Welcome & Introductions

- Steering Committee
- Metro Staff
- Caltrans Staff
- Technical Consultants
- Community Facilitation Consultants
Today’s Meeting Objectives

• Review findings of the exploration program
• Summarize contents of draft report
• Discuss planned outreach activities

Guiding Principles

• Develop reliable geotechnical information for tunnel options
• Respect Route Neutrality
• Clearly communicate the purpose and scope of the study to solicit public input
Purpose of the Study

<table>
<thead>
<tr>
<th>Task</th>
<th>Status</th>
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<tbody>
<tr>
<td>Consider all practical routes for the extension of Route 710</td>
<td>✓</td>
</tr>
<tr>
<td>Gather information on subsurface conditions</td>
<td>✓</td>
</tr>
<tr>
<td>Provide for public input and involvement</td>
<td>On-going</td>
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</tbody>
</table>

Objective of the Study

- A total of 5 potential zones were investigated
- Collected geotechnical, geological, and hydro-geological information for each zone
- Information to be used for screening purposes
Study Zones

Scope of Tunnel Study

• Collected and reviewed existing information
• Completed field exploration
  • 25 deep core borings
  • 17 Seismic reflection lines
  • 78 surface wave measurements
• Evaluated collected data
• Prepared draft summary report
Organization of Report

Volume I – Main Report with Figures and Plates
Volume II – Appendices A and B, Boring Logs, GW monitoring data
Volume III – Appendix C – Geophysical data
Volume IV – Appendices D and E – In situ and laboratory test results
Volume V – Appendix F – Environmental Site Assessment

Data Collection and Review (Section 2)

• San Gabriel and Raymond Basin water wells
• NEIS and Avenue 45 Sewer tunnels
• Metro Gold Line
• Superfund sites
• Faulting and seismicity
• Data base search on contaminated sites
• Oil and gas information
• Geology and groundwater reports
• Caltrans as-built Log of Test Borings
### Exploration Summary (Section 3)

<table>
<thead>
<tr>
<th>Zone</th>
<th>No. of Existing Borings</th>
<th>No. of Borings Completed in Current Study</th>
<th>No. of Seismic Reflection Lines</th>
<th>No. of Surface Wave Lines</th>
<th>Approximate Length of Zone (miles)</th>
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<tbody>
<tr>
<td>1</td>
<td>74</td>
<td>7</td>
<td>4</td>
<td>20</td>
<td>5.0 to 5.5</td>
</tr>
<tr>
<td>2</td>
<td>61</td>
<td>5</td>
<td>3</td>
<td>12</td>
<td>5.0 to 5.5</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>12</td>
<td>6</td>
<td>24</td>
<td>4.5 to 5.0</td>
</tr>
<tr>
<td>4</td>
<td>34</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>6.0 to 7.5</td>
</tr>
<tr>
<td>5</td>
<td>77</td>
<td>0</td>
<td>2</td>
<td>12</td>
<td>9.5 to 11.0</td>
</tr>
</tbody>
</table>

### Summary of Data and Faulting Zones 1, 2, and 3 (Section 4)

[Map showing zones and fault lines]
Summary of Data and Faulting, Zones 4 and 5 (Section 4)

Groundwater Conditions (Section 5)
- Located within 5 groundwater basins
- Several groundwater production wells and monitoring wells exist within the 5 zones
- Tunnel will not affect the surface water features
- No springs are known to occur in the upland areas
Groundwater Basins

Hazardous Waste Studies (Section 6)

- ESA completed for all 5 zones
- Findings are based on:
  - Data base research
  - Historical reference documents
  - Agency web site data bases
- Contaminated soil and groundwater identified in Zones 1, 4, and 5
- Isolated contaminated areas found in all five zones.
Limits of Potential Groundwater Contamination

Main Contaminants
PCE - Perchloroethylene
TCE - Trichloroethylene

Status of Contaminated Groundwater Sites Per EPA

- **Zone 1**
  - Containment in place
  - Groundwater treatment began in 1998
- **Zone 4**
  - Currently evaluating extent of contamination
  - Record of Decision to be completed in next few years
  - Remedial and containment plans to be developed after Record of Decision
- **Zone 5**
  - Plan for containment is being evaluated, Installation of containment planned to begin in next few years
  - Cleaning up of the SUPERFUND site to be determined later
Subsurface Conditions (Sections 7 through 11)
Zone 1 (to SR-2 at I-5) – Section 7

- Uniform geologic conditions consisting mainly of Puente Formation
  - Weak sandstone with thin siltstone interbeds
- Alluvium has potential for high groundwater inflows
- Several inactive faults within the Zone
- Potential gassy conditions
- Superfund site located in the northwest portion
- Groundwater is approximately 20 to 50 feet below surface
Zone 2 (to SR-2) – Section 8

- Topanga, Puente and Fernando Formations:
  - Topanga Formation (siltstone, sandstone)
  - Puente Formation (sandstone, siltstone, shale)
  - Fernando Formation (sandstone, conglomerate)
- Shallow alluvium at northwest end
- Variable geologic structures
- Several inactive faults within the zone
- Raymond fault crosses near northwest end
- Groundwater locally up to 20 ft below surface
Representative Geologic Cross Section for Zone 3

Zone 3 (to I-210) – Section 9

- Variable geologic conditions
  - Alluvium
  - Sedimentary Rock (Fernando, Puente, Topanga Formations)
  - Igneous and Metamorphic Rock
- Northern portion of the zone in alluvium
- North of Eagle Rock Fault cobbles and boulders may be encountered
- Variable geologic structures (faults, folds, etc)
- Raymond Fault considered active and a groundwater barrier
- Several inactive faults
- Variable groundwater depths
Zone 4 (to I-210) – Section 10

- Mostly alluvium with some Fernando and Puente Formation rock near south end
  - Alluvium may contain cobbles and boulders
  - Fernando Formation: mudstone
  - Puente Formation: sandstone, siltstone, and mudstone
- Raymond and Alhambra Wash Faults are considered active and act as a groundwater barrier
- Potential for high groundwater inflows in alluvium
- Potential for caving soils
- Groundwater levels not uniform across the zone
- Superfund site located in the central portion
Zone 5 (to I-605) – Section 11

- Mostly alluvium with some Fernando and Puente Formation rock near south end
  - Alluvium may contain cobbles and boulders
  - Fernando Formation: mudstone
  - Puente Formation: sandstone, siltstone, and mudstone
- Alhambra Wash Fault is considered active
- Potential for high groundwater inflows in alluvium
- Groundwater levels not uniform across the zone
- Superfund site located in the south central portion
- Perennial Rio Hondo and San Gabriel Rivers and recharge lakes at eastern portion
Geologic Zone Comparison
Summary of Findings  (Section 13)

<table>
<thead>
<tr>
<th>Zone</th>
<th>Predominant Geologic Formation(s)</th>
<th>Number of Geologic Formations</th>
<th>Percent of Zone in each Formation</th>
<th>Number of Report Faults</th>
<th>Number of Active Faults Crossing Zone</th>
<th>Potential for Gassy Conditions*</th>
<th>Percent of Zone Under Superfund Site</th>
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<tr>
<td>1</td>
<td>Puente Alluvium</td>
<td>2</td>
<td>80 to 90 10 to 20</td>
<td>5</td>
<td>0</td>
<td>H 5 to 10</td>
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<td>2</td>
<td>Puente Topanga Fernando Alluvium</td>
<td>4</td>
<td>70 to 80 10 to 15 5 to 10</td>
<td>7</td>
<td>1 (NW Portal)</td>
<td>H 0</td>
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<td>3</td>
<td>Topanga Alluvium Puente Fernando Diorite</td>
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<td>30 to 40 10 to 20 20 to 30 5 to 10 10 to 20</td>
<td>7</td>
<td>3b M 0</td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>Alluvium Fernando Puente</td>
<td>3</td>
<td>70 to 80 10 to 15</td>
<td>5</td>
<td>2</td>
<td>L 5 to 15</td>
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<tr>
<td>5</td>
<td>Alluvium Fernando Puente</td>
<td>3</td>
<td>75 to 85 10 to 15 5 to 10</td>
<td>3</td>
<td>1</td>
<td>L 5 to 30</td>
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</table>

*H-High, M-Moderate, L-Low
b Includes potentially active faults

Key Geotechnical Factors for Tunneling

- Type of material (soil or rock)
- Uniformity of geology
- Rock/soil strength
- Stability of the ground
- Groundwater conditions
- Faults, especially active faults
- Potential for gas (methane, hydrogen sulfide)
- Contaminated soil, rock, or groundwater
Geotechnical Feasibility of Tunneling

- Feasible in all 5 zones
- Each zone presents unique challenges
- Technology exists to address challenges
- Has been done successfully in Los Angeles, California, and around the world

Ground Stability

- Loss of ground leads to surface settlement
- Groundwater magnifies issues
- Alluvium (soil deposits)
- Extensive in Zones 4 and 5, some in Zone 3, limited in Zones 1 and 2
Special Pressurized Face Tunneling Machines

Slurry TBM

Compressed Air

Airlock

Mixshield Slurry Face Support

Slurry Feed

Slurry Discharge
**Watertight Segmental Lining**

- Designed to resist ground loads, hydrostatic pressures
- Gaskets provide watertight seal
- Significant structural capacity

**Arrowhead Tunnels**
Uniformity of Geologic Units

Soil  Weak (Soft) Rock  Hard Rock

TBM with Rock/Soil Cutterhead

- Riverside Badlands Tunnel
- Single TBM for 8-mile tunnel
- Weak sedimentary rock; hard rock (gneiss); and alluvium
Natural Gas

- Puente Formation – Zones 1 and 2
- Proper safety precautions necessary
- Regulated by Cal/OSHA

Special Provisions to Deal with Gassy Conditions

- Ventilation is critical
- Designed to prevent “dead spots”
- Spark-free electrical equipment
- Continuous gas monitoring
- Safety training
Active Faults in Zones 2, 3, 4, and 5

Configuration after Earthquake

Oversized Vault Section
Fault Crossing with Segmental Tunnel

Contaminated Soil and Groundwater

- Potential safety hazard
- Cannot allow plume to migrate
- Must dispose of properly
- Disposal costs can be significant
- Zones 1, 4, and 5
Geotechnical Challenges

<table>
<thead>
<tr>
<th>Zone</th>
<th>Significant Ground Stability</th>
<th>Non-Uniform Conditions</th>
<th>High Gas Potential</th>
<th>Active Faults</th>
<th>Soil and GW Contamination</th>
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<td>1</td>
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Summary

- Geotechnically feasible to tunnel in all zones
- Each zone has some challenges
- Technology exists to address these challenges
Tunnel Study - Schedule

- NTP
- Encroachment Permit
- Drilling
- Geophysical Testing
- Lab Testing
- Data Evaluation
- Draft Report
- Community Meetings
- Final Report

Questions and Answers
TAC Comments and Questions

- Project team met the expectation of TAC
- Geotechnical Report is easy to understand by a layperson
- What is the risk associated with fault displacement?
- Is the tunnel safe during an earthquake?
- Why more field testing conducted within Zone 3 compared to other zones?
- Why ventilation and emergency access shafts are not considered in this study?

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TAC Comments and Questions

- Why not consider other factors related to tunnel construction in the feasibility study?
- Can you separate the geotechnical tunnel consideration for constructability, long term performance, and/or both?
- What is the purpose of the three community meetings if the comments are due by November 30?
- Can you determine the cost of the tunnel project?
- What will Caltrans/Metro do in the next phase?
Outreach Milestones

- SC and TAC Mtg No. 6
- Draft Summary Report
- Three Community Meetings
- Final Summary Report
- Final SC and TAC Mtg

Upcoming Community Meetings - 2010

- La Canada Flintridge, Glendale, Northeast LA
  Location: Wilson Middle School - 1221 Monterey Road
  Glendale, CA
  Date: January 20, 2010

- Pasadena, South Pasadena and San Marino
  Location: San Marino Center - 1800 Huntington Blvd.
  San Marino, CA
  Date: January 26, 2010

- El Sereno, Monterey Park, Alhambra
  Location: Los Angeles Christian Presbyterian Church - 2241 N.
  Eastern Ave., Los Angeles, CA
  Date: February 2, 2010
## Geotechnical Report DVD

### Public Library Locations:

<table>
<thead>
<tr>
<th>South Pasadena Public Library</th>
<th>Glendale Public Library</th>
<th>La Canada Flintridge Library</th>
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</thead>
<tbody>
<tr>
<td>1100 Oxley Street</td>
<td>222 E. Harvard Street</td>
<td>4545 North Oakwood Avenue</td>
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<table>
<thead>
<tr>
<th>Alhambra Civic Center and Library</th>
<th>Monterey Park Bruggemeyer Library</th>
<th>Crowell Library</th>
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<tbody>
<tr>
<td>101 S. First Street</td>
<td>318 S. Ramona Avenue</td>
<td>1890 Huntington Drive</td>
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<table>
<thead>
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<th>Pasadena Public Library</th>
<th>El Sereno Branch Library</th>
<th>Arroyo Seco Regional Library</th>
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<tr>
<td>285 E. Walnut Street</td>
<td>5226 S. Huntington Dr.</td>
<td>6145 N. Figueroa Street</td>
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<table>
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<th>Cypress Park Branch Library</th>
<th>Lincoln Heights Branch Library</th>
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<td>1150 Cypress Avenue</td>
<td>2530 Workman Street</td>
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</table>

[Visit 710 tunnel study site](www.710tunnelstudy.info)

## Next Steps

- Continued feedback on Draft Report
- Comments due by November 30, 2009
- Final Summary Report – Feb/Mar 2010
- Presentation to TAC/SC – Feb/Mar 2010
See You Next Meeting!