Virginia Center *for* Transportation
INNOVATION & RESEARCH

We bring innovation to transportation.

Bringing Innovation to Transportation in Virginia-VDOT's Research Program

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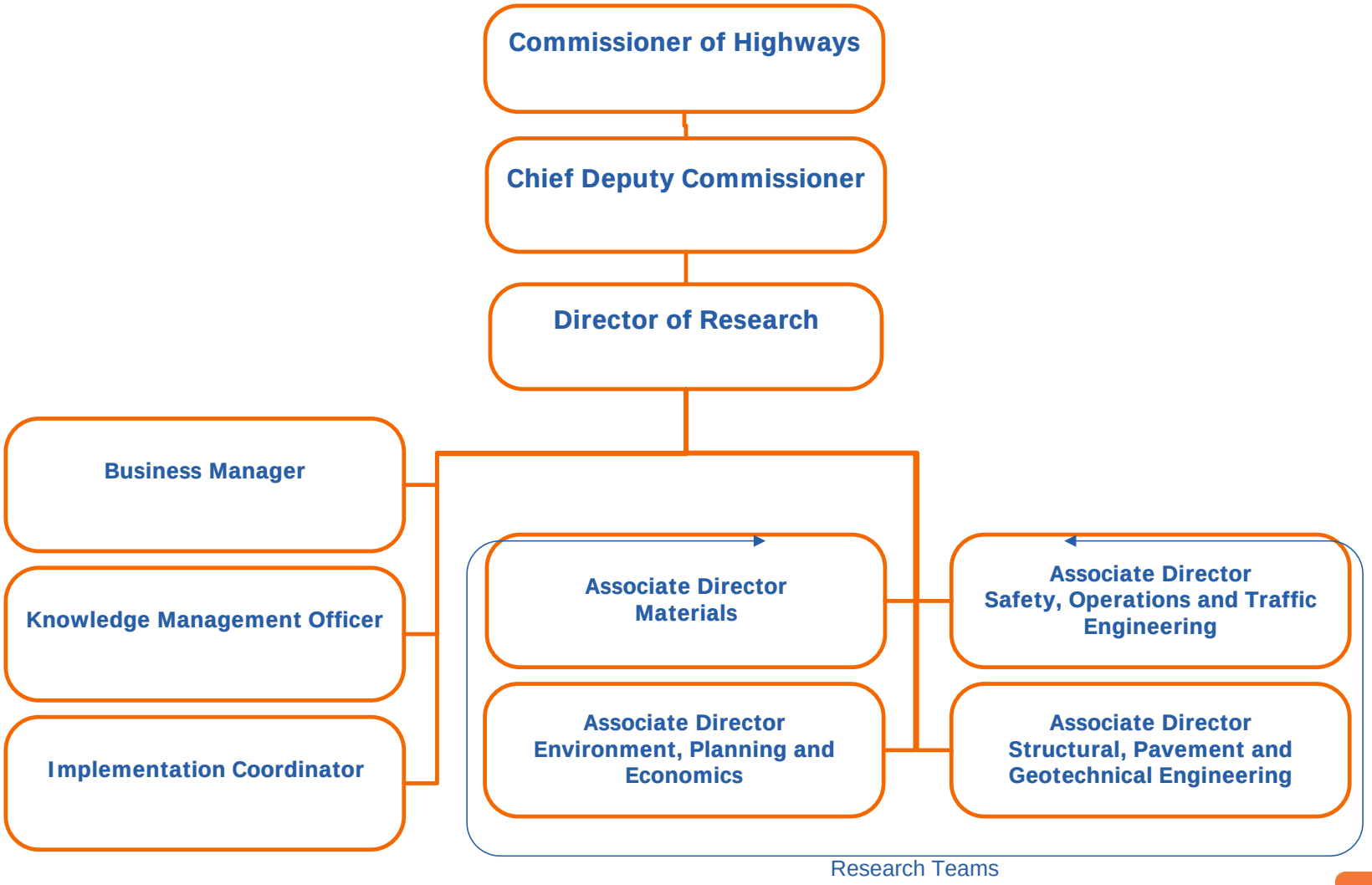
Director of Research

Geohazards 2013 13th Annual Technical Forum
July 31, 2013

Transportation Research???

VCTIR

VCTIR Leadership Team



Core Functions

- Develop and deliver an applied research program that supports the VDOT mission
- Provide expert consultation to VDOT Operations
- Provide post-research implementation support
- Provide technical oversight of university contract research
- Provide educational opportunities for future professionals through graduate assistantship program

Staffing

- In house staff (50 Full time employees)
- 34 scientists
- 7 technicians
- 9 Admin & Library staff
- Faculty, GRAs, and undergraduate students through contract research projects conducted with universities

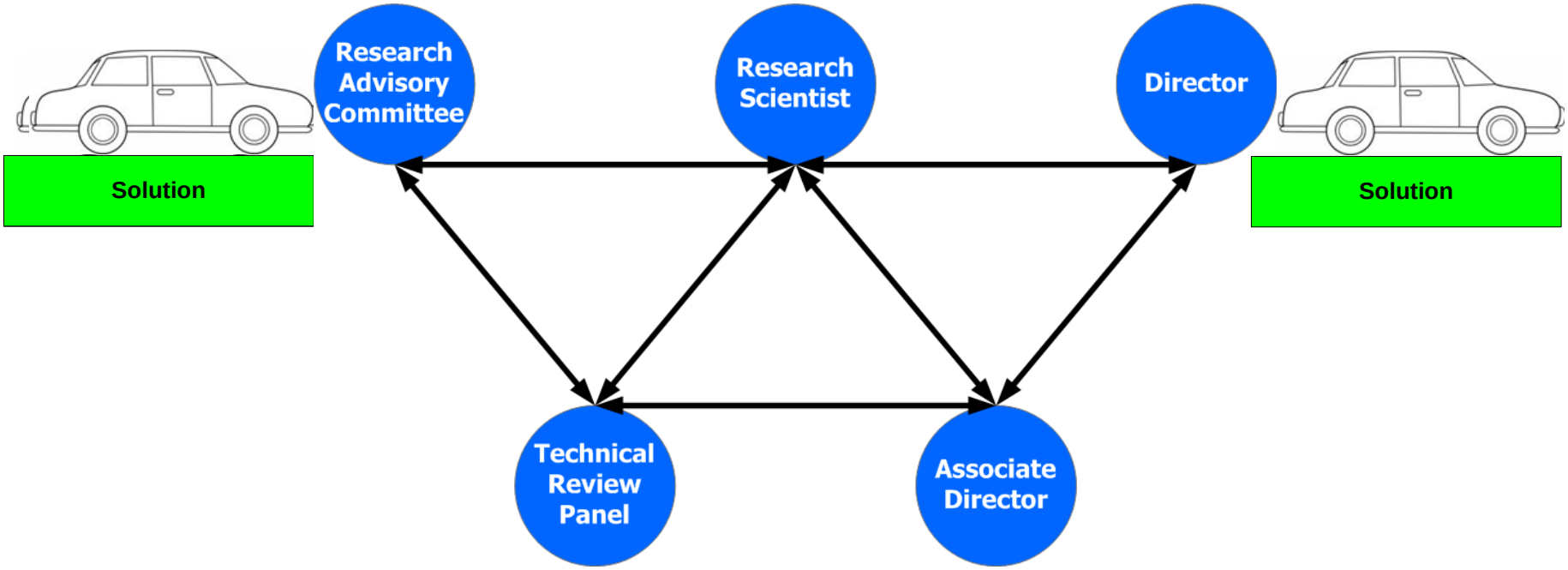
Universities Play Key Role

- Expansion of the research program
- Partnerships to leverage resources, attract grants for collaborative research
- Shared laboratories
- Effective access to faculty and students

Benefits of University Partnerships to VDOT

- Effective balance of very practical and academic approaches
- Graduate research assistants contribute to projects and get hands-on practical experience understanding transportation in Virginia—future VDOT/private professionals
- Broad array of subject matter expertise coupled with extensive practical knowledge of transportation in VA

VCTIR's Research Methodology



Research Advisory Committees Guide the Programs

- Asphalt
- Concrete
- Environmental
- Structure and Bridge
- Geotechnical
- Pavements
- System Operations
- Traffic and Safety
- Transportation Planning

Technical Review Panels Guide the Projects

- Function of the TRP:
  - Guide the research project from initiation to implementation
  - Provide peer review of the proposed methodology/expected deliverables

❖Prior to submission to TRP we conduct an in-house peer review of the project proposal to insure the scientific approach is valid

Who sits on of the TRP?

- **The Champion**: Recognized for his/her role, responsibilities, and authority within VDOT Organizational structure
- Technical experts from the field (within VDOT and external)
- Technical experts within VCTIR

Process

- Project kickoff meeting (scope, schedule, deliverables)
- Key attendees:
  - Champion
  - Principal Investigator (s)
  - Associate Director and Director
  - Implementation Coordinator
- TRP members as their schedules allow

Process

- Project completion meeting (focusing on deliverables)
- All key attendees identified previously
- TRP members
- Others (know the business!)
- Implementation discussion

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Environment, Planning, and Economics Team

Amy A. O'Leary, Ph.D.
Associate Director

VCTIR Environment, Planning, and Economics Team

The Team's Research Areas: Diverse

- For the environment and history areas they include:
  - Air quality
  - Water quality
  - Stormwater management
  - Waste management
  - Endangered species
  - Mitigating animal-vehicle collisions
  - Historic bridges
  - Cultural resource management

Research Areas, cont.

- In the planning and multimodal areas:
  - Access management
  - Land development risk
  - Linking safety with the planning process
  - Trip generation methods
  - Socioeconomic and land use forecasting
  - Transit and rail studies
  - Public involvement

Research Areas, cont.

- For economics, finance, and special studies ("red phone studies")
  - Life cycle costing and cost benefit analysis
  - Transportation finance and funding options
  - Studies for the Va. General Assembly
  - Other special studies for the Secretary of Transportation, VDOT Commissioner, or other VDOT executives

Knowledge Management at VDOT

Knowledge Management Office

Knowledge Management at VDOT

KM Program Areas:

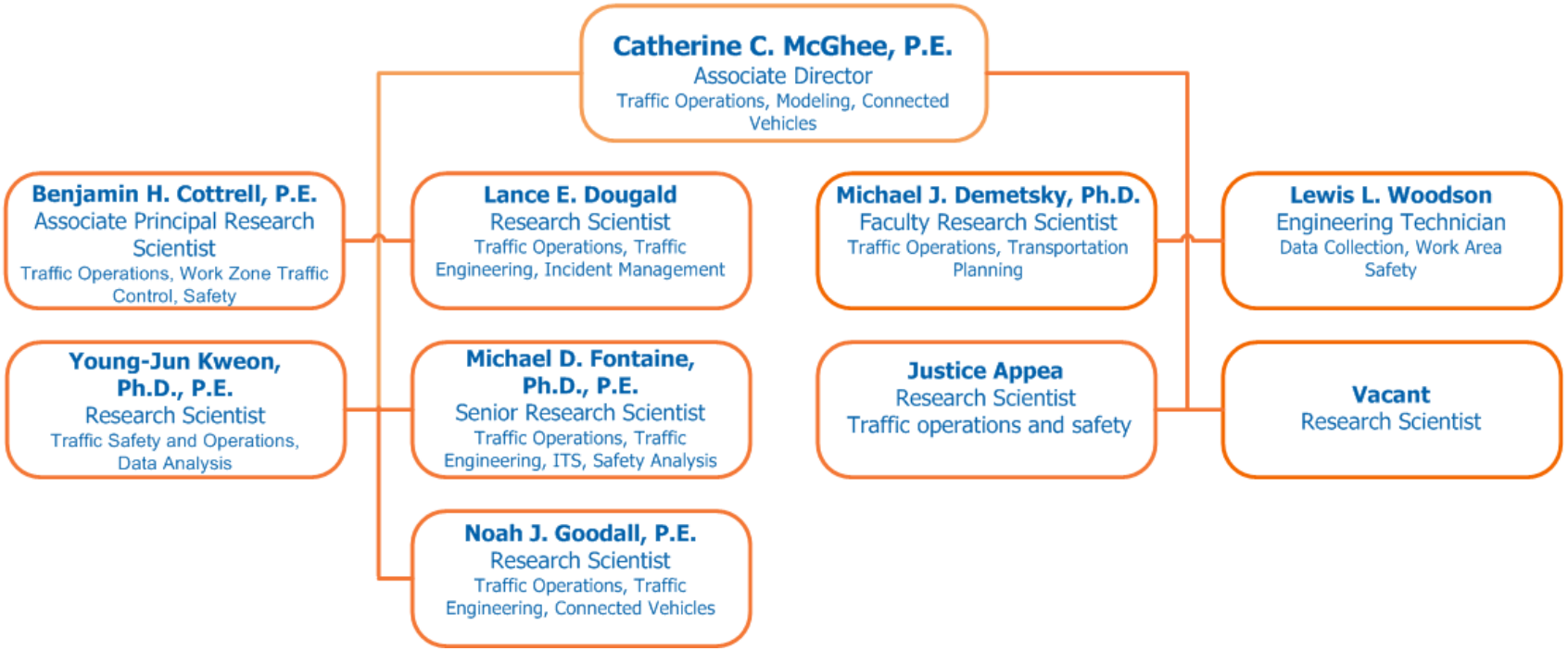
- Knowledge Sharing, Transfer and Collaboration
- Business Process Management
- Strategic Planning
- Program Evaluation
- Organizational Change Management
- Succession Planning
- Knowledge Portal

Knowledge Management at VDOT

Library Services:

- Circulation of Print Collection
- Access to online full-text resources
- Interlibrary loan
- Document Deliver
- Research Assistance
- Research Synthesis Bibliographies

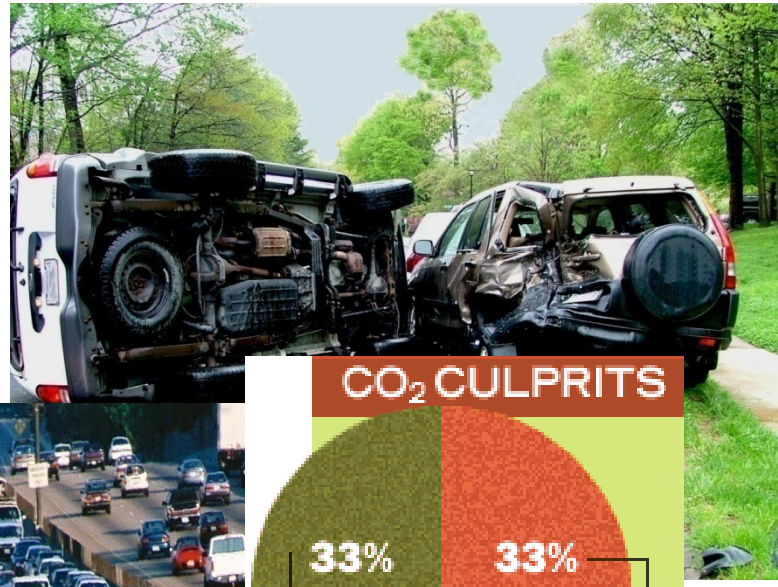
VCTIR Safety, Operations, and Traffic Engineering Team



Safety and Mobility Issues

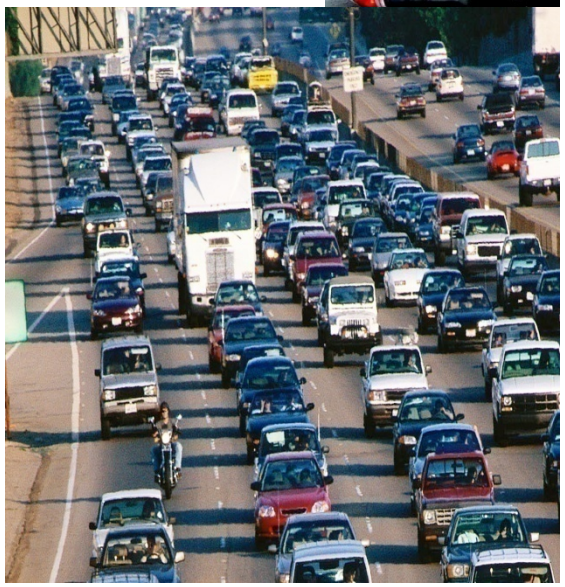
Safety

- 33,963 deaths/year (2009)
- 5,800,000 crashes/year
- **Leading cause of death for ages 4 to 34**



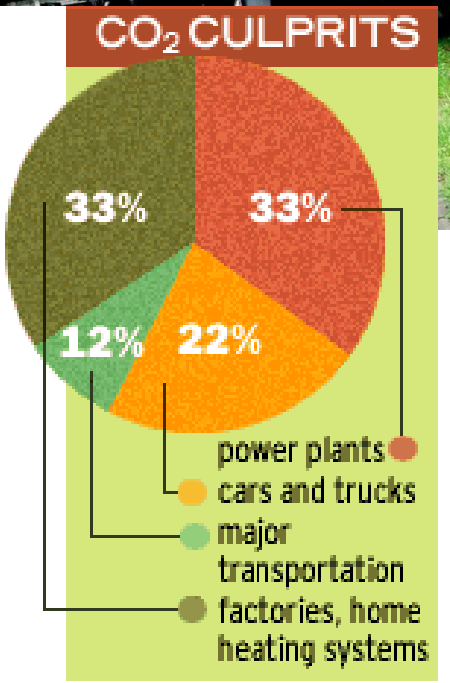
Mobility

- 4.2 billion hours of travel delay
- $78 billion cost of urban congestion



Environment

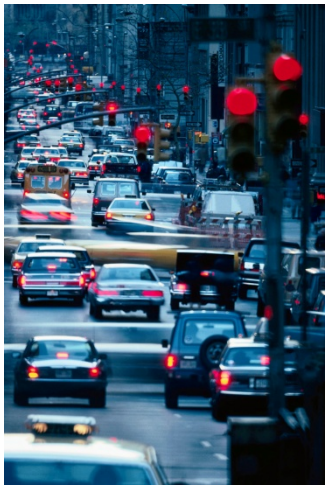
- 2.9 billion gallons of wasted fuel



**Slide adapted from USDOT*

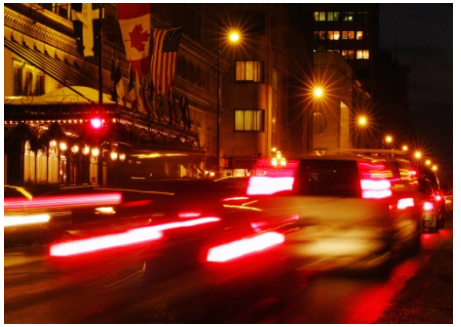
Traffic Signal Control: Current Practice

- Traffic signal timings are currently set based on historic traffic counts
- Timing plans developed for different days of the week and times of day
- Drawbacks:
  - Regular retiming is necessary to deal with changes in traffic patterns
  - Cannot adapt well to unexpected changes (crashes, special events, etc.)

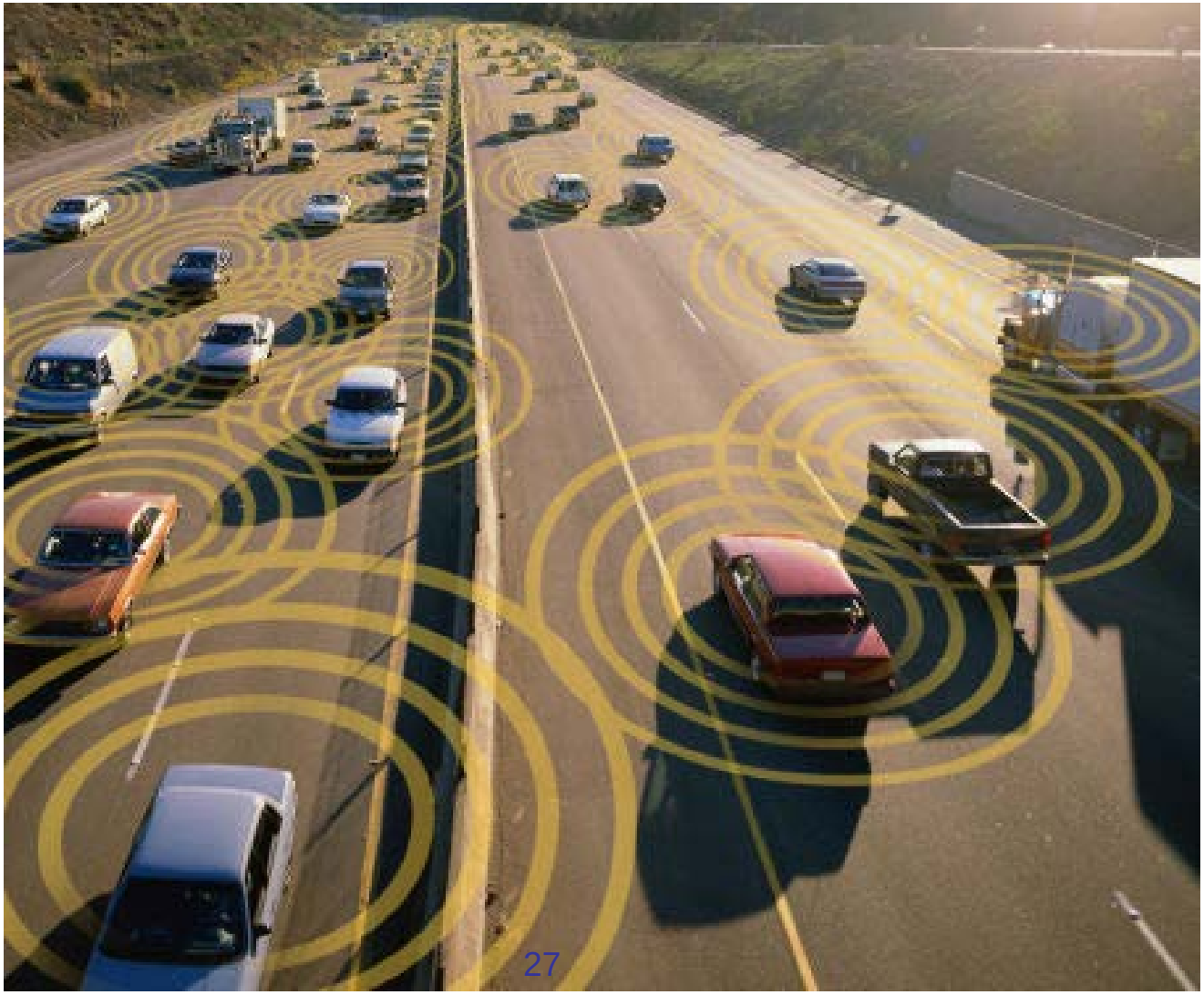


Adaptive Traffic Signal Control

- Adaptive traffic signals use advanced computing to optimize signals on the fly at individual intersections or along a route
- No fixed timing plans
- Can adapt to variations in flow
  - Seasonal variations (shopping, recreational traffic)
  - Crashes or incidents

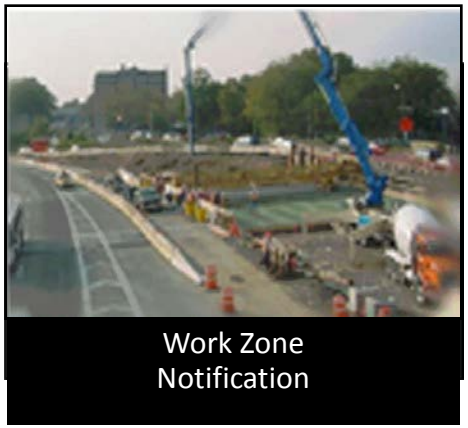


Connected Vehicles



Opportunities for Safer Driving

- **Greater situational awareness**
  - Your vehicle can “see” nearby vehicles and knows roadway conditions you can’t see
- **Reduce or even eliminate crashes thru:**
  - Driver Advisories
  - Driver Warnings
  - Vehicle Control



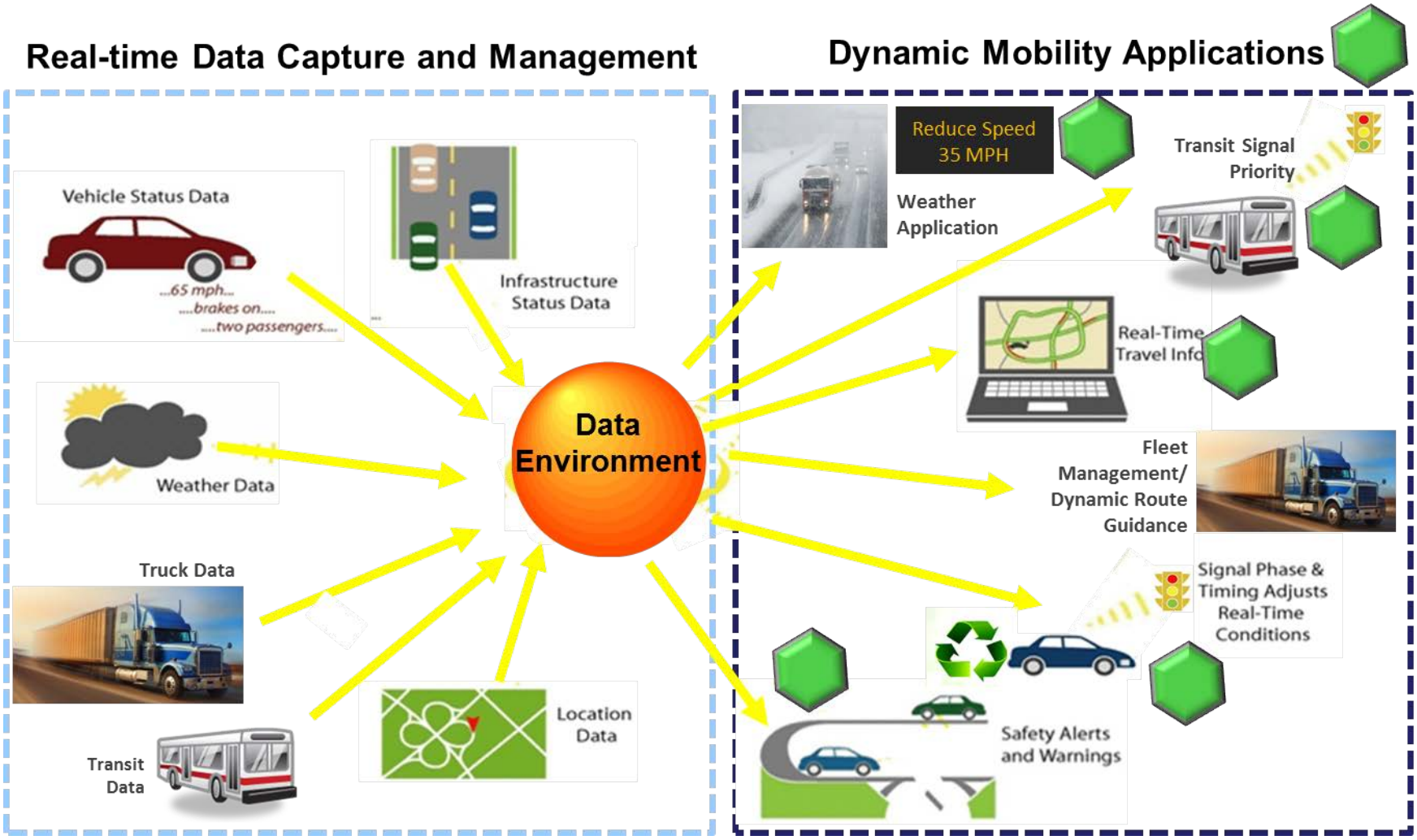
Work Zone Notification

Intersection Collision Avoidance

IntelliDrive has the potential to address 82% of the vehicle crash scenarios involving unimpaired drivers

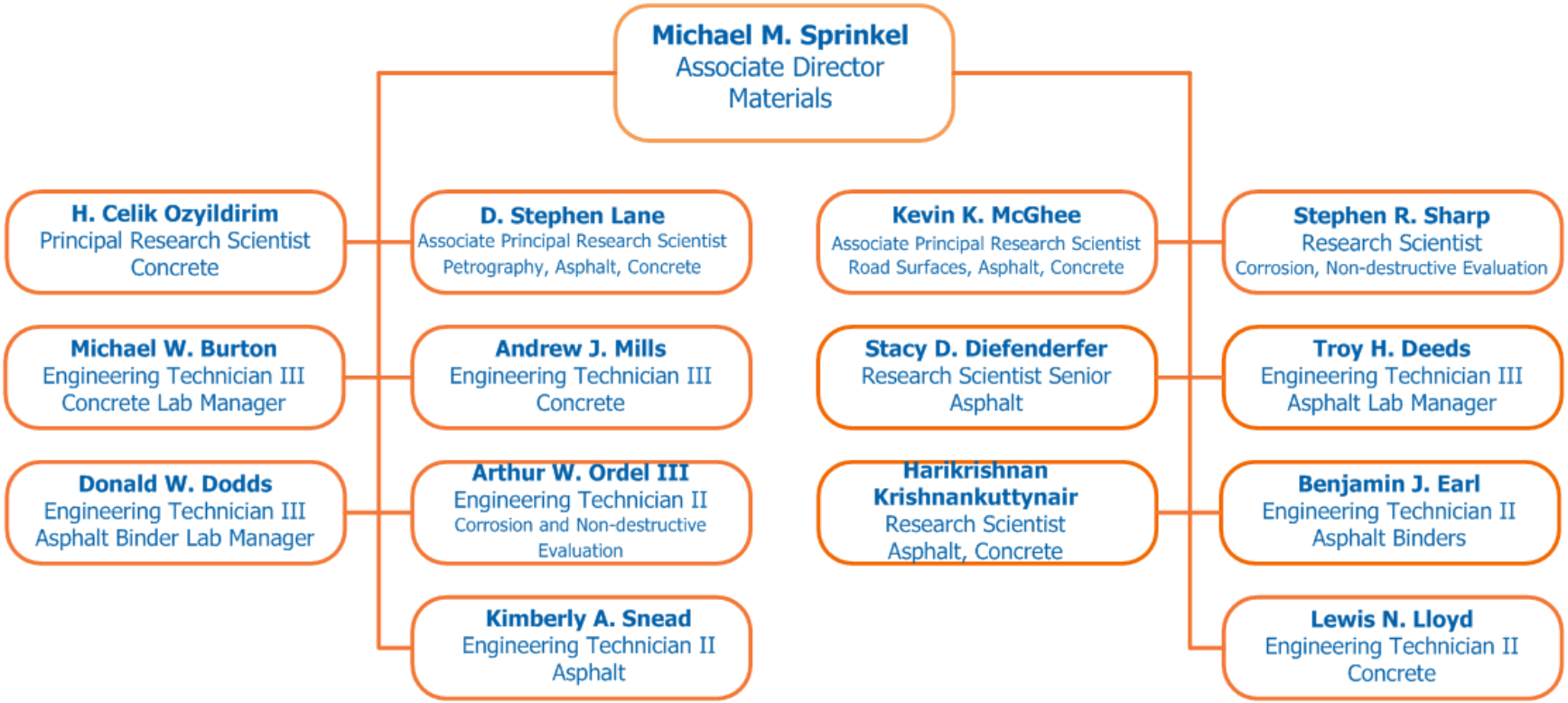
**Slide adapted from USDOT*

Opportunities for Enhanced Mobility



Adapted from USDOT

VCTIR Materials Team



High RAP Mixtures in Virginia

- Currently VDOT allows up to 30% RAP in HMA
- VDOT is interested in increasing RAP usage.
- Lack of understanding of how the binder in the RAP affects the virgin binder is a limiting factor on RAP use.
- Will compare no RAP, 25%, 40%, and 100% RAP
- Lab Performance - modulus, fatigue, rut potential, and permeability

Warm Mix Asphalt (WMA)

- WMA: Allows the production of asphalt mixtures at temperatures significantly below those of Hot Mix Asphalt
- WMA technologies
  - Foaming
  - Chemical modifiers
  - Wax modifiers

Warm Mix Asphalt (WMA)

- VDOT benefits
  - Improved compaction and density
  - Longer material life
  - Reduced emissions
  - Longer paving season
  - Lower material costs
  - Increased competition
- Contractor benefits
  - Fuel savings
  - Increased workability
  - Longer paving season
  - Larger market area

HMA

WMA

High Performance Lightweight Concrete On Route 33

Over Mattaponi River

Over Pamunkey River

Ultra High Performance Concrete on Route 624 over Cat Point Creek

UHPC Girder

Steel Fibers in UHPC Girder

30,000 psi. vs. 8,000 psi

Roller Compacted Concrete Pavement

Benefits

- Carry heavy/slow moving trucks
- Durable
- Open to traffic quicker than conventional concrete

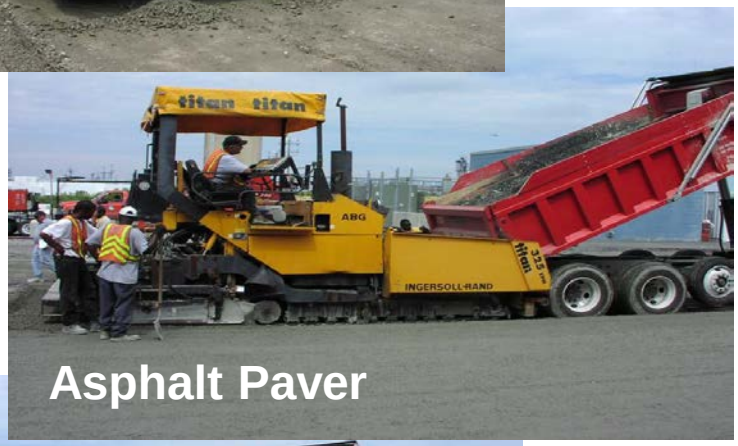
Special Considerations

- Smoothness
- Unreinforced

Projects

- Staffordboro Commuter lot
- Craney Island Expansion

Stiff mix

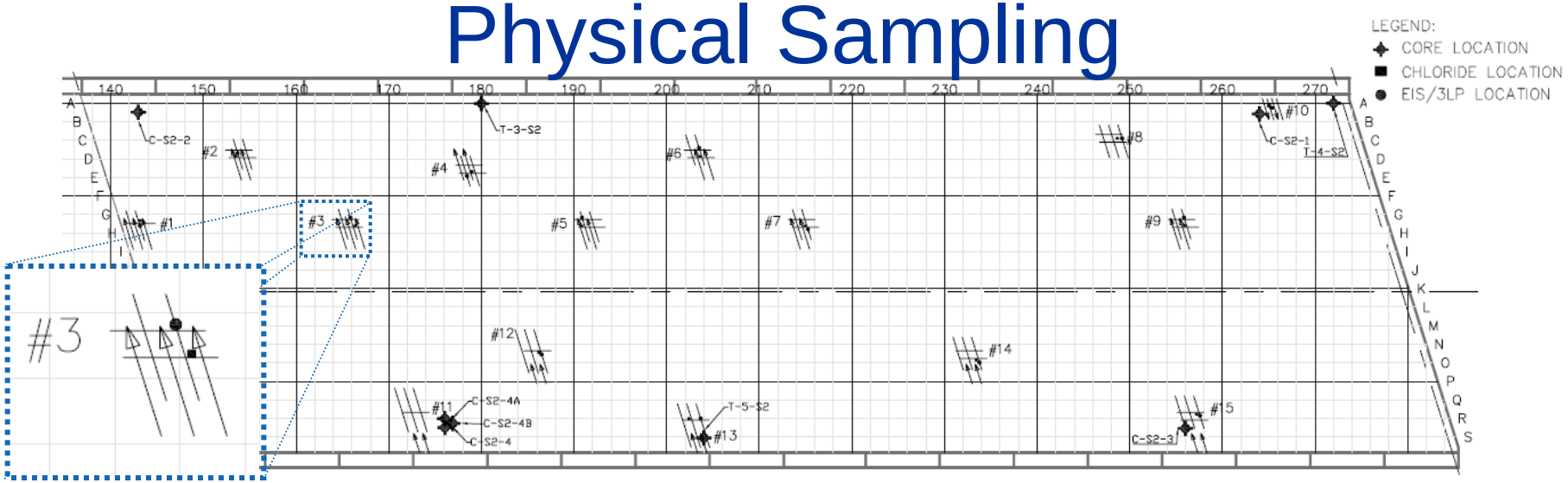


Asphalt Paver

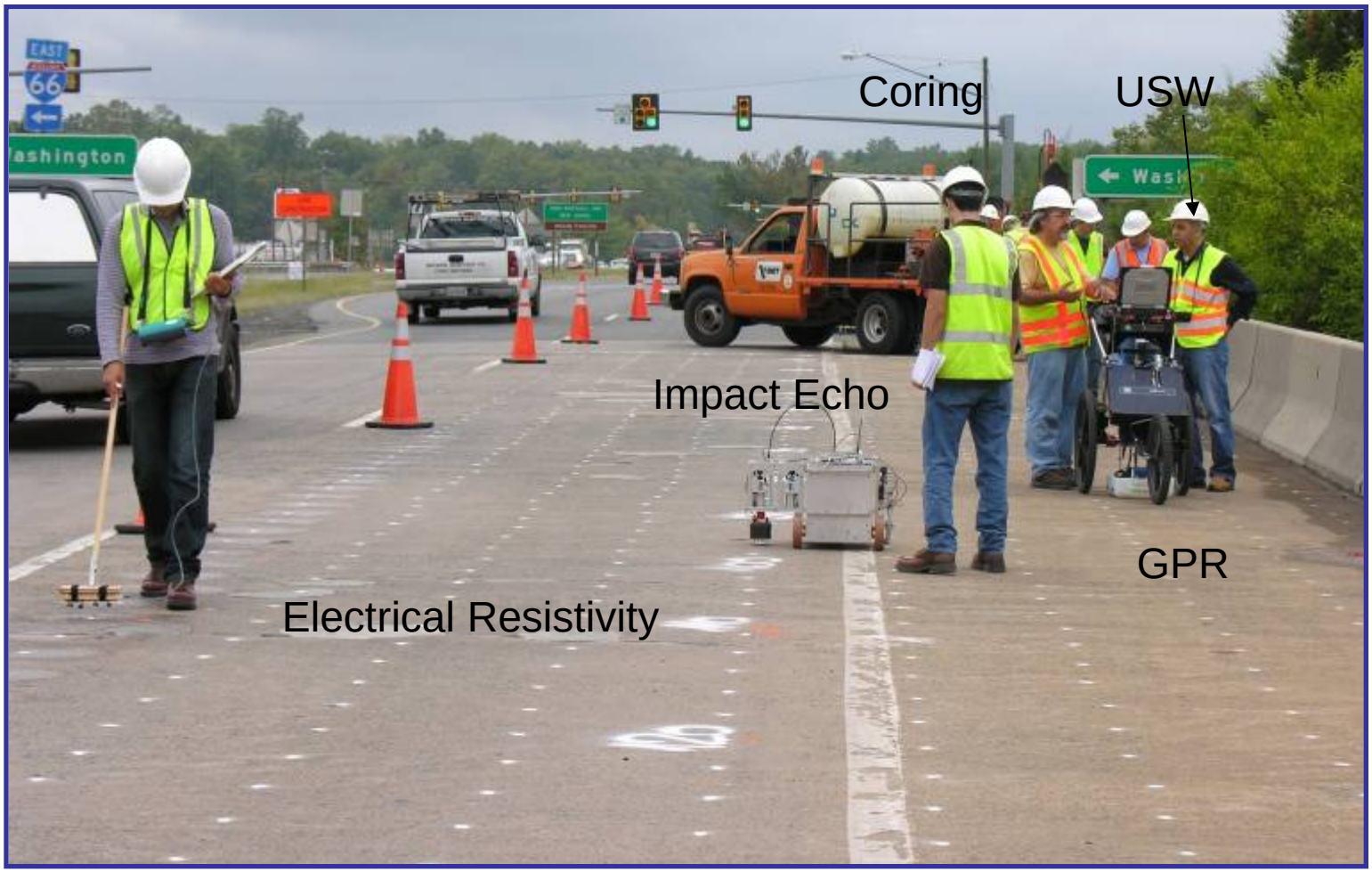
Asphalt Roller

VCTIR Structural, Pavement, and Geotechnical Engineering Team

Corrosion Testing and Physical Sampling



Non-Destructive Testing and Evaluation



Next Generation Inspection

Pavement Recycling

Full-depth reclamation

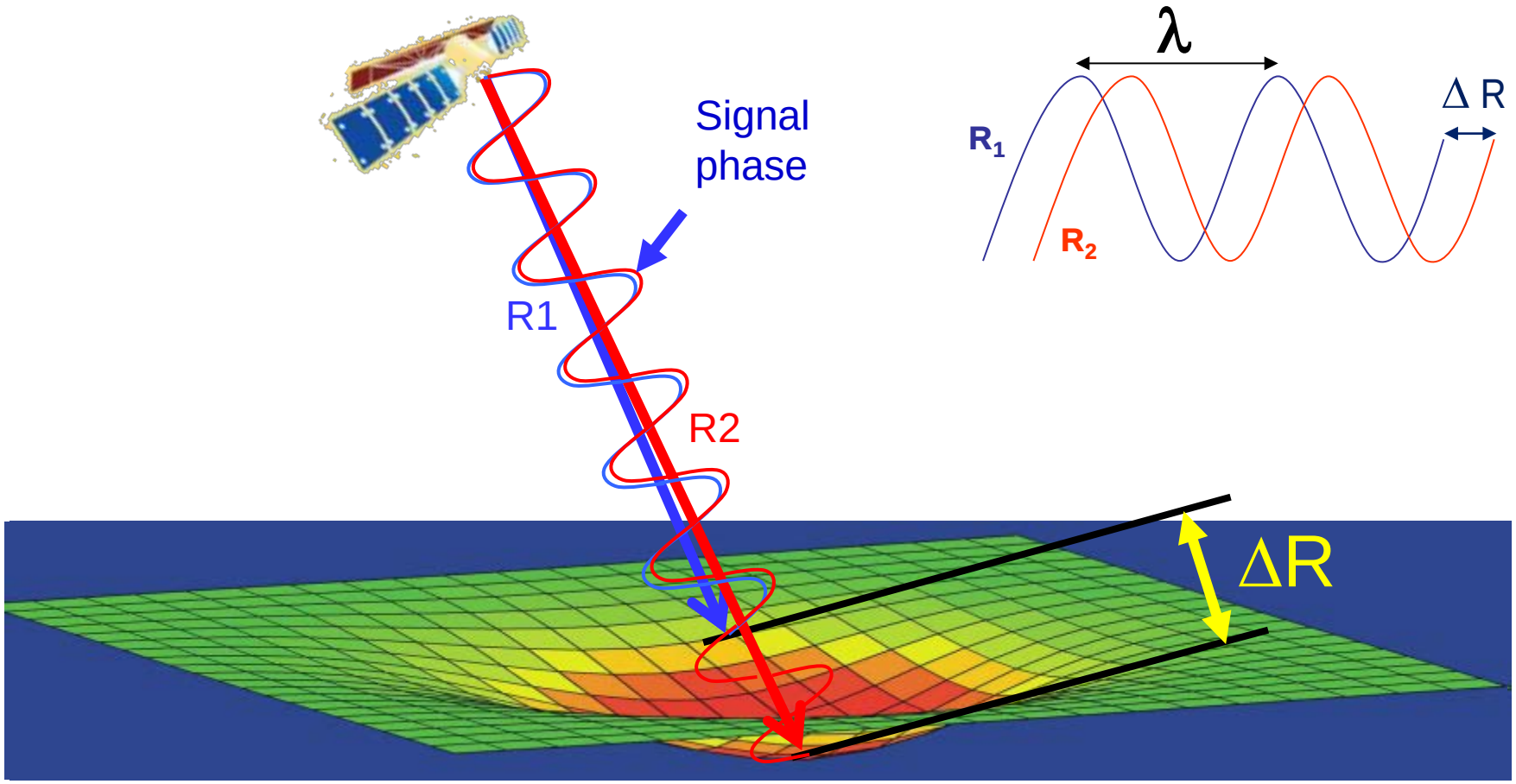

Cold in-place recycling (CIR)


Cold central plant (CCPR)

Activities:
Characterize materials properties
Develop pavement-design input values
Implement specifications and guidelines

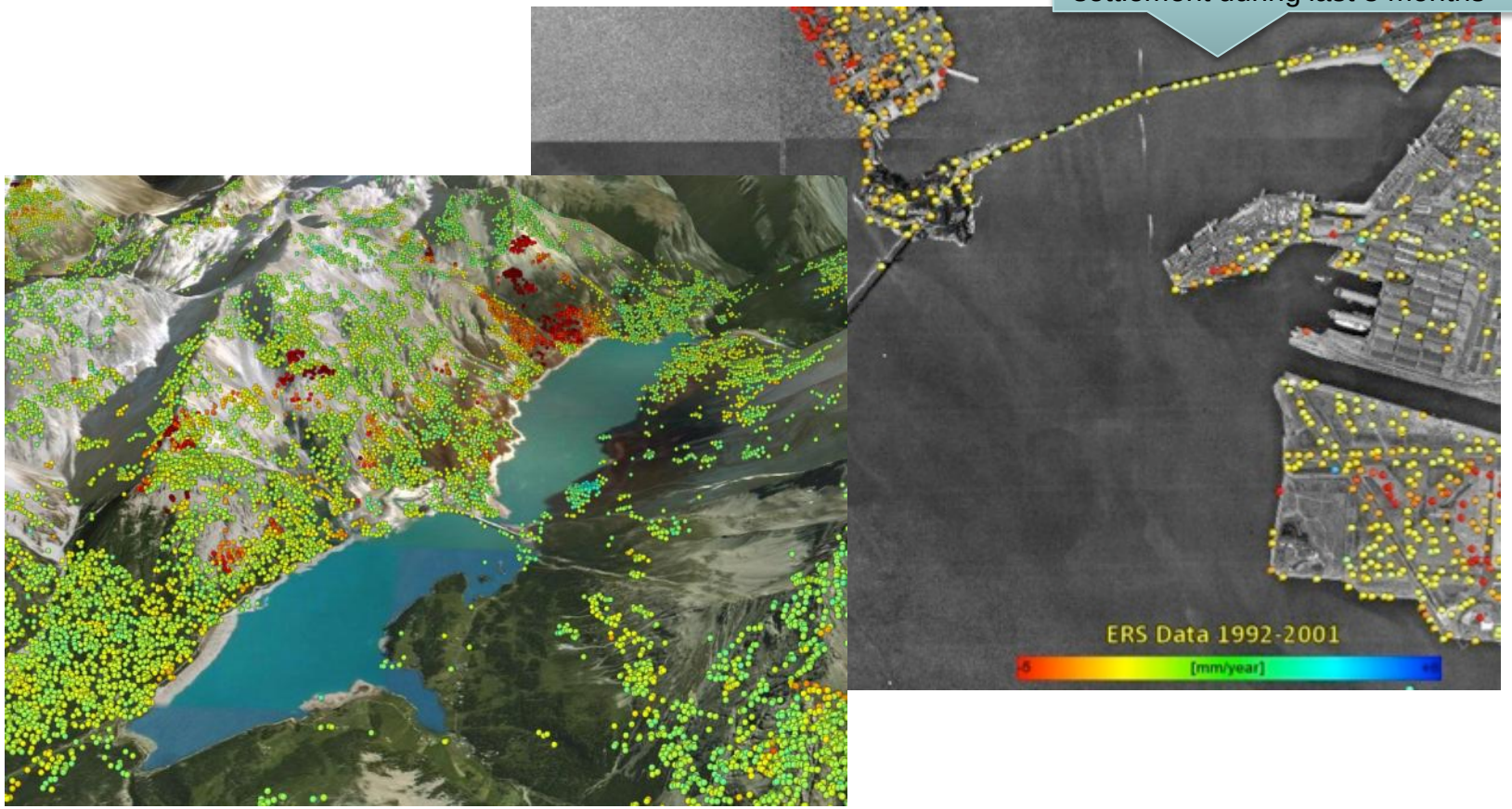
Goal is pavement recycling as a standard pavement rehabilitation option

Interferometric Synthetic Aperture Radar (InSAR)

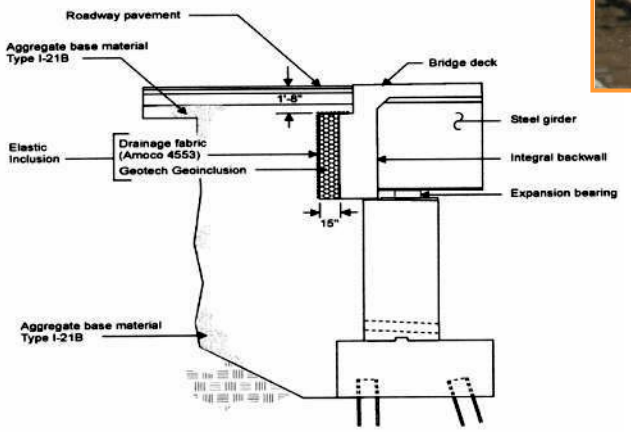


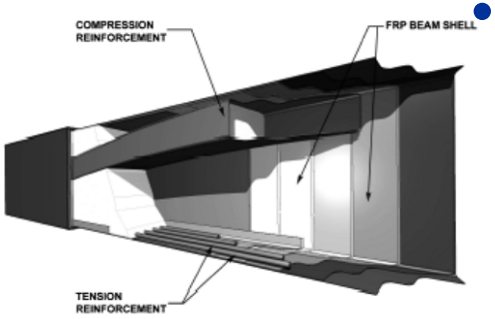
InSAR Applications

- Image analysis methods for detecting significant events (movement of a **rockslide**, subsidence due to a potential **sinkhole**, **settlement** of a structure.)



Innovative Structural Systems





- Integral and Semi-integral Abutments
- HPC and LWC Prestressed beams
- Full-depth precast decks
- Geosynthetic Reinforced Soil Abutments
- FRP Composite Deck/Superstructure systems

Geosynthetic Reinforced Soil Integrated Bridge System

GRS-IBS Abutments feature:

- Reduced construction cost (25 -60%)
- Reduced construction time
- Construction less dependent on weather conditions
- Flexible design -easily field modified for unforeseen site conditions (e.g. obstructions, utilities, different site conditions)
- Easier to maintain (fewer bridge parts)

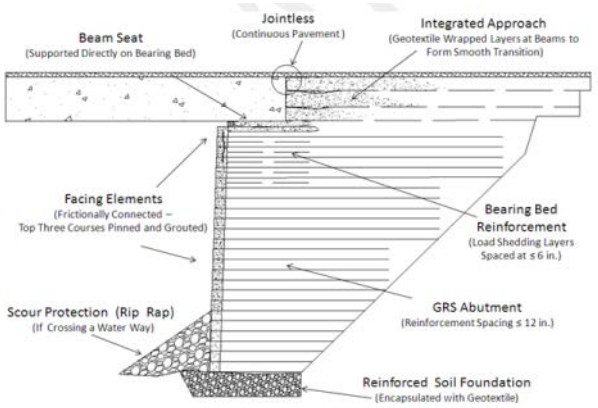


Figure 1.1. Profile of a GRS Abutment.
From Adams et al. (2011a). [Pending permission by authors]

Full-scale testing by Virginia Tech

Designing for use on Towlston Road over Rocky Run in Fairfax County

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