Simulation | | | | Ohio GES | | | |
|---|---|---|---|---|---|---|---|---|
| | *N (stops)* | *Light* | *Medium* | *Heavy* | *N (stops)* | *Light* | *Medium* | *Heavy* |
| **Agriculture** | 688 | 40% | 53% | 7% | 1,007 | 40% | 52% | 8% |
| **Construction** | 82,675 | 71% | 22% | 8% | 606 | 71% | 22% | 8% |
| **Government** | 49,513 | 90% | 7% | 3% | 1,112 | 90% | 7% | 3% |
| **Health** | 61,102 | 96% | 4% | 0% | 302 | 96% | 4% | 0% |
| **Hotel & Real Estate** | 36,115 | 93% | 7% | 0% | 130 | 93% | 7% | 0% |
| **Manufacturing** | 7,373 | 37% | 35% | 28% | 211 | 36% | 35% | 29% |
| **Other Services** | 247,519 | 89% | 10% | 2% | 629 | 89% | 9% | 2% |
| **Retail** | 249,715 | 68% | 21% | 11% | 320 | 68% | 21% | 11% |
| **Transportation Handling** | 35,051 | 4% | 22% | 74% | 349 | 4% | 22% | 74% |
| **Wholesale** | 46,368 | 29% | 46% | 25% | 2,754 | 29% | 46% | 25% |
| **Overall** | **816,119** | **74%** | **16%** | **10%** | **7,420** | **74%** | **18%** | **8%** |



# Freight Model: Applications / Implementation - BMC

- **Modeling**
  - Assess travel and economic benefits of freight infrastructure improvements
  - Create visuals of Goods and service delivery at TAZ-level
- **Environmental**
  - Emissions analysis (additional detail on vehicle type for freight travel)
  - Enhanced mode choice capability (addition of rail, water and air cargo modes)
- **Stakeholder Outreach**
  - Address local issues with last mile access and egress to freight facilities
  - Assess rail access constraints in Baltimore region

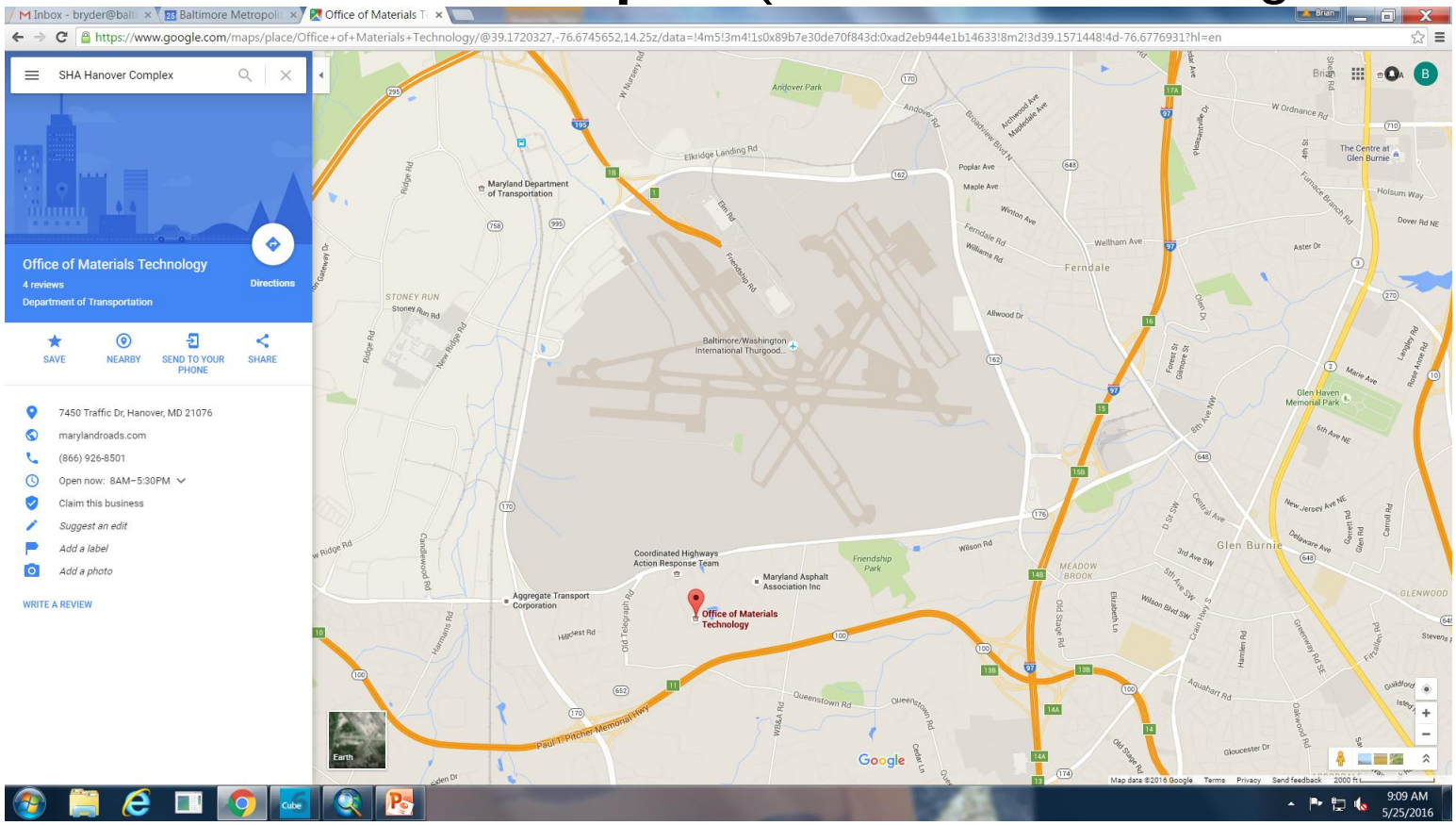
# Freight Model: Applications / Implementation - SHA

- **Modeling**
  - Volume and value of freight flows (current and future)
- **Trends**
  - Effect of supply chains, supply-demand interactions, external variables and agency policies
  - Balancing of goods and people movement, relation of freight to regional, statewide and national economy
- **Performance Management**
  - Infrastructure needs, effects for freight movement and economic value added
  - Communication and messaging of transportation investments

# Freight Stakeholder Briefing

## Friday, June 17th – 10:00 am to 12:00 pm

**SHA Hanover Complex** (OMT/OOC Training 3 O134)



# Contacts

www.rsginc.com

## Agency Contacts

### BMC

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