Welcome

Topics to be discussed (times approximate):

- Introduction, Background and Review – 10 minutes
  • Q&A
- Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor – 15 minutes
  • Q&A
- Regional Travel Demand Model and Forecasts – 40 minutes
  • Four (4) Q&A Sections
- 2040 No-Build Traffic Volumes for MD 355 Corridor – 15 minutes
  • Q&A
- MD 355 Traffic Operations (Existing and 2040 No-Build) – 30 minutes
  • Q&A
- MD 355 Crash History Data – 10 minutes
  • Q&A
- Additional Technical Q&A

Note: Each topic will include multiple question and answer sections. Please hold questions and comments until the Questions slide is shown.
Introduction – Purpose of this Meeting

The goal of this special event is to:

- Review and explain detailed technical information associated with Travel Demand and Ridership Forecasting and Traffic Operations Analyses.

- Provide specific information about how we: collect and use existing data; describe the analysis tools and prediction models we use; and explain how the output information is used to as part of the planning process.

- Respond to questions and concerns members may have about our processes through direct interaction with our engineers and forecasting specialists.
Background – Why We Have a Process

- Forecasting methodologies are continuously evolving and may differ slightly from project to project.

- Issues raised can be technical or process-related:
  - what work was done?
  - what assumptions were made or input used?
  - how the methods and approaches were chosen?

- This process is mainly driven by established best-practices and professional experience.

- Lead Federal Agencies provide guidance to encourage improvement in the state-of-the-practice in relation to how project-level forecasting is applied using approved models developed by local Metropolitan Planning Organizations.
Travel and land use forecasting is critical to project development and overall National Environmental Policy Act (NEPA) processes.

Forecasts provide important information to project managers and decision-makers, and provide foundations for determining purpose and need.

They are essential in evaluating:

- Alternative performance based on evaluation criteria
- Environmental impacts such as noise and safety (based on traffic volume or exposure) and emissions (based on traffic volume and speed)
- Land development effects (change in land development patterns due to changes in accessibility)
- Indirect and/or cumulative effects (such as watershed effects)
Review – Previously Discussed Topics

- Existing and forecasted 2040 No-Build traffic volumes for MD 355
- Intersection LOS and corridor travel times along MD 355
- Existing and forecasted 2040 No-Build trip patterns for MD 355 corridor
- Trends in transit ridership for the MD 355 corridor
- Overview of data and modeling processes used
Review – Feedback We Have Heard From the CAC

- Provide more background of where data comes and how it is processed
- Review the history of traffic volumes in the MD 355 corridor
- Discuss the data inputs to the modeling process, including land use and transportation network assumptions
- Explain the model processes, outputs, and analysis results in more detail
- Need more understanding of data pertaining to trip patterns (i.e. thru trips, average trip lengths)
Review – Travel Forecasting Process

PROJECT INITIATION - Define Study Area

Select Travel Forecasting Model (MWCOG, BMC, MSTM or other)

Study Area Calibration and Validation of Forecasting Model for Transit and Highway

Travel Demand Forecasting for Future Alternatives

Transit (Person Ridership)

Post-Processing to Station Level Ridership

OUTPUT
Future Corridor Level Transit Ridership

Highway (Vehicular Volumes)

NCHRP 765 & NCHRP 255 Post Processing

OUTPUT
Future Traffic Volumes (ADT & Peak Hour)
Questions: Review

✓ Introduction, Background and Review
  ▪ Q&A
  ▪ Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
  ▪ Regional Travel Demand Model and Forecasts
  ▪ 2040 No-Build Traffic Volumes for MD 355 Corridor
  ▪ MD 355 Traffic Operations (Existing and 2040 No-Build)
  ▪ MD 355 Crash History Data
  ▪ Additional Technical Q&A
Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor

Topics to be discussed:

- Sources of Data and SHA Methodology
- Existing Volumes for MD 355
- Comparisons to Historic Volume Data on MD 355
Sources of Traffic Count Data

Standard Practice for SHA:

- Traffic counts (cars, trucks, and pedestrians) are from the Maryland State Highway Administration’s Traffic Monitoring System (TMS) ([http://shagbhisdadt.mdot.state.md.us/itms_Public/default.aspx](http://shagbhisdadt.mdot.state.md.us/itms_Public/default.aspx))

- Manual intersection counts are typically done for 13-hour periods (6 AM to 7 PM), and machine (tube) counts are usually done for 48 hours.

Sources of Volume Data – 13 Hour Intersection Count

| Station ID: | S1998150177 |
| Date: | Thursday 09/18/2014 |
| Location: | MD 355 at MD 547 |
| Comments: LOS AM:(0.77) PM:D(0.85) |

### PEAK HOURS

| Interval (dd): | 15 min |

| Station ID: | S1998150177 |
| County: | Montgomery |
| Town: | none |
| Weather: | Clear |

#### MD 355

| Hour Begin | From North | | | From South | | | From East | | | From West | | | Strathmore Rd | | | Grand Total |
|-------------|------------|-----------------|-----------------|------------|-----------------|-----------------|------------|-----------------|-----------------|------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 6:00        | 0          | 5               | 193             | 0           | 1               | 168             | 19             | 188             | 0               | 11              | 1               | 17              | 28              | 1               | 1               | 1               | 1               | 2               | 413             |
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| 6:30        | 0          | 16              | 270             | 3            | 2               | 153             | 31             | 193             | 0               | 60              | 2               | 17              | 77              | 0               | 1               | 1               | 8               | 10              | 568             |
| 6:45        | 0          | 37              | 297             | 9            | 4               | 184             | 48             | 238             | 0               | 78              | 1               | 19              | 98              | 0               | 3               | 2               | 8               | 37              | 716             |
| 7:00        | 0          | 39              | 396             | 12           | 4               | 219             | 89             | 310             | 0               | 151             | 4               | 26              | 181             | 0               | 2               | 2               | 2               | 6               | 944             |
| 7:15        | 0          | 66              | 385             | 7            | 4               | 228             | 148            | 588             | 0               | 167             | 8               | 32              | 207             | 0               | 3               | 0               | 6               | 8               | 1092            |
| 7:30        | 0          | 51              | 479             | 14           | 2               | 216             | 86             | 280             | 0               | 167             | 9               | 32              | 238             | 0               | 4               | 12              | 6               | 24              | 1087            |
| 7:45        | 0          | 49              | 486             | 16           | 3               | 289             | 66             | 359             | 0               | 174             | 6               | 36              | 217             | 0               | 6               | 3               | 3               | 11              | 1117            |
| 8:00        | 0          | 38              | 486             | 18           | 6               | 216             | 68             | 284             | 0               | 157             | 8               | 98              | 182             | 0               | 8               | 17              | 8               | 91              | 1010            |
| 8:15        | 0          | 28              | 348             | 6            | 0               | 201             | 70             | 382             | 0               | 108             | 5               | 41              | 149             | 0               | 0               | 3               | 3               | 910             |
| 8:30        | 0          | 28              | 382             | 3            | 3               | 271             | 68             | 342             | 0               | 115             | 1               | 34              | 150             | 0               | 1               | 0               | 4               | 899             |
| 8:45        | 0          | 65              | 340             | 3            | 0               | 300             | 48             | 356             | 0               | 95              | 0               | 53              | 148             | 0               | 2               | 12              | 30              | 44              | 950             |
| 9:00        | 0          | 47              | 345             | 6            | 0               | 295             | 63             | 361             | 0               | 114             | 1               | 65              | 180             | 0               | 0               | 1               | 2               | 11              | 950             |
| 9:15        | 0          | 44              | 281             | 1            | 3               | 325             | 39             | 365             | 0               | 84              | 2               | 50              | 134             | 0               | 2               | 10              | 6               | 18              | 843             |
| 9:30        | 0          | 39              | 283             | 4            | 2               | 320             | 55             | 401             | 0               | 84              | 1               | 38              | 93              | 0               | 4               | 11              | 12              | 27              | 843             |
| 9:45        | 0          | 39              | 283             | 4            | 2               | 320             | 55             | 401             | 0               | 84              | 1               | 38              | 93              | 0               | 4               | 11              | 12              | 27              | 843             |
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| 10:15       | 0          | 41              | 272             | 5            | 2               | 326             | 35             | 295             | 0               | 45              | 2               | 35              | 79              | 0               | 1               | 0               | 5               | 11              | 573             |
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| 10:45       | 0          | 39              | 203             | 0            | 2               | 276             | 17             | 295             | 0               | 68              | 0               | 40              | 108             | 0               | 1               | 0               | 4               | 5               | 650             |
Sources of Volume Data – 48 Hour Class Count

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Total: 103, 15,941, 1,666, 221, 456, 35, 0, 43, 18, 1, 0, 0, 2, 18,486

Percentage: 0.56%, 86.23%, 0.01%, 1.20%, 2.47%, 0.19%, 0.00%, 0.23%, 0.10%, 0.01%, 0.00%, 0.00%, 0.00%, 0.01%

Total Class 1-3: 17,710, Percent Class 1-3: 95.80%, Total Class 4: 221, Percent Class 4: 1.20%, Total Class 5-13: 555, Percent Class 5-13: 3.00%
Existing Daily MD 355 Traffic Volumes

Clarksburg

Germantown
Existing Daily MD 355 Traffic Volumes
Existing MD 355 Traffic Volumes

Peak Hour Traffic Trends

- Traffic volumes in the peak direction range between 500-700 vehicles per hour near MD 121 to over 3,000 per hour just south of the Beltway

- AM Peak Directional Distribution –
  - 70-80% from Rockville to Clarksburg
  - 60-70% south of Rockville down through Bethesda

- PM Peak Directional Distribution –
  - 70-80% in Clarksburg
  - 60-70% in Germantown and Gaithersburg
  - 50-60% from Rockville down to Bethesda

- Time of Peaks –
  - AM Peak generally ranges from 7:00-8:00 around Clarksburg to 8:00-9:00 in Bethesda
  - PM Peak generally occurs between 5:00-6:00 for the entire project corridor
History of Traffic Volumes on MD 355 (2004-2014)
History of Traffic Volumes on MD 355

- Traffic volumes part of SHA counting program - taken every three years – estimated for years in between
- Isolated 48-hour counts – provides snapshot at specific points – can be impacted by weather, traffic incidents
- Not intended for analysis – provides a snapshot of conditions and is used for Federal system reporting
- Traffic volumes have been generally stagnant past decade
  - Graph shows decreases typically occurred in late 2000’s
  - Volumes generally rebounded to pre-recession volumes (mirrors Maryland and national trend)
    - 2004-2009 traffic – average of 4.7% decrease
    - 2009-2014 traffic – average of 1.4 % increase
History of Traffic Volumes on MD 355

- 2015 MD 355 BRT study traffic volumes developed using traffic counts along entire corridor instead of spot locations
- Study volumes balanced to account for daily variations in traffic
- Study volumes are the official volumes that will be used for analyses in this process
- Will conduct new count at MD 355 / Little Seneca intersection – potential for volume changes since recent counts
Existing Traffic Volumes and Traffic Volume History

Key Takeaways:

- Existing traffic volumes are based on recent 13-hour intersection counts and 48-hour machine counts
- Traffic Volumes differ greatly for different sections of MD 355
- Directionality of peak traffic increases toward the north end of project area
- SHA Program count volumes have been stagnant the last decade along MD 355
- Volumes developed for this project are the official volumes being used for this study
Questions: Existing Traffic & Traffic History

- Introduction, Background and Review
- Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
  - Q&A
- Regional Travel Demand Model and Forecasts
- 2040 No-Build Traffic Volumes for MD 355 Corridor
- MD 355 Traffic Operations (Existing and 2040 No-Build)
- MD 355 Crash History Data
- Additional Technical Q&A
Regional Travel Demand Model and Forecasts Agenda

Topics to be discussed:

- Travel Demand Forecasting Overview and Four-Step Model
- Overview of the Metropolitan Washington Council of Governments (MWCOG) Regional Travel Demand Model
- Model Inputs & Assumptions
- Model Outputs
Travel Demand Forecasting: Overview

What is Travel Demand Forecasting?

- Computer models that predict:
  - Travel Patterns
  - Traffic Volumes
  - Transit Ridership

- Based on changes to:
  - Transportation networks (highway or transit)
  - Land Use (density, intensity, mix of employment/residential)

- The prediction process can be done at a Region, Statewide, or Local level; each providing their own level of detail.

- The MD 355 corridor is being modeled using a regional model using the MWCOG model customized for the MD 355 study area
Travel Demand Forecasting: Applications

What do we use Travel Demand Forecasting for?

- Ridership Forecasting and New Starts/Small Starts Applications
- Project Planning and Corridor Studies
- Long Range Transportation Planning
- Air Quality Conformity Determination
- Transportation Improvement Program (TIP)
- Scenario Analysis
- Subarea Studies
Travel Demand Model: Four Step Model

- **Trip generation** - How many trips are generated in the region?
- **Trip distribution** - Where do the trips go within the region as well as outside the region?
- **Mode choice** - What travel mode is used for each trip? (ex. bus or walk)
- **Trip Assignment** - What is the route of each trip?

Use of Four Step Models is Industry Standard in the Washington Region

Graphic from Meyer & Miller (2001), p. 272
Source: MWCOG
Questions: Travel Demand Forecasting Overview

- Introduction, Background and Review
- Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
- Regional Travel Demand Model and Forecasts
  - Travel Demand Forecasting Overview and Four-Step Model
    - Overview of the Metropolitan Washington Council of Governments (MWCOG) Regional Travel Demand Model
    - Model Inputs & Assumptions
    - Model Outputs
  - 2040 No-Build Traffic Volumes for MD 355 Corridor
  - MD 355 Traffic Operations (Existing and 2040 No-Build)
  - MD 355 Crash History Data
  - Additional Technical Q&A
Metropolitan Washington Council of Governments Regional Demand Model

- Metropolitan Washington Council of Governments (MWCOG) regional demand model is being used in the forecasting process (http://www.mwcog.org/)

- Four-step model calibrated to replicate travel conditions in the Metropolitan region

- Additional validation conducted for conditions on the MD 355 corridor

- Latest officially adopted regional model (v 2.3.57) and planning assumptions (Round 8.3) used
Travel Demand Forecasting: Model Area

- 6,800 sq. mi.
- 22 jurisdictions
- Includes DC, and portions of Maryland, Virginia, and West Virginia
Metropolitan Washington Council of Governments Regional Demand Model

- MWCOG Round 8.3 Cooperative Land Use Forecasts (officially adopted October 2014) used as latest population and employment forecast
  - Land Use is a major input to the model – affects all four steps of the modeling process – forecasts include:
    - Population
    - Households
    - Employment by type (office, retail, industrial, other)
  - MWCOG Land Use forecasts developed using regional “top-down” and local “bottom-up” approach
  - Local projections based on Montgomery County Master Plan and Pipeline developments
Travel Demand Model: Calibration and Validation

- Calibrates and validates all steps of the model to observed data:
  - Traffic Counts
  - Transit Ridership counts
  - Census Data
  - Household Travel Surveys

- Final results validated to match
  - Traffic volumes across regional screenlines
  - Metrorail boardings by station group
  - Regional transit boardings

- MD 355 corridor specific validation
  - Traffic volumes across corridor screenlines
  - Ridership on existing corridor transit services
    - Ridership on corridor Ride On and Metrobus Routes
    - Metrorail Red Line station boardings

Source: MWCOG
Questions: MWCOG Model Overview

- Introduction, Background and Review
- Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
- Regional Travel Demand Model and Forecasts
  - Travel Demand Forecasting Overview and Four-Step Model
  - Overview of the Metropolitan Washington Council of Governments (MWCOG) Regional Travel Demand Model
    - Model Inputs & Assumptions
    - Model Outputs
  - 2040 No-Build Traffic Volumes for MD 355 Corridor
  - MD 355 Traffic Operations (Existing and 2040 No-Build)
  - MD 355 Crash History Data
  - Additional Technical Q&A
MWCOG Model Inputs and Assumptions

- Population and Employment Forecasts
  - Guides ultimate output of each step of the model
  - Dictates how many trips are generated by the model of each purpose
  - Regional growth estimated and allocated through regional cooperative process
    - Updated Cooperative Land Use Forecasts updated approximately each year (Currently Round 8.3)
    - Maryland National Capital Park and Planning Commission provides estimates within Montgomery County based on:
      - Review of building permits
      - Projects in development pipeline
      - Long-term planned developments/redevelopments
MWCOG Model Inputs: Study Area

- Study Area: Focus for analysis and results
  - Full region is modeled; study area focuses results on an area of interest

- The study area is selected to capture areas most likely to be affected by an improvement (BRT)

- MD 355 Study Area includes 127 Transportation Analysis Zones (TAZs)
  - Out of 3722 regionally
  - Out of 375 in Montgomery County
MWCOG Model Inputs: TAZs

- All model steps are aggregated to TAZs that represent relatively small geographic areas
  - MWCOG Model region includes 3722 TAZs (375 TAZs in Montgomery County)
  - TAZs smaller in denser areas, larger in less developed areas

- Land Use Forecasts developed at TAZ level
  - Population
  - Households
  - Employment by Type
MWCOG Model Inputs: Population Growth

- **Study Area:**
  - 308,100 residents in 2014 (30% of County Total)
  - 409,300 residents in 2040 (34% of County Total)

- **33 percent population increase in Study Area**
  - Largest increase in District 2 (around White Flint area)
  - Most districts show higher growth than County average

### Population Growth (2014-2040)

<table>
<thead>
<tr>
<th>District</th>
<th>2014</th>
<th>2040</th>
<th>Growth</th>
<th>Percent Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>87,900</td>
<td>101,800</td>
<td>13,900</td>
<td>15.9%</td>
</tr>
<tr>
<td>2</td>
<td>80,200</td>
<td>122,700</td>
<td>42,500</td>
<td>53.0%</td>
</tr>
<tr>
<td>3</td>
<td>48,000</td>
<td>68,000</td>
<td>20,000</td>
<td>41.5%</td>
</tr>
<tr>
<td>4</td>
<td>66,000</td>
<td>76,200</td>
<td>10,200</td>
<td>15.5%</td>
</tr>
<tr>
<td>5</td>
<td>26,000</td>
<td>40,600</td>
<td>14,600</td>
<td>56.2%</td>
</tr>
<tr>
<td>Total</td>
<td>308,100</td>
<td>409,300</td>
<td>101,200</td>
<td>32.9%</td>
</tr>
<tr>
<td>County Total</td>
<td>1,011,000</td>
<td>1,213,000</td>
<td>202,000</td>
<td>20.0%</td>
</tr>
</tbody>
</table>
MWCOG Model Inputs: Employment Growth

- **Study Area:**
  - 282,800 jobs in 2014 (54% of County Total)
  - 369,200 jobs in 2040 (50% of County Total)

- 28 percent increase in Study Area
  - Largest increase in District 2 (around White Flint area)
  - Only District 2 shows higher growth rate than County average

<table>
<thead>
<tr>
<th>District</th>
<th>2014</th>
<th>2040</th>
<th>Growth</th>
<th>Percent Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>94,500</td>
<td>114,100</td>
<td>17,600</td>
<td>20.1%</td>
</tr>
<tr>
<td>2</td>
<td>84,600</td>
<td>122,100</td>
<td>37,500</td>
<td>46.7%</td>
</tr>
<tr>
<td>3</td>
<td>61,300</td>
<td>78,700</td>
<td>17,400</td>
<td>36.3%</td>
</tr>
<tr>
<td>4</td>
<td>30,600</td>
<td>39,500</td>
<td>8,900</td>
<td>28.0%</td>
</tr>
<tr>
<td>5</td>
<td>9,800</td>
<td>14,800</td>
<td>5,000</td>
<td>19.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>282,800</td>
<td>369,200</td>
<td>86,300</td>
<td>28.0%</td>
</tr>
<tr>
<td><strong>County Total</strong></td>
<td>528,000</td>
<td>738,000</td>
<td>210,000</td>
<td>39.8%</td>
</tr>
</tbody>
</table>
MWCOG Model Inputs: Networks

- Highway Network replicates Regional Roadway system
  - Includes facilities that accommodate regional traffic: freeways, arterials, collectors, etc.

- Local roadways within TAZs not included in model
  - Replaced by representative connections neighborhood streets to highway network (centroid connectors)

- Each roadway includes important attributes used to make routing decisions:
  - Capacity
  - Distance
  - Cost (i.e. tolls)
  - Use restrictions (i.e. HOV2)
MWCOG Model Inputs: Networks

- Future Transportation Networks
  - Include all existing facilities and services
  - Adds key facilities for 2040 based on 2014 MWCOG Constrained Long Range Plan (CLRP), including:
    - Purple Line from Bethesda to New Carrollton
    - Corridor Cities Transitway (CCT) from Shady Grove to COMSAT
    - I-270/US 15 HOV Lanes Extension
    - I-270/Watkins Mill Road Interchange
    - Mid-County Highway Extension from MD 27 to Montgomery Village Avenue
    - Connection of Little Seneca Parkway with Observation Drive
    - Construct Snowden Farm Parkway from MD 355 to MD 27

Source: MWCOG CLRP

montgomerycountymd.gov/rts
MWCOG Model Inputs: Networks

- Transit Network includes all public transportation modes
  - Metrorail, Commuter Rail, Metrobus, Ride-On
    - Physical transit facilities (stops/stations, dedicated runningways)
    - Travel times including wait times, transfer times, station access times, etc.)
    - Costs (Fares, parking costs)
  - Attributes used to calculate travel time by time of day for use in mode choice and trip assignment
Model Inputs: Representation of Transit Systems

Walk or drive to BRT

Walk to feeder bus

(transfer from Feeder bus to BRT)

Walk from BRT bus to destination
Questions: Model Inputs and Assumptions

✓ Introduction, Background and Review
✓ Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
✓ Regional Travel Demand Model and Forecasts
  ✓ Travel Demand Forecasting Overview and Four-Step Model
  ✓ Overview of the Metropolitan Washington Council of Governments (MWCOG) Regional Travel Demand Model
  ✓ Model Inputs & Assumptions
    • Model Outputs
      ▪ 2040 No-Build Traffic Volumes for MD 355 Corridor
      ▪ MD 355 Traffic Operations (Existing and 2040 No-Build)
      ▪ MD 355 Crash History Data
      ▪ Additional Technical Q&A
MWCOG Model Outputs

- Overall
  - Trip productions and attractions
  - Trip origins and destinations
  - Trips by mode

- Roadway
  - Roadway volumes by time of day

- Transit
  - Total daily ridership on Build Alternative BRT
    - Boardings and Alightings by Stop
    - Mode of Access at Stations
    - Park-and-Ride usage
  - Passenger loads
  - New transit trips/change in transit mode share

Future Bus Ridership (2040)
Study Area Travel Markets

- Travel **to/from** the Study Area
- Travel **through** the Study Area
- Travel **within** the Study Area
Travel Markets: To/From Study Area

- Daily Trips to/from the Study Corridor (2040):

<table>
<thead>
<tr>
<th></th>
<th>Total Daily Trips</th>
<th>Percent Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>178,900</td>
<td>38%</td>
</tr>
<tr>
<td>Frederick County</td>
<td>59,900</td>
<td>4%</td>
</tr>
<tr>
<td>West Montgomery</td>
<td>437,700</td>
<td>7%</td>
</tr>
<tr>
<td>East Montgomery</td>
<td>390,900</td>
<td>8%</td>
</tr>
</tbody>
</table>

Source: 2040 No-Build Analysis, MWCOG
## Travel Markets: To/From Study Area

- **Daily Trips to/from the Study Corridor (2040):**

<table>
<thead>
<tr>
<th>Area</th>
<th>Total Daily Trips</th>
<th>Percent Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>178,900</td>
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<td>4%</td>
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</tr>
<tr>
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<td>8%</td>
</tr>
</tbody>
</table>

Source: 2040 No-Build Analysis, MWCOG
Travel Markets: To/From Study Area

- Daily Trips to/from the Study Corridor (2040):

<table>
<thead>
<tr>
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<th>Percent Transit</th>
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</thead>
<tbody>
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<tr>
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<tr>
<td>West Montgomery</td>
<td>437,700</td>
<td>7%</td>
</tr>
<tr>
<td>East Montgomery</td>
<td>390,900</td>
<td>8%</td>
</tr>
</tbody>
</table>

- An additional 300,000 trips are made between other portions of Montgomery County and DC

Source: 2040 No-Build Analysis, MWCOG
Travel Markets: Through Trips

- Commute Trips from Frederick County to DC make up a small portion of commute trips in the region
  - Less than 4% of commuters from Frederick County commute to DC
  - More than 25% of commuters from Frederick County commute to Montgomery County
  - Approximately 24% of Montgomery County commuters travel to DC

<table>
<thead>
<tr>
<th>From/To</th>
<th>District of Columbia</th>
<th>Frederick, MD</th>
<th>Howard, MD</th>
<th>Montgomery, MD</th>
<th>Prince George's, MD</th>
<th>Other</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>District of Columbia</td>
<td>160,090</td>
<td>35</td>
<td>570</td>
<td>20,930</td>
<td>15,015</td>
<td>28,330</td>
<td>224,970</td>
</tr>
<tr>
<td>Frederick, MD</td>
<td>4,080</td>
<td>60,050</td>
<td>2,300</td>
<td>26,045</td>
<td>1,590</td>
<td>9,063</td>
<td>103,128</td>
</tr>
<tr>
<td>Howard, MD</td>
<td>9,930</td>
<td>935</td>
<td>48,684</td>
<td>13,945</td>
<td>13,515</td>
<td>19,699</td>
<td>106,708</td>
</tr>
<tr>
<td>Montgomery, MD</td>
<td>105,595</td>
<td>4,715</td>
<td>6,750</td>
<td>259,395</td>
<td>28,475</td>
<td>39,277</td>
<td>444,207</td>
</tr>
<tr>
<td>Prince George's, MD</td>
<td>135,285</td>
<td>700</td>
<td>8,620</td>
<td>43,530</td>
<td>152,075</td>
<td>54,393</td>
<td>394,603</td>
</tr>
<tr>
<td>Other</td>
<td>213,483</td>
<td>4,690</td>
<td>27,843</td>
<td>42,253</td>
<td>70,229</td>
<td>1,046,886</td>
<td>1,404,384</td>
</tr>
<tr>
<td>Grand Total</td>
<td>628,463</td>
<td>71,125</td>
<td>94,767</td>
<td>406,098</td>
<td>280,899</td>
<td>720,054</td>
<td>2,679,000</td>
</tr>
</tbody>
</table>

Source: 2006 – 2010 CTPP
Travel Markets: Through Trips

How do through trips affect traffic...?

- MD 355 and I-270 serve different travel markets

- Long distance trips are better served by I-270:
  - Travel from Clarksburg to Bethesda during the morning peak is 66% faster via I-270 than MD 355

In North Bethesda:

<table>
<thead>
<tr>
<th></th>
<th>% Traffic Starting or Ending in Montgomery County</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 355</td>
<td>83%</td>
</tr>
<tr>
<td>I-270</td>
<td>49%</td>
</tr>
</tbody>
</table>
Travel Markets: Through Trips

- How do through trips affect traffic...?
Travel Markets: Through Trips

- How do through trips affect traffic...?
Travel Markets: Through Trips

- How do through trips affect traffic...?
Travel Markets: Through Trips

- How do through trips affect traffic...?
  - MD 355 and I-270 serve different travel markets
  - Long distance trips are better served by I-270:
    - Travel from Clarksburg to Bethesda during the morning peak is 66% faster via I-270 than MD 355
  - In Germantown:

<table>
<thead>
<tr>
<th></th>
<th>% Traffic Starting or Ending in Montgomery County</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 355</td>
<td>85%</td>
</tr>
<tr>
<td>I-270</td>
<td>42%</td>
</tr>
</tbody>
</table>

In Germantown
Travel Markets: Through Trips

- How do through trips affect traffic...?
Travel Markets: Through Trips

- How do through trips affect traffic...?

In Germantown

On MD 355
Travel Markets: Through Trips

- How do through trips affect traffic...?
Travel Markets: Within Study Area

- **Intra-Study Area Trips** forecast to grow by 27% by 2040
  - 504,000 in 2014
  - 639,000 in 2040
- **Short trips prevalent**: Largest numbers of trips within districts, or between adjacent districts
- **Major market for future trips** within the corridor is non-Commute trips
- **Most trips in 2040** are associated with District 2

<table>
<thead>
<tr>
<th>From/To District</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Corridor Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>101,942</td>
<td>29,794</td>
<td>6,134</td>
<td>2,086</td>
<td>471</td>
<td>140,427</td>
</tr>
<tr>
<td>2</td>
<td>33,964</td>
<td>143,191</td>
<td>25,101</td>
<td>5,405</td>
<td>1,112</td>
<td>208,773</td>
</tr>
<tr>
<td>3</td>
<td>7,852</td>
<td>28,843</td>
<td>68,343</td>
<td>13,512</td>
<td>1,863</td>
<td>120,413</td>
</tr>
<tr>
<td>4</td>
<td>5,002</td>
<td>10,635</td>
<td>20,008</td>
<td>66,741</td>
<td>7,901</td>
<td>110,287</td>
</tr>
<tr>
<td>5</td>
<td>2,081</td>
<td>3,642</td>
<td>4,662</td>
<td>13,000</td>
<td>35,890</td>
<td>59,275</td>
</tr>
<tr>
<td>Corridor Total</td>
<td>150,841</td>
<td>216,105</td>
<td>124,248</td>
<td>100,744</td>
<td>47,237</td>
<td>639,175</td>
</tr>
</tbody>
</table>

Source: 2040 No-Build Analysis, MWCOG
Questions: Mode Outputs

✓ Introduction, Background and Review
✓ Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
✓ Regional Travel Demand Model and Forecasts
  ✓ Travel Demand Forecasting Overview and Four-Step Model
  ✓ Overview of the Metropolitan Washington Council of Governments (MWCOG) Regional Travel Demand Model
  ✓ Model Inputs & Assumptions
  ✓ Model Outputs
  ▪ 2040 No-Build Traffic Volumes for MD 355 Corridor
  ▪ MD 355 Traffic Operations (Existing and 2040 No-Build)
  ▪ MD 355 Crash History Data
  ▪ Additional Technical Q&A
2040 Future No Build Traffic Forecasts

- MWCOG Travel Demand Model provides Average Daily Traffic (ADT) volumes for roadway links.
- Raw data from model post processed using industry standard procedures.
- NCHRP Report 765 - methodology for converting future raw model ADTs to usable ADTs based on comparison of 2015 model volumes versus 2015 counts.
- Grow peak hour volumes for links and intersection movements based on percentage of ADT growth.
- Review area Traffic Impact Study reports for additional data points.
Traffic Forecasts – 2040 No-Build Results

Gaithersburg (2015)

Gaithersburg (2040 No-Build)
Regional Travel Demand Model and 2040 No-Build Forecasts

Key Takeaways:

- Use Industry Standard Methodologies
- Latest Planning Assumptions
- Latest Regional Travel Demand Model
- Corridor-focused Approach
- Calibrated & Validated Network for both vehicles and transit
- Travel Markets
  - Short trips
  - Trips within the Study Corridor
  - Many non-commute trips along the corridor
Questions: Review

✓ Introduction, Background and Review
✓ Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
✓ Regional Travel Demand Model and Forecasts
✓ 2040 No-Build Traffic Volumes for MD 355 Corridor

✓ Q&A
  ▪ MD 355 Traffic Operations (Existing and 2040 No-Build)
  ▪ MD 355 Crash History Data
  ▪ Additional Technical Q&A
Traffic Operations Agenda

- Data Sources
- Software Used
- Traffic Operations Methodology
  - Existing Volumes and Network Inputs
  - Calibration and Evaluation Measures
  - Future No Build Assumptions and Results
Traffic Operations – Data Sources

- Existing traffic (cars, trucks, and pedestrian) counts are from the Maryland State Highway Administration’s Traffic Monitoring System (TMS) (previously discussed in Existing Traffic slides) (http://shagbhisadt.mdot.state.md.us/itms_Public/default.aspx)

- Signal timing were the latest available from Montgomery County’s Division of Traffic Engineering and Operations

- Bus travel time & boarding/alighting from WMATA, Ride On, and MTA

- Field Observations (7:00-9:00am and 4:00-6:00pm)
  - Vehicle and Bus Travel Times by segment
  - Intersection queuing, driver behaviors, lane configurations, signal timing and phasing data
  - Congestion patterns using the Maryland SHA Mobility Report for validation of simulation model (page III.B.23)

- MWCOG model growth (previously discussed in the Travel Demand Forecasting slides)
**Traffic Operations – Data Sources**  
*(MD SHA Mobility Report – MD 355)*

<table>
<thead>
<tr>
<th>Limits:</th>
<th>Washington DC Line to MD 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corridor Length:</td>
<td>19.7 miles</td>
</tr>
<tr>
<td>Speed Limit:</td>
<td>25 MPH – 45 MPH</td>
</tr>
<tr>
<td>Travel Lanes:</td>
<td>(2-4) Northbound (2-4) Southbound</td>
</tr>
<tr>
<td>Signal Controlled Intersections:</td>
<td>80</td>
</tr>
<tr>
<td>Grade Separated Interchanges:</td>
<td>3</td>
</tr>
<tr>
<td>Major Cross Streets:</td>
<td>MD 191, MD 410, MD 547, MD 187, Montrose Pkwy, MD 28, Shady Grove Rd, I-370, MD 117, MD 124, Middlebrook Rd, MD 118, MD 27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Routes and Ridership:</th>
<th>Ride On Routes</th>
<th>Avg Daily Ridership</th>
<th>Red Line Routes</th>
<th>Avg Daily Ridership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride On 46</td>
<td>3,683</td>
<td>Shady Grove</td>
<td>13,444</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rockville</td>
<td>4,900</td>
<td></td>
</tr>
<tr>
<td>Ride On 55</td>
<td>7,920</td>
<td>Twinbrook</td>
<td>4,569</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>White Flint</td>
<td>3,951</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grosvenor</td>
<td>5,857</td>
<td></td>
</tr>
<tr>
<td>Ride On 75</td>
<td>479</td>
<td>Medical Center</td>
<td>6,221</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bethesda</td>
<td>10,608</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2012 AADT</th>
<th>Truck Percentage</th>
<th>Peak Hour Traffic Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>33,000 - 64,000</td>
<td>2 - 6</td>
<td>7.5% - 9%</td>
</tr>
</tbody>
</table>
Traffic Operations – Software Used

- Synchro/SimTraffic 9.0
  - Macroscopic/microsimulation software

  - Inputs
    - Existing AM and PM peak hour traffic volumes
    - Projected 2040 peak hour volumes
    - Includes trucks
    - Lanes, speed, signal timings

  - Able to optimize signal timing – Future Build

- Limited ability to model complex operations such as BRT
- Used for No Build and Purpose and Need
Traffic Operations – Software Used

- **VISSIM 7.0 (In Preparation)**
  - Microscopic simulation software
  - Dynamic interaction of
    - Vehicles,
    - Pedestrians/bicycles,
    - Transit;
  - Model complex operations (e.g., transit signal priority, BRT, streetcar)

- **Benefits**
  - More refined analysis of screened alternatives
  - Report the traffic operations results for all modes including transit and pedestrian

- **Inputs**
  - Existing AM and PM peak hour volumes
  - Projected 2040 peak hour volumes
  - Includes trucks
  - Lane, speed, signal timings
  - Transit routes/schedules, stops, and boarding and alighting data
Questions: Travel Operations Data and Software Used

✓ Introduction, Background and Review
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✓ Regional Travel Demand Model and Forecasts
✓ 2040 No-Build Traffic Volumes for MD 355 Corridor
✓ MD 355 Traffic Operations (Existing and 2040 No-Build)
   ✓ Data and Software Used
     • Model Calibration
     • Model Outputs
   ▪ MD 355 Crash History Data
   ▪ Additional Technical Q&A
Traffic Operations – Calibration Example

MD 355 AM Peak Hour
Southbound

Cross Streets / Direction of Traffic Flow →
Questions: Traffic Operations Model Calibration

✓ Introduction, Background and Review
✓ Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
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✓ MD 355 Traffic Operations (Existing and 2040 No-Build)
  ✓ Data and Software Used
  ✓ Model Calibration
    • Model Outputs
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  ▪ Additional Technical Q&A
Traffic Operations – Model Outputs

- Vehicle delays per approach/intersection:
  - Level of Service (LOS) grade based on Highway Capacity Manual (HCM)

- Intersection-to-intersection car travel times (SimTraffic and VISSIM)

- Transit travel times and reliability measures (VISSIM)

- Pedestrian delays at certain intersections (BRT Station Areas – VISSIM)

Why are these Model Outputs important?

- Show operational change over time – 2015 versus 2040
- Compare future alternative scenarios analysis results
- Help identify potential issues with future scenarios
Traffic Operations – Level of Service

**LOS A – Free Flow**
Segment: Travel speed as a % of free flow speed > 85%
Intersection: Delay ≤ 10 seconds/vehicle

**LOS B – Unimpeded Flow**
Segment: Travel speed as a % of free flow speed > 67 to 85%
Intersection: Delay between 10 to 20 seconds/vehicle

**LOS C – Stable Flow**
Segment: Travel speed as a % of free flow speed > 50 to 67%
Intersection: Delay between 20 to 35 seconds/vehicle

**LOS D – Approaching Unstable Flow**
Segment: Travel speed as a % of free flow speed > 40 to 50%
Intersection: Delay between 35 to 55 seconds/vehicle

**LOS E – Unstable Flow**
Segment: Travel speed as a % of free flow speed > 30 to 40%
Intersection: Delay between 55 to 80 seconds/vehicle

**LOS F – Breakdown Flow**
Segment: Travel speed as a % of free flow speed ≤ 30%
Intersection: Delay > 80 seconds/vehicle
Traffic Operations – Intersection Delay

- **Center Dr**: 2,700 vehicles (47%), 102 seconds per vehicle
- **Jones Bridge Rd**: 1,290 vehicles (23%), 81 seconds per vehicle
- **Weighted Average of All Vehicles**: 77 sec/veh
- **LOS E**: 45 vehicles (1%), 72 seconds per vehicle
- **1,675 vehicles (29%)**: 39 seconds per vehicle
Traffic Operations – Intersection LOS and Corridor Speed (Synchro/SimTraffic: 2040 No Build AM Example)

Overall Intersection LOS (based on Synchro delay)

Link LOS (based on SimTraffic speeds)

Approach LOS (based on Synchro delay)
Traffic Operations

Key Takeaways:

- Latest software used for operational analysis
- Recent data used in the development of the models
- Calibrated & Validated Networks for both vehicle and transit
- Model outputs relevant to the bus rapid transit study
Questions: Traffic Operations Model Outputs

✓ Introduction, Background and Review
✓ Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
✓ Regional Travel Demand Model and Forecasts
✓ 2040 No-Build Traffic Volumes for MD 355 Corridor
✓ MD 355 Traffic Operations (Existing and 2040 No-Build)
  ✓ Data and Software Used
  ✓ Model Calibration
  ✓ Model Outputs

- MD 355 Crash History Data
- Additional Technical Q&A
Crash History Data

- Crash Data is collected from the Maryland State Police

- Per Federal requirements, a three year period is reviewed for potential safety concerns
  - Approximately 1,900 recorded from 2011 to 2013 for MD 355 study corridor (including 5 fatal crashes)

- Data is compared to State Highway rates for potentially high crash locations (i.e. above State crash rates for each roadway facility type)

- Not just safety issue - crashes negatively impact reliability of travel times

- Pedestrian crashes of particular concern in this study due to the need for access proposed to BRT station locations
Crash History Data - Pedestrians

- Four sections had high pedestrian crash rates
- Total of 65 pedestrian crashes in corridor
- Number of pedestrian crashes noted in parentheses below

<table>
<thead>
<tr>
<th>Roadway Sections (North to South)</th>
<th>Total Crashes (2011 to 2013)</th>
<th>Crashes Per Mile</th>
<th>Significantly High Crash Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 121 to MD 27</td>
<td>109</td>
<td>33</td>
<td>Opposite Direction, Rear End, Left Turn</td>
</tr>
<tr>
<td>MD 27 to Great Seneca Creek</td>
<td>193</td>
<td>66</td>
<td>Left Turn, Angle</td>
</tr>
<tr>
<td>Great Seneca Creek to I-370</td>
<td>382</td>
<td>94</td>
<td>Opposite Direction, Left Turn, Pedestrian (13)</td>
</tr>
<tr>
<td>I-370 to MD 28</td>
<td>339</td>
<td>97</td>
<td>Left Turn, Pedestrian (15)</td>
</tr>
<tr>
<td>MD 28 to MD 547</td>
<td>444</td>
<td>114</td>
<td>Left Turn, Angle</td>
</tr>
<tr>
<td>MD 547 to I-495</td>
<td>132</td>
<td>101</td>
<td>Opposite Direction</td>
</tr>
<tr>
<td>I-495 to Cedar Lane</td>
<td>94</td>
<td>127</td>
<td>Sideswipe</td>
</tr>
<tr>
<td>Cedar Lane to Woodmont Ave</td>
<td>112</td>
<td>144</td>
<td>Rear End, Left Turn, Pedestrian (8)</td>
</tr>
<tr>
<td>Woodmont Ave to MD 410</td>
<td>112</td>
<td>122</td>
<td>Rear End, Sideswipe, Left Turn, Angle, Pedestrian (8)</td>
</tr>
</tbody>
</table>
Questions: Crash History

- Introduction, Background and Review
- Existing Traffic Volumes and Traffic Volume History for MD 355 Corridor
- Regional Travel Demand Model and Forecasts
- 2040 No-Build Traffic Volumes for MD 355 Corridor
- MD 355 Traffic Operations (Existing and 2040 No-Build)
- MD 355 Crash History Data
  - Q&A
  - Additional Technical Q&A
Additional Technical Q&A