MIT CONCRETE SUSTAINABILITY HUB

Doing more with less: economically-efficient management of pavement networks

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September 20, 2017

Asset management allocation tools are critical to economically-efficient infrastructure

Roads D

Solutions to Raise the Grade

Fix the federal Highway Trust Fund by raising the federal motor fuels tax, and explore alternative, long-term funding mechanisms.

Increase investment at all levels of government to reduce the backlog of rehabilitation needs.

Use asset management best practices to prioritize projects and improve the condition, security, and safety of assets while minimizing costs over its entire life span.

FHWA has issued new performance management rules due to MAP-21

FHWA motivation for performance management:

- Provide the **most efficient investment** of Federal transportation funds
- Refocus on **national transportation goals**
- Increase **accountability and transparency**
- **Improve decision-making** through performance-based planning and programming

Pavement network performance management process

Set targets → Measure performance → Implement strategies to meet targets

% Good
% Poor

Pavement Management System

Which strategies?
At what cost?

How to allocate funds to obtain best performance at lowest cost?

Many approaches to allocate funds

Pavement Segment	Pavement Condition Index
A	45
B	47
C	51
D	52
E	56
F	62
G	67

- How to prioritize which segments to repair?
- Will targets be met?
- Which strategies should be used?
    - Many short term fixes?
    - Few long-term fixes?

An optimization modeling approach is required to answer these questions: Performance-Based Planning

Goal of MIT asset management research: improve allocation decisions

Key elements of pavement management systems for performance-based planning

Objective: prioritize projects that maximize performance and minimize cost

Current & historical pavement network data → Projection of network performance → Allocation of resources

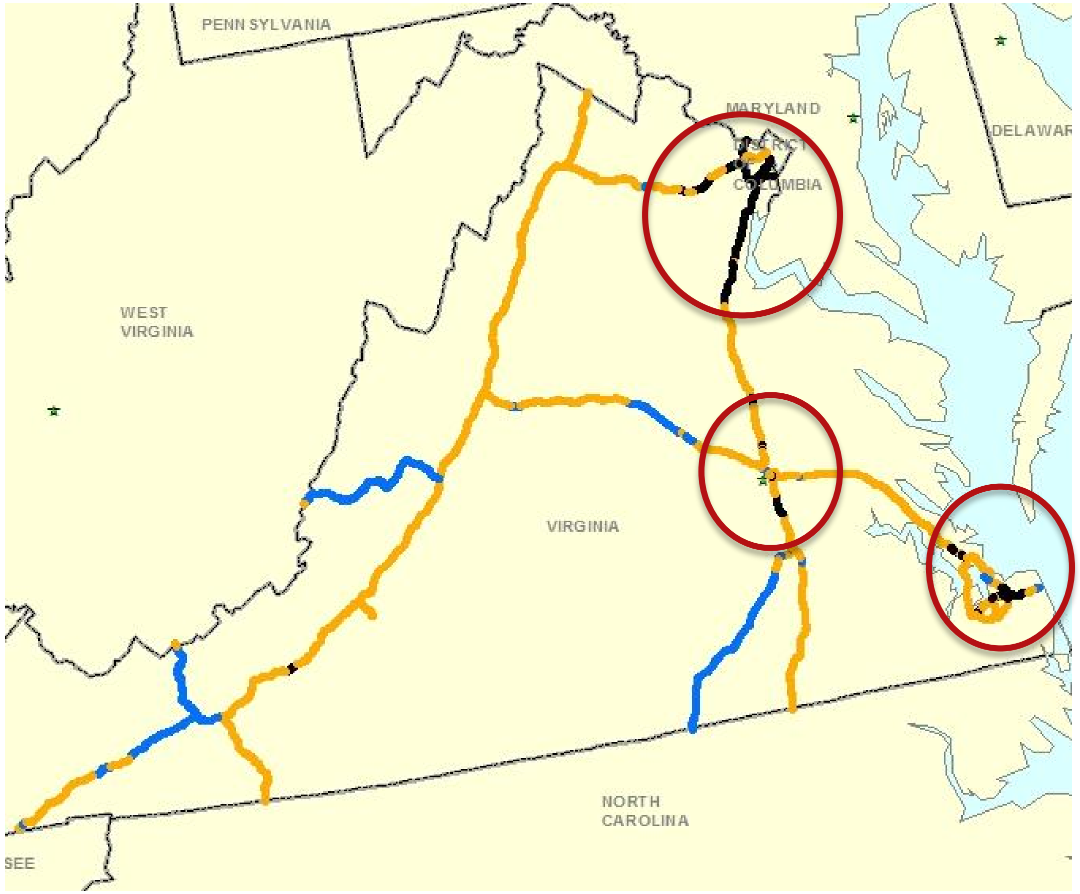
Key Considerations

- Projection of network performance:
  - Analysis period
  - Available maintenance, rehabilitation, and reconstruction activities
  - Uncertainty in prices and deterioration
- Allocation of resources:
  - Optimization algorithm
  - Optimization metrics
  - Scale of network

Key elements of the MIT allocation model

Key Considerations	Conventional models	MIT model
Analysis Period	Short analysis periods (~5 yr)	Long analysis period (20+ yr)
Available MRR activities	Prescriptive decision rules for limited MRR alternatives	Dynamic decision rules for diverse set of MRR alternatives
Uncertainty in prices & deterioration	Deterministic data & analysis	Risk analysis including uncertainty

Example with VA interstate network



Blue	**Low expenditures per unit area**
Yellow	**Medium expenditures per unit area**
Black	**High expenditures per unit area**

Expected roadway expenditures over 50 year analysis period

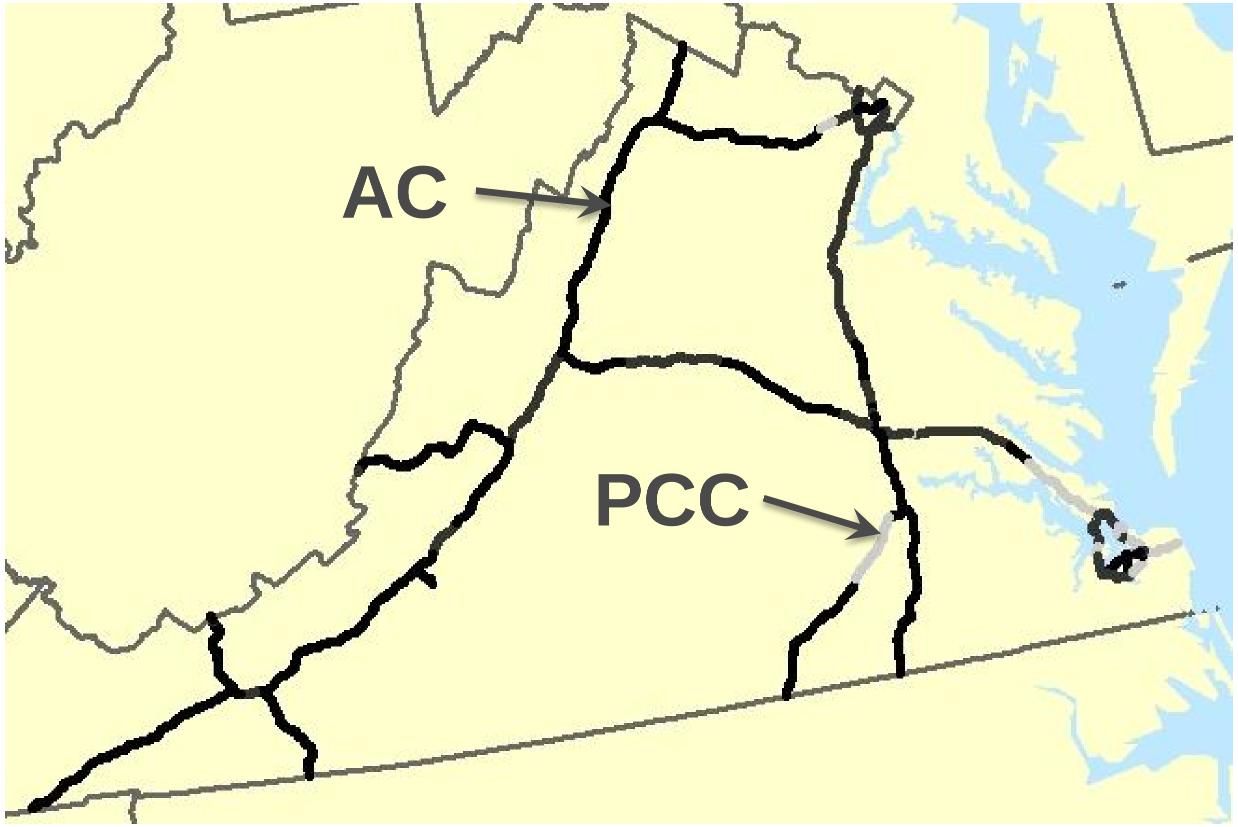
Budget=$67m/yr

MRR activities including concrete overlays

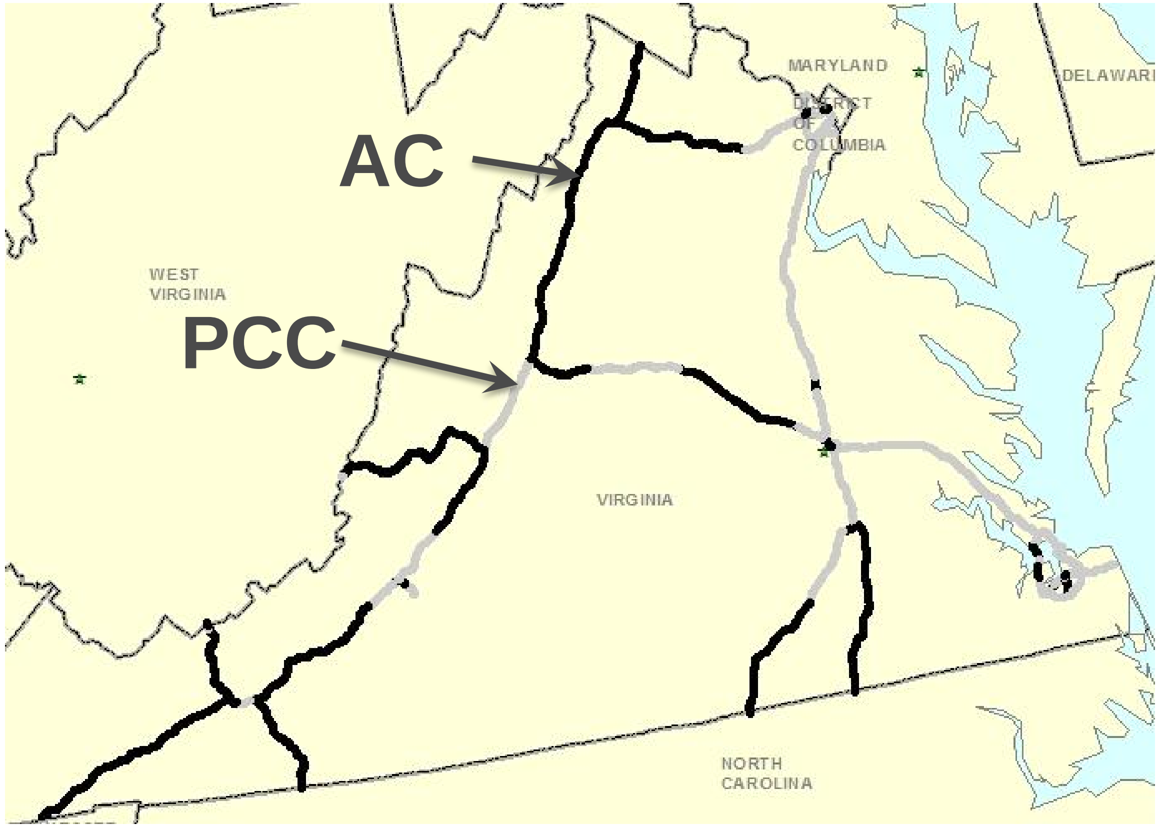
Objective: minimize traffic-weighted roughness

Allocation strategy diversifies after 50 years

Current Composition of System



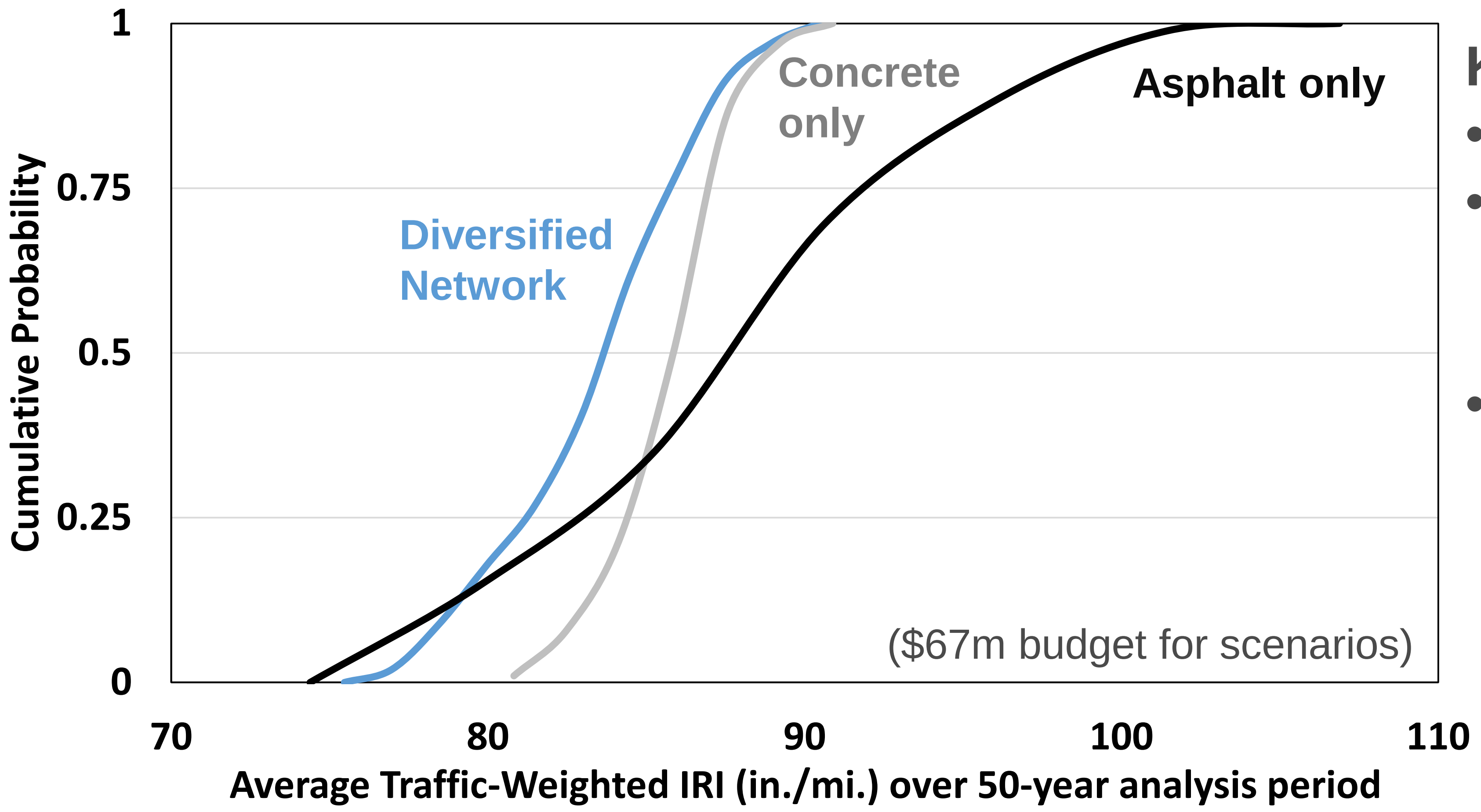
Expected Composition in Year 50



Fixed budget ($67m)

Diversity of MRR alternatives is a means to enhance network performance

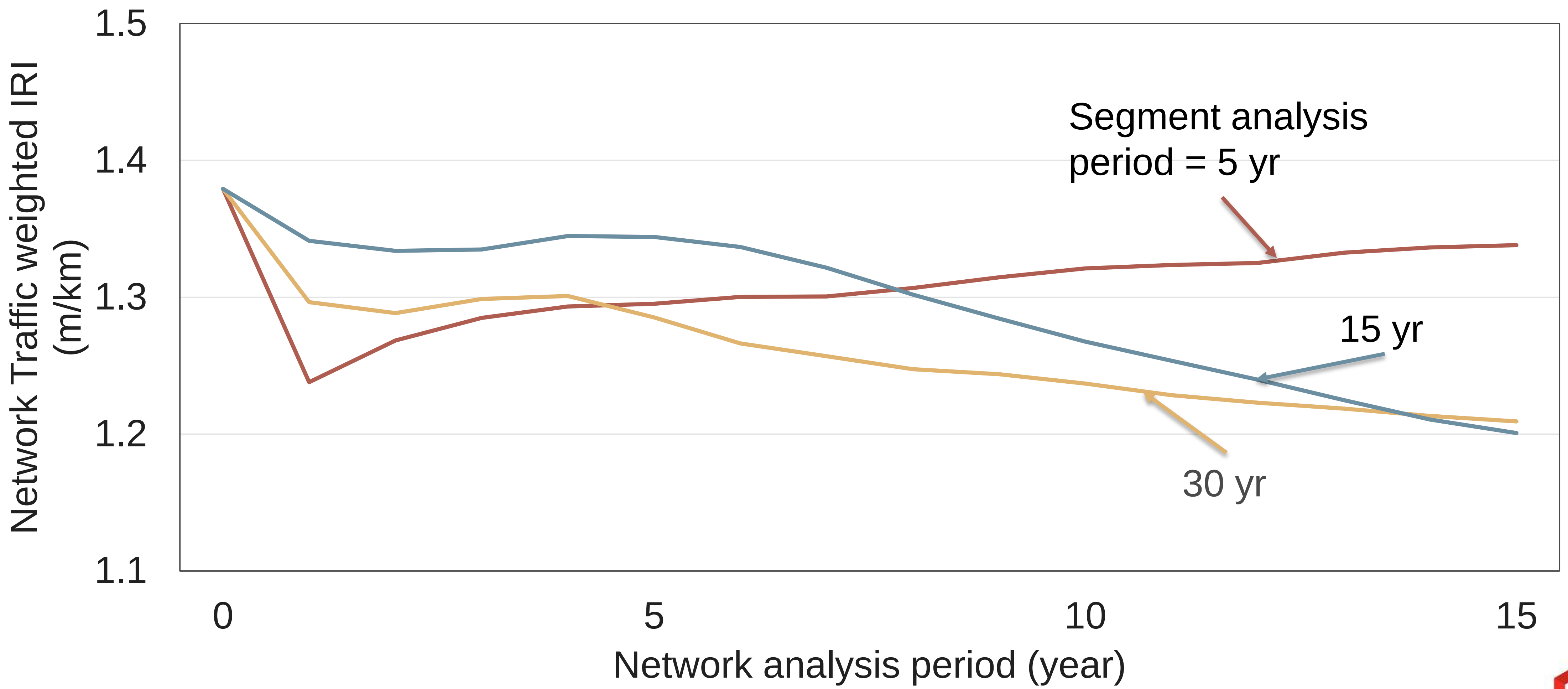
Single material network performs worse than a diversified network



Key Considerations:

- Analysis period
- Available maintenance, rehabilitation, and reconstruction activities
- Uncertainty in prices and deterioration

Longer analysis period improves network performance



Analysis period influences mix of fixes

Key considerations for performance-based planning

Analysis period

- Explore impacts of longer segment and network analysis periods

Cost and deterioration data

- Include uncertainty
- Evaluate data pedigree (time period and source of training data)

MRR alternatives

- Include concrete overlays

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Thank you

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