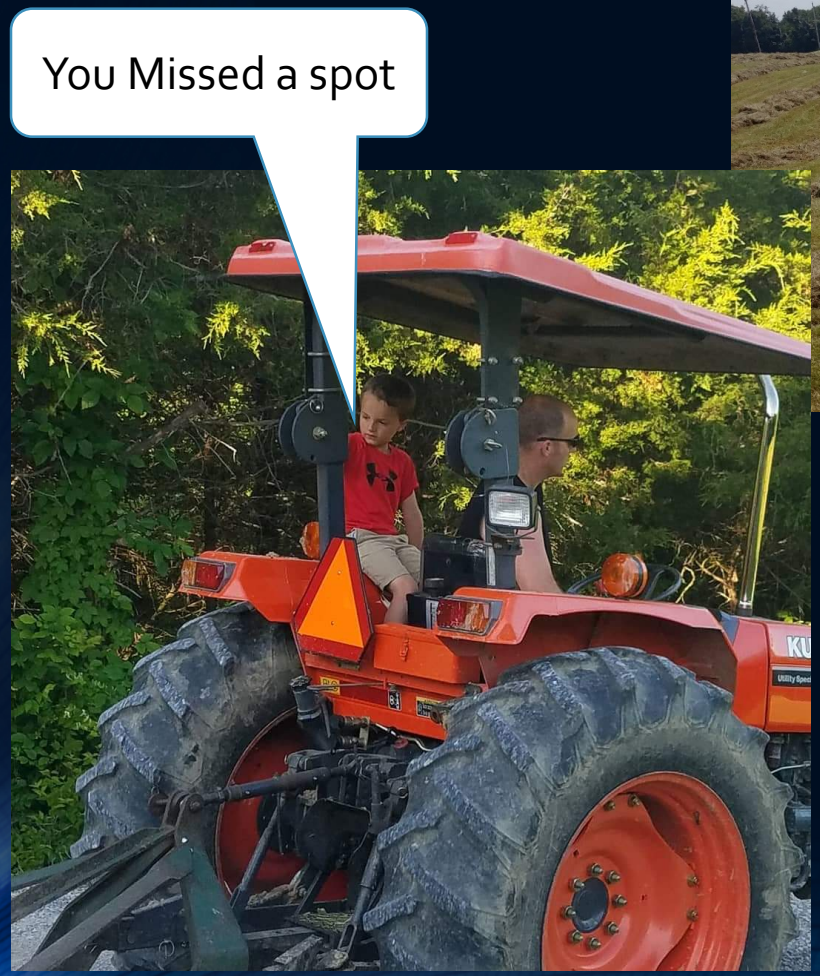
FLEXIBLE DESIGN IN KENTUCKY

KENTUCKY
TRANSPORTATION
CABINET

My Thoughts On Flexible Design



Think like a farmer!

KENTUCKY TRANSPORTATION CABINET

Farm Versus DOT's

- Limited Resources
- Limited Funding
- A great deal of needs

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Farm Equipment

- Purchase one new piece of equipment or look at upgrading all equipment

Transportation System

- Build one "Cadillac" project or upgrade the system

KENTUCKY TRANSPORTATION CABINET

Mission

To provide a safe, efficient, environmentally sound and fiscally responsible transportation system that delivers economic opportunity and enhances the quality of life in Kentucky.

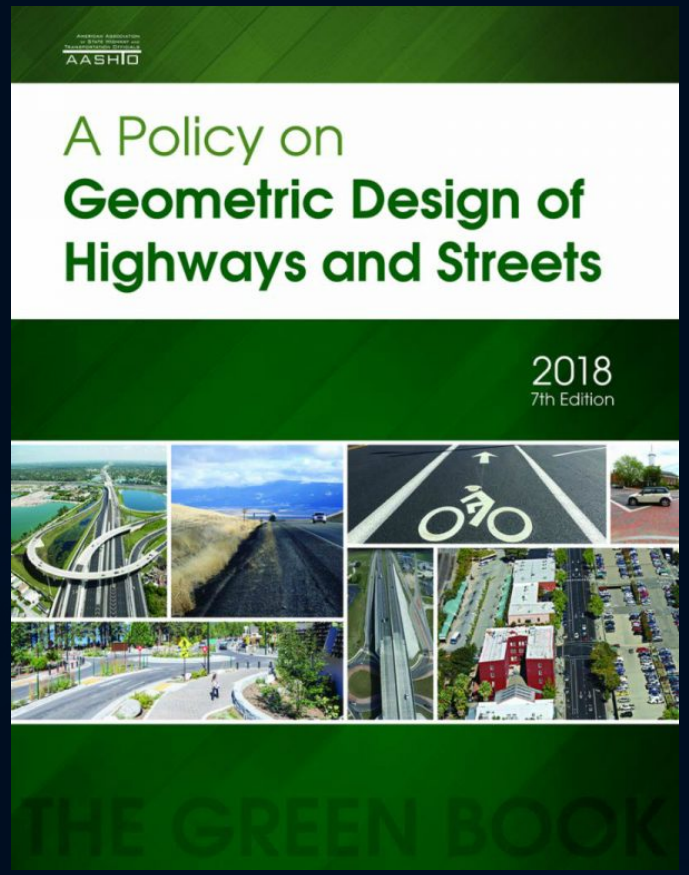
Our Focus

Safety *Communication* *Teamwork* *Efficiency* *Innovation*

ENTUCKY TRANSPORTATION CABINET

KENTUCKY TRANSPORTATION CABINET

AASHTO 2018



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It's time to Preserve!

- KYTC maintains 28,000 centerline miles of roadway and 8,843 bridges

KENTUCKY TRANSPORTATION CABINET

FLEXIBLE DESIGN IN KY

- Performance Based Flexible Solutions (PBFS) (2016) – "Bottom Up Approach"

KENTUCKY TRANSPORTATION CABINET

Bridging Kentucky

- Six year program to improve the safety and soundness of over 1,000 bridges across the state.
- Investing $700 million
- Rehabilitate, repair, or replace deficient/sub-standard structures

KY Transportation Center Study

Existing Cross Section	Crash Rate (C/MV)	Travel Speed (mph)
2 Lane, 10 ft L, 2 ft S	5.4	41.4

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KY Transportation Center Study

Cross Section	Crash Rate (C/MV)	Cost/Mile (millions)	Travel Speed (mph)	Miles
2 Lane 12 ft L, 8 ft S	2.9	$7.2	46.7	69.4

Miles improved w/$500 m

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KY Transportation Center Study

Cross Section	Crash Rate (C/MV)	Cost/Mile (millions)	Travel Speed (mph)	Miles
4 Lane 12 ft L, 8 ft S	2.4	$21.5	55.9	23.3

Miles improved w/$500 m

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KY Transportation Center Study

Design	Miles Improved w/ $500 m	Crash Rate Reduction	Travel Speed Increase	Total Gains w/ $500 m Crash Reduction	Total Gains w/ $500 m Travel Time Reduction
Practical	69.4	2.5	5.3	173.5	367.8
Typical	23.3	3.0	14.5	69.9	337.9

More miles, fewer crashes and fewer delays for same budget!

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Changing the way we determine design criteria?

Old Approach

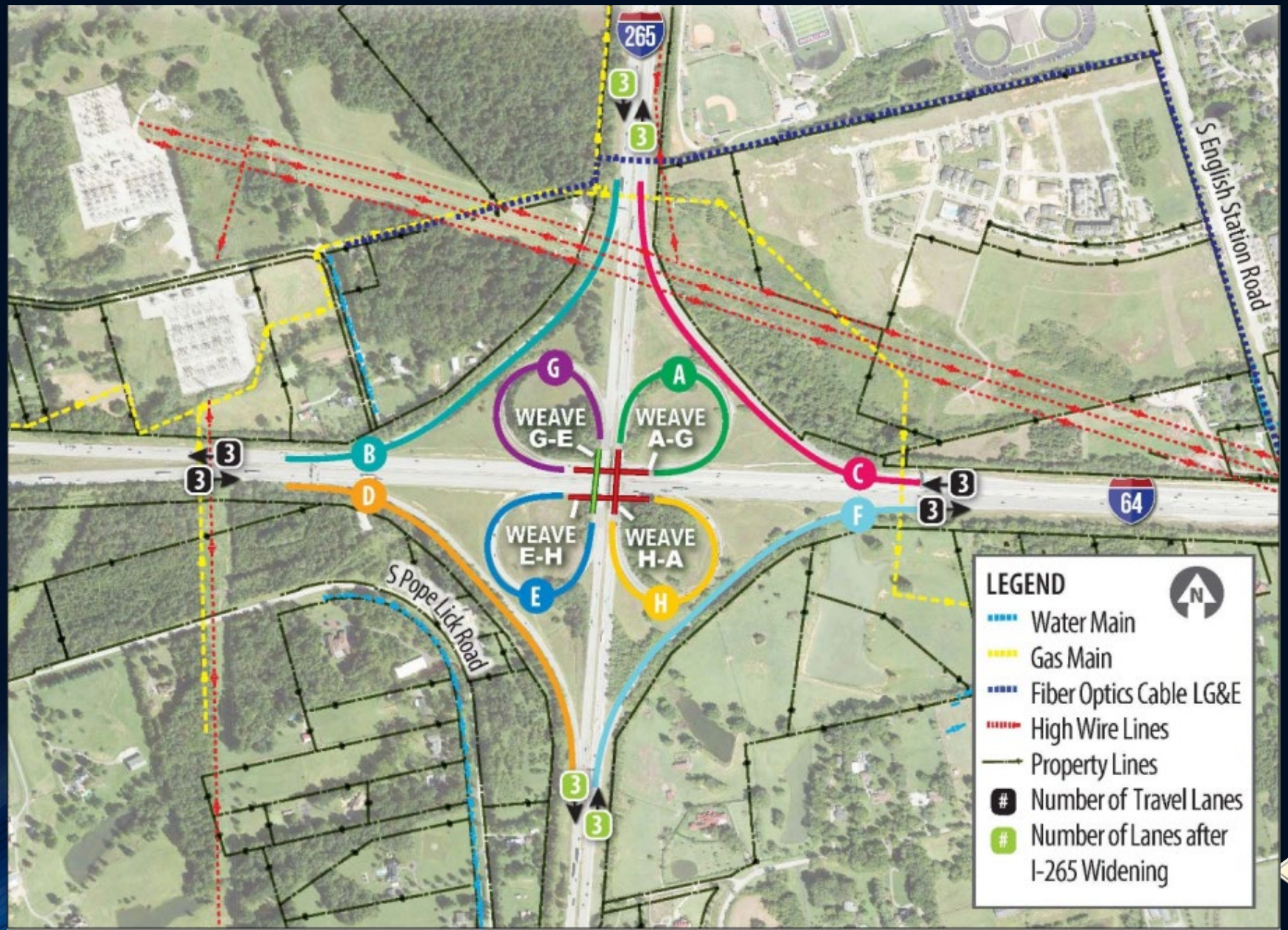
1. Design speed influenced by posted or statutory speed limit
2. 20 year traffic forecast

New Approach

1. Existing operating speed. What is the speed based on existing geometrics
2. 5,10,15, or 20 year traffic forecast

KENTUCKY TRANSPORTATION CABINET

I-64/I-265 SYSTEM INTERCHANGE



I-64/I-265 PREFERRED ALTERNATIVE

I-MOVEKY
KENTUCKY TRANSPORTATION CABINET

CHALLENGES

Project
Budget

Safety
Mobility
Economic development
Utilities
Right of Way
Local officials Interest
Public input
Environmental

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MOVING FORWARD

- Well defined Purpose and Need – Planning Phase
- Training for Project Managers
- Design Executive Summary documentation
- Evaluation of past Flexible Design projects that have been constructed

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IN CONCLUSION

- Look at the big picture
- Collaboration between all Stakeholders (State, FHWA, Public)
- Think like a Farmer!

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VDOT
Virginia Department of Transportation

VDOT Performance-Based Practical Design

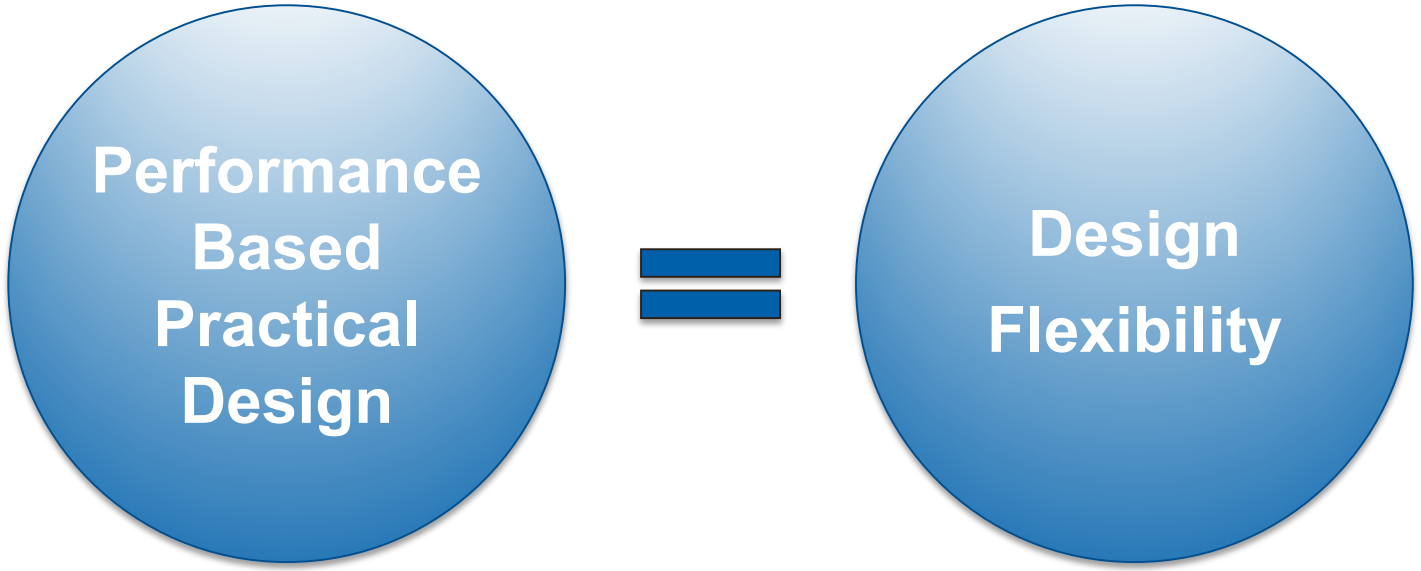
Philosophy, Process and Implementation

Why did this happen?

"Limited transportation dollars have consequences."

~Former Virginia Secretary of Transportation Aubrey Layne

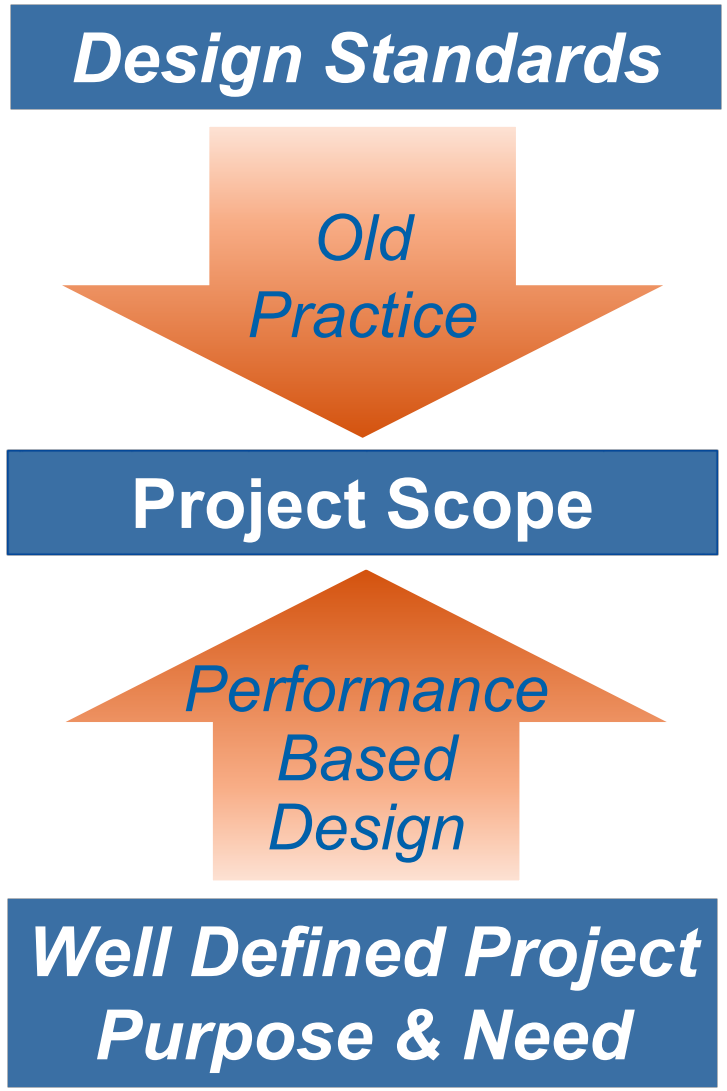
- Making the most of limited funding (Return on Investment)
- Improving safety and mobility
- Increasing public engagement and improving public satisfaction
- Ensuring projects are appropriate to their surroundings



What is it exactly?

- Design standards dictate the project scope
- Strip down to meet budget
- Limited use of Design Exceptions and Waivers

- Purpose & Need dictate the project scope
- Builds up from existing conditions to meet the project purpose & need
- Makes efficient use of Design Exceptions and Waivers



Performance-Based Planning

Does this decision tree make sense?

New Engine

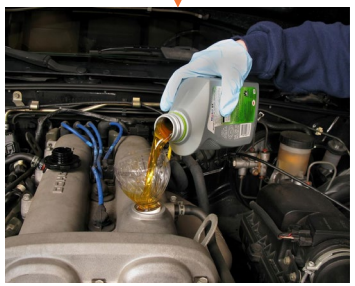
New Car

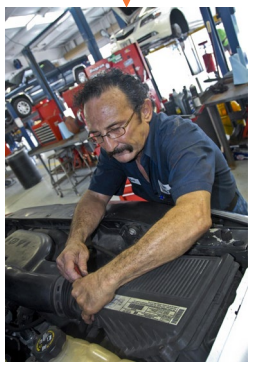
Performance-Based Planning

Or is this more logical...

Understand the problem

Develop/Test Solutions





Performance-Based Planning

Key Principles

- Identify the project specific need(s) to address
- Consider options using and improving existing transportation system
  - *Operational improvements*
  - *Transportation demand management*
  - *Innovative intersections*
  - *Reallocation of existing typical sections and right of way*
- Expand the transportation system when the above options do not provide a solution

Needs → Solutions

Needs drive toward solutions

as opposed to

Solutions in search of a need

- **Process of planning and developing performance driven solutions improves chance of project funding**
- **Focus on planning and project development feeds cost effective solutions into the project evaluation process**
- **Existing projects are re-evaluated for more cost effective solutions**

VDOT's Focus

To Create, Maintain and Nurture an Environment of Problem Solving

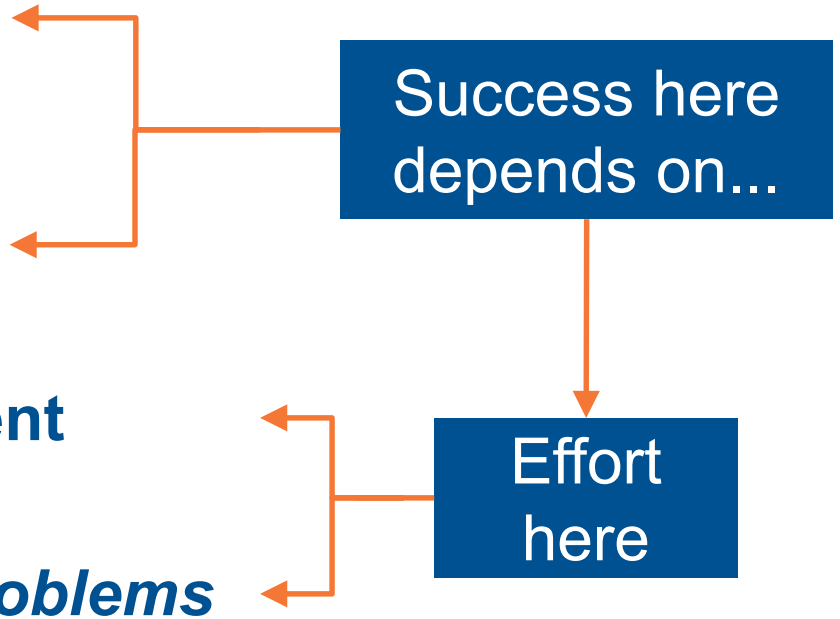
- Adjust standards and policies to provide flexibility
- Encourage early alternate design investigation
- Support designer creativity using knowledge and experience
- Focus on economic, innovative and practical solutions

Roadblocks

- Overly conservative practices and rigid standards
- Perception that flexibility contradicts safety (Nominal vs. Substantive)
- Inconsistent application across Districts, personnel and projects
- Eliminating decisions in silos (disciplines, divisions, districts)
- Lack of technical knowledge, experience and understanding
- Conflicting project, corridor and political goals

Performance-Based Planning and Programming

- **Performance based programming**
  - ***SMART SCALE***
  - ***State of Good Repair***
  - ***Highway Safety Improvement Program***
- **Performance Based Planning/Project Development**
  - ***Philosophy***
  - ***Innovative thinking to solve transportation problems***



Cost Matters

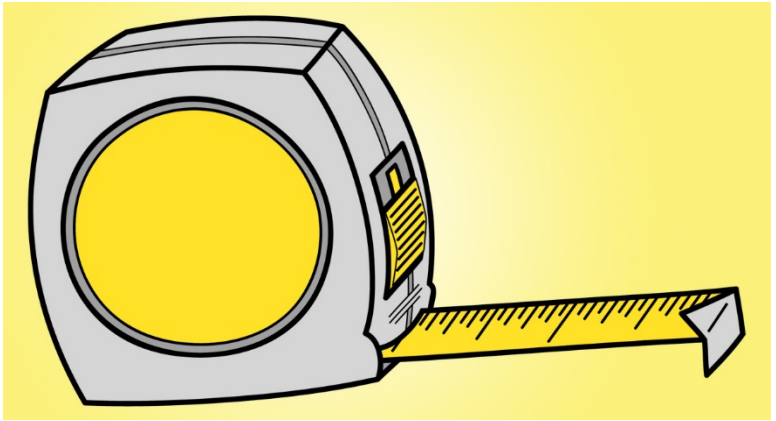
- SMART SCALE requires project assessment based on benefits relative to cost
- Incentive to be cost effective
- Incentive to find creative solutions
- Encourages efficient use of existing facilities

Official SMART SCALE Score is

$$\frac{\text{Benefit}}{\text{Requested \$}}$$

Measures of Benefit (Scoring)

- Safety
- Congestion Mitigation
- Accessibility
- Environmental Quality
- Economic Development
- Land Use Coordination



Strengthening the Planning Process

- Better chance of realizing success when funding with performance-based planning
- Approach every transportation problem with goal to find cost-effective solutions
- Convince local/regional decision makers and public to see innovative solutions rather than settling for a less than optimal project (bandaids)
- Performance-based programming processes fed by performance-based planning process

Success Story

Warrenton Southern Interchange – Culpeper District

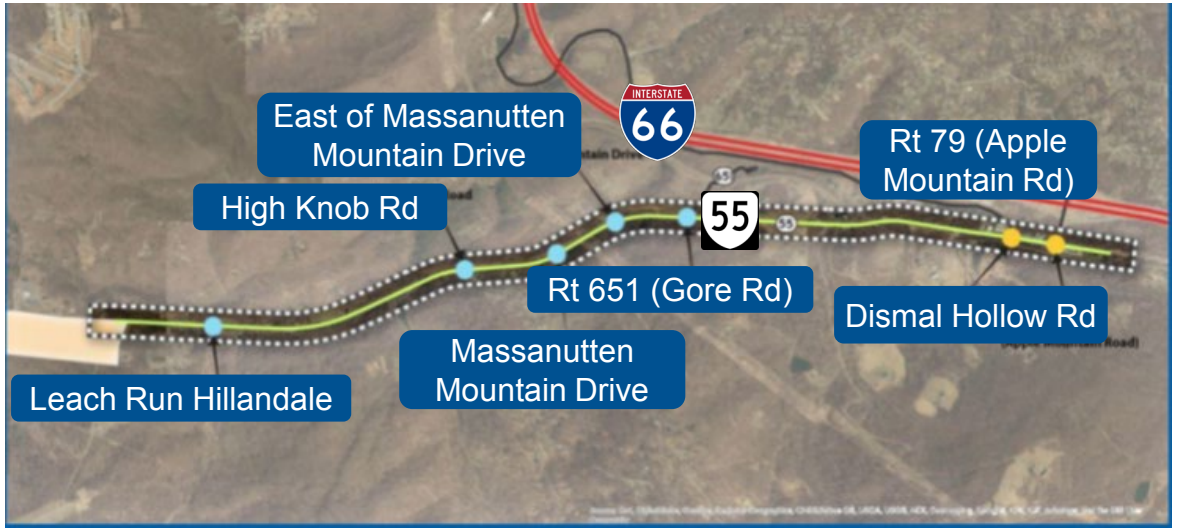
- Needs to reduce accidents, reduce congestion and improve system linkage
- Initial project full diamond interchange with >$45M estimate
- Significant bridge costs and ramp widths to accommodate volumes
- Alternate ramp design reduced right of way and gas transmission impacts
- Retaining walls eliminated
- Budget was reduced to $27M
- Still met the same needs/benefits

Success Story

Route 55 East/John Marshall Highway – Staunton District

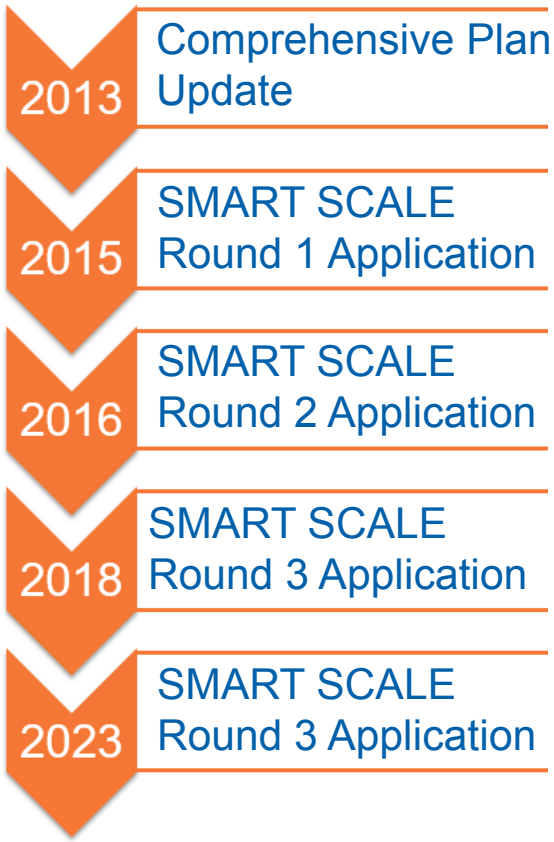
Existing Conditions

- Poor pavement markings
- Need for signage upgrades
- Sight distance issues
- Deficient traffic control elements
- Rear-end/Fixed object off-road crashes
- 121 crashes over 5-year period
- Localized congestion at Rt 79 intersection only



Success Story

Route 55 East/John Marshall Highway – Staunton District



Rounds 1 and 2

- Widen to 4-lane divided
- $24-32 million
- Benefit points less than 1
- SMART SCALE score <0.5
- Near bottom in District rankings

Round 3

- Added targeted spot safety improvements
  - Rumble strips
  - Raised pavement markings
  - Guardrail improvements
  - Sign improvements
  - Speed feedback signage
  - Variable message boards
  - Fixed object removal
- $1.6 million
- Benefit points > 4
- SMART SCALE score > 25
- 3rd highest ranked project in district

Success Story

Route 624 Morgans Ford Bridge – Staunton District

Maintenance, Safety and Capacity Needs

- Replacement of low water crossing bridge
- Structurally deficient
- Sufficiency rating 2 out of 100
- Raise bridge and realign substandard curves
- Three deaths over two years
- One lane existing but ADT exceeds one lane volumes
- Environmental, historical and constructability constraints

Success Story

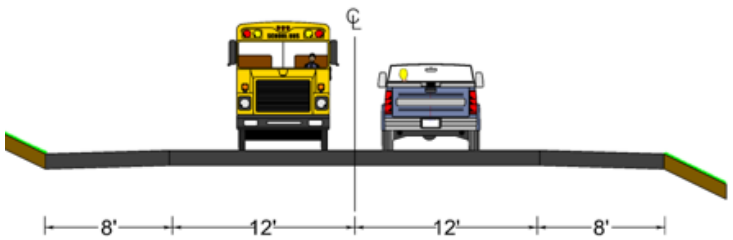
Route 624 Morgans Ford Bridge – Staunton District

Solutions

- Reduce speed limit
- Add truck restrictions
- Add Heritage tourism signage
- Aesthetic treatments to bridge
- Widen for need rather than standard

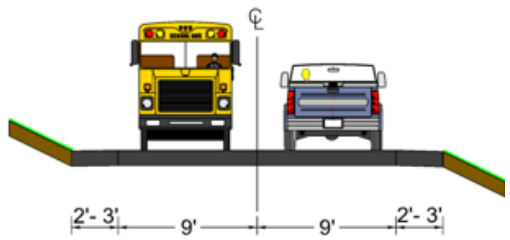
VDOT and AASHTO Minimum Design Criteria

- Two 12-foot lanes
- Two 8-foot shoulders
- Minimum pavement width 40 feet



Staunton District Recommended Criteria

- Two 9-foot lanes
- Two 2 to 3-foot shoulders
- Proposed pavement width 22 to 24 feet



Summary

- VDOT is constantly evolving and adapting
- Performance Based Design is a continuous process
- It's all about being problem solvers
- Don't let the standards get in the way of safe common sense solutions
- Experience and courage lead to innovation
- Ability to think outside the norms

"The definition of insanity is doing something over and over again and expecting **a different** result."
- Albert Einstein

*"The problem is that agencies sometimes lose sight of **common sense** as they create regulations."*
-Fred Thompson

Questions?

GDOT
Georgia Department of Transportation

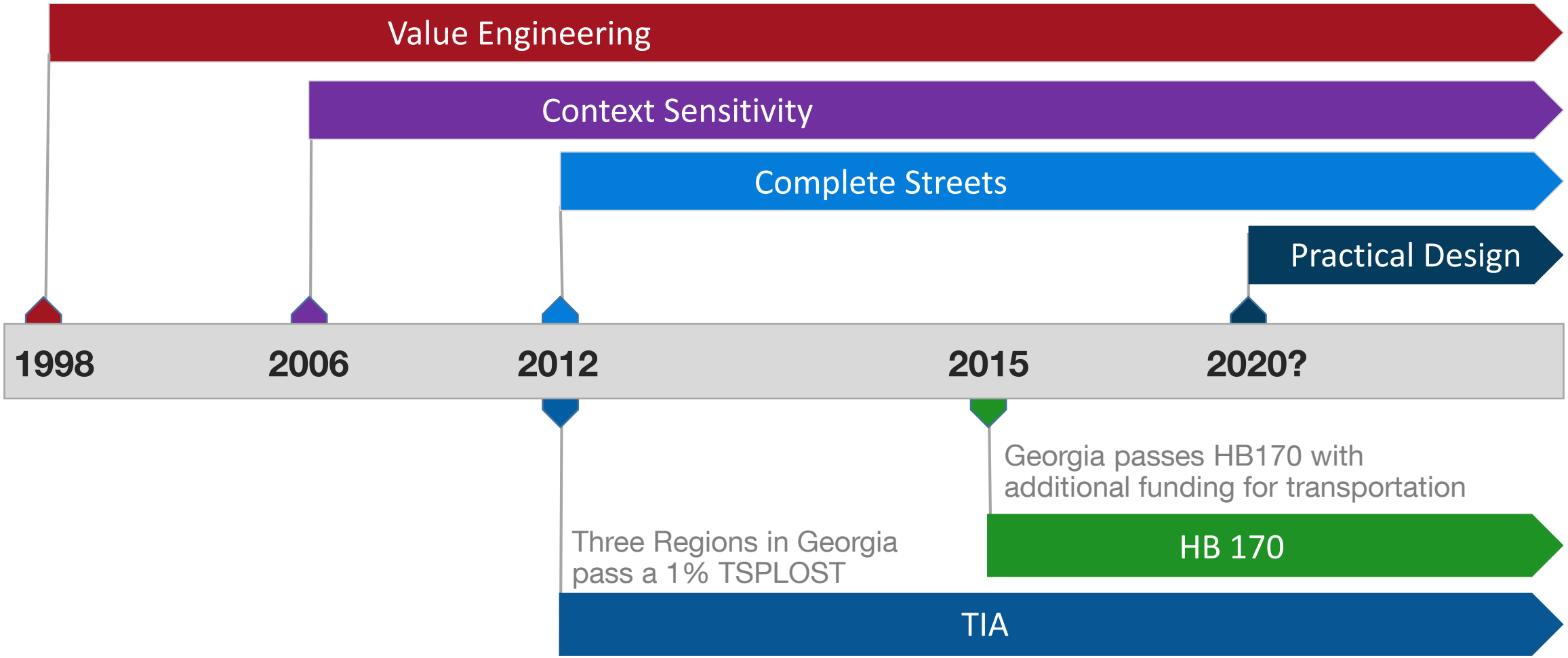
Implementing Practical Design

Christopher Rudd, PE

Asst. State Roadway Design Engineer

Practical Design

Why Implement?



Value Engineering

a systematic process of review and analysis of a project, during the concept and design phases, by a multidiscipline team of persons not involved in the project, that is conducted to provide recommendations for:

1. *providing the needed functions [of the project] safely, reliably, efficiently, and at the lowest overall cost;*
2. *improving the value and quality of the project; and*
3. *reducing the time to complete the project.*

Performance-Based Practical Design

a "design up" approach where transportation decision makers exercise engineering judgment to build up the improvements from existing conditions to meet both project and system objectives. PBPD uses appropriate performance-analysis tools, considers both short and long term project and system goals while addressing project purpose and need.

Georgia Department of Transportation

Context Sensitive Solutions

a collaborative, interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure conditions.

Complete Streets

streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists, or public transportation riders.

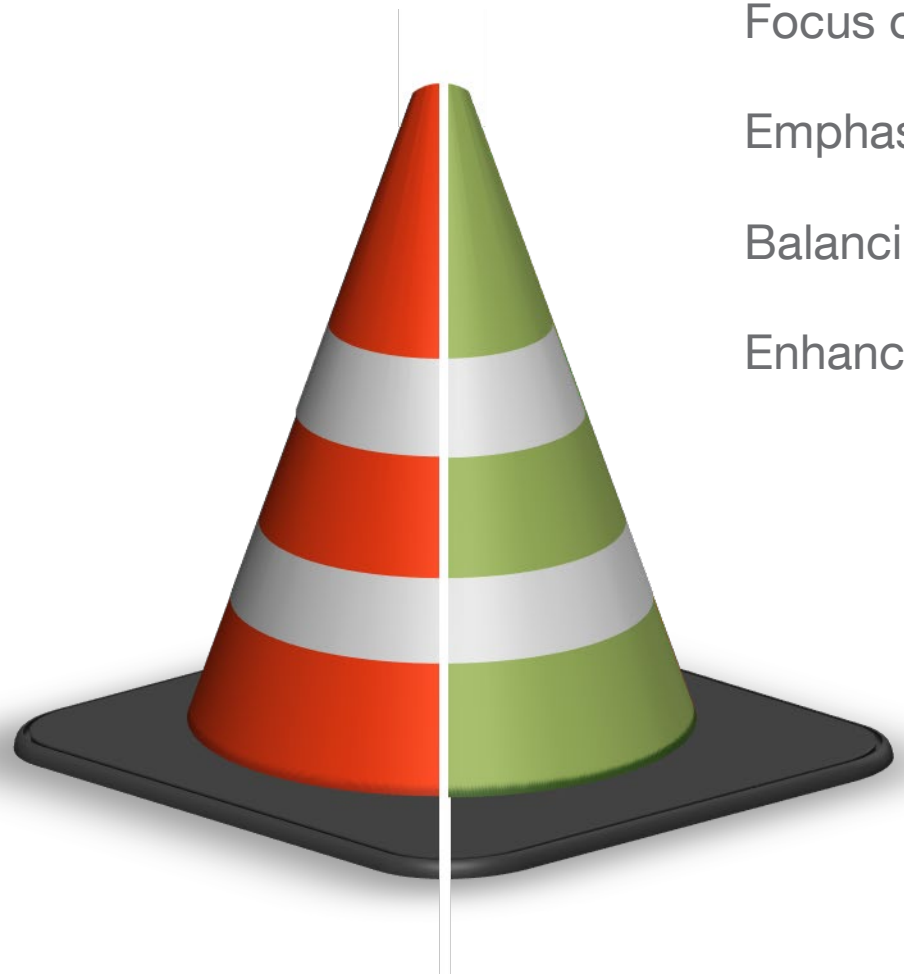
approaches vary based on community context. They may address a wide range of elements, such as sidewalks, bicycle lanes, bus lanes, public transportation stops, crossing opportunities, median islands, accessible pedestrian signals, curb extensions, modified vehicle travel lanes, streetscape, and landscape treatments.

Performance-Based Practical Design

a "design up" approach where transportation decision makers exercise engineering judgment to build up the improvements from existing conditions to meet both project and system objectives. PBPD uses appropriate performance-analysis tools, considers both short and long term project and system goals while addressing project purpose and need.

What it is NOT

- ✕ Compromise of Safety
- ✕ Design to Budget
- ✕ Reducing Costs ‘At All Costs’
- ✕ Indifferent to Context
- ✕ Elimination of Standards



What it IS

- ✓ Focus on Need and Purpose
- ✓ Emphasis on Engineering Judgement
- ✓ Balancing of Project Measures
- ✓ Enhancement of Overall Program

Areas of Influence

Design Documentation

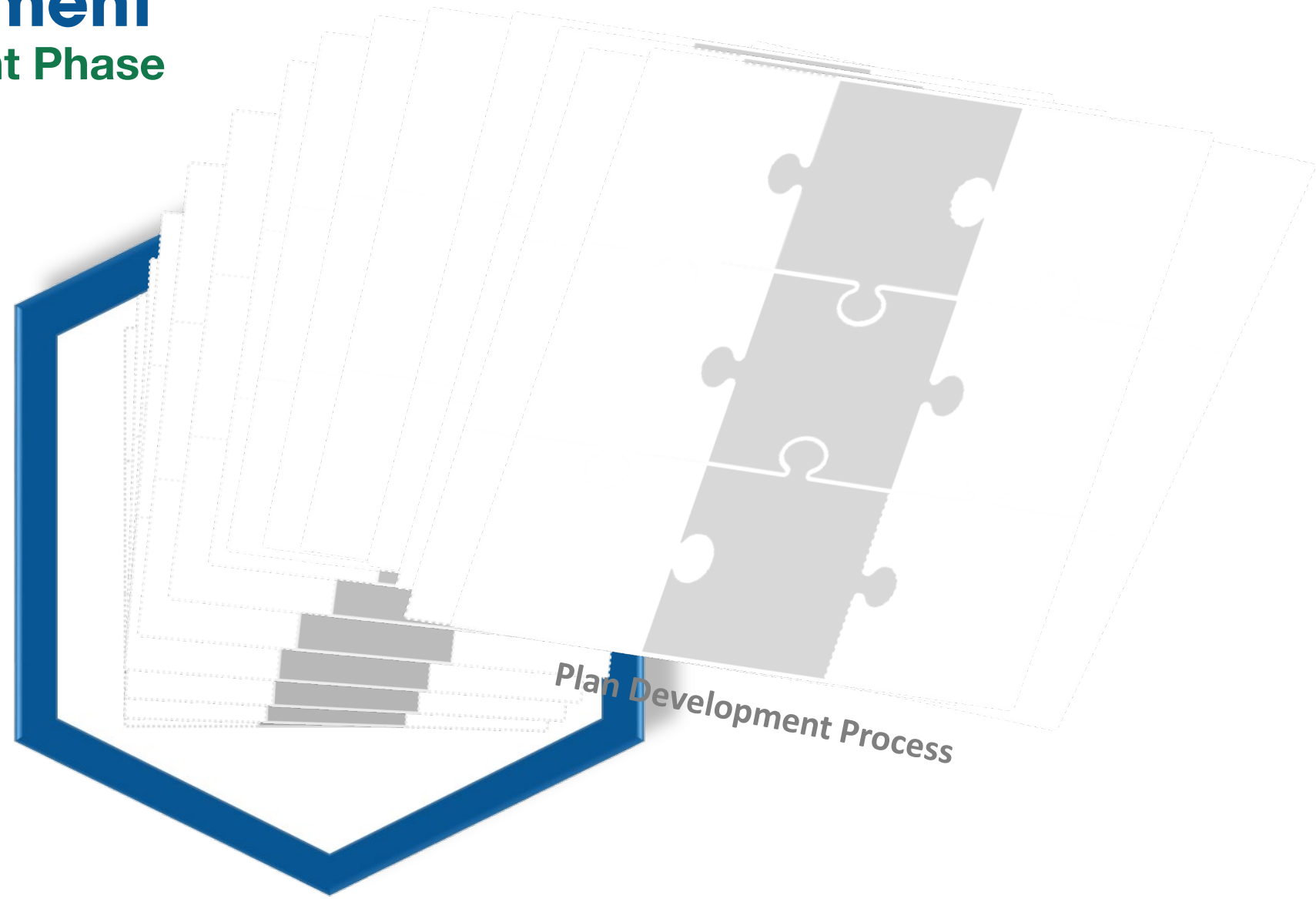
Method (the Process) of … / reports of the project

Process Refinement

In the Plan Development Phase

Process Refinement

In the Plan Development Phase



Process Refinement

In the Plan Development Phase

- Soil Surveys
- Traffic Studies
- Pavement Studies
- Wall Designs/Studies
- Right of Way

Scope Conformance

Need & Purpose

Need

Goals

Identify Need

Establish Goals & Priorities

Scope Conformance

Need & Purpose

Need 

Goals 

PLANNING & BACKGROUND DATA

Project Justification Statement: The following project justification statement was prepared by the Office of the State Transportation Planning Administrator.

State Route 11/State Route 49/US 41/Industrial Highway is currently a two-lane undivided facility, located just south of the City of Macon in Bibb County. This roadway is functionally classified as an urban principal arterial, and is listed as a designated bicycle route. This project was originally added to the Department's Construction Work Program in 2002. This project has also been identified in Macon-Bibb County's 2035 Long Range Transportation Plan.

Based upon existing traffic information obtained from the GDOT STARS database, the 2010 existing Average Annual Daily Traffic (AADT) on SR 11 between Avondale Mill Road and Walden Road is approximately 5,300 vehicles, of which, 15% represents truck traffic. With these current volumes, this route operates at a level of service (LOS) "C," which is considered acceptable based on LOS performance measures set in accordance with the 2035 Statewide Transportation Plan. According to volume projections based upon the last 15 years of historical data, the 2035 traffic volumes on this route are projected to increase to approximately 5,800 AADT, causing the level of service to remain operating at a LOS of "C." The truck percentage is expected to remain a significant proportion of traffic into the future.

The predominant land use along this route within the area of this project is heavy commercial/industrial, as reflected through the relatively high percentage of truck volumes. The presence of trucks, large turning movement volumes into these local industrial facilities, and lack of existing passing opportunities are expected to cause the roadway to experience operational issues in the future.

Between the years 2008 and 2010, the crash rate for this section of roadway was below the statewide average. However, in that same year range (2008 – 2010), "rear end" crashes were the second highest type of crash that occurred. This is indicative of potential operational problems such as lack of sight distance, lack of turn lanes, and high numbers of access points within a short distance. By providing operational improvements on this corridor, traffic operations should improve.

Scope Conformance

Need & Purpose

Need

Goals

Project Justification Statement:
This project justification statement was prepared by ARCADIS U.S., Inc., approved by Georgia Department of Transportation (GDOT), and is on record at GDOT's Office of Traffic Operations.

The proposed project is intended to reduce crash severity and frequency at the intersection. The purpose of this concept report is to provide an evidence-based comparison of intersection alternatives, justifying the preferred intersection control for this location. The proposed project is to be included in the GDOT Office of Traffic Operations Safety Lump Program.

This project was proposed by GDOT District 3, who observed a high crash rate at the intersection. Collision data for the project intersection was collected for the period 2014 – 2018. A total of 16 crashes were reported during this time, resulting in 8 injury and 8 property damage only collisions. The predominant crash type at this location is an angle collision, accounting for 44% of all crashes reported over the most recent five years. A summary of the collision data is included as Attachment 5.

Roundabouts have been identified as one of nine proven countermeasures by the Federal Highway Administration (FHWA). The installation of a roundabout in comparison to traditional safety countermeasures, such as traffic signals, resulted in a greater reduction in crash occurrence and, in many instances, operational improvements. Drivers generally traverse roundabouts at slower speeds, correlating with reduced collision severity. Roundabouts also have fewer conflict points than traditional intersection controls, resulting in reduced crash frequency. FHWA crash modification factors propose that converting the project intersection from stop controlled on the minor approached to a single lane roundabout is expected to reduce occurrence of injury and property damage only crashes.

Scope Conformance

Need & Purpose

Need

Goals

The purpose of this project is to improve operations at the intersection of State Route (SR) 81 and SR 138. SR 138 is a principal arterial and SR 81 is a minor arterial. They are both two lane facilities that have intermittent turn lanes, center two-way left turn lanes and sidewalks. This intersection was identified for improvements through a 2015 GDOT Office of Planning review of the SR 81 corridor in Walton County after meeting with County officials. Most of the area nearby

This project is justified by the need to address congestion and safety and operational issues. These improvements will address the major performance goal of reducing crashes with the secondary benefit of addressing capacity issues.

Scope Conformance

Need & Purpose

Identify Need

Establish Goals & Priorities

Include All Modes

Scope Conformance

Need & Purpose

Identify Need

Establish Goals & Priorities

Include All Modes

Establish Budget

Scope Conformance
Need & Purpose

Need

Goals

Modes

Budget

Identify Need

Establish Goals & Priorities

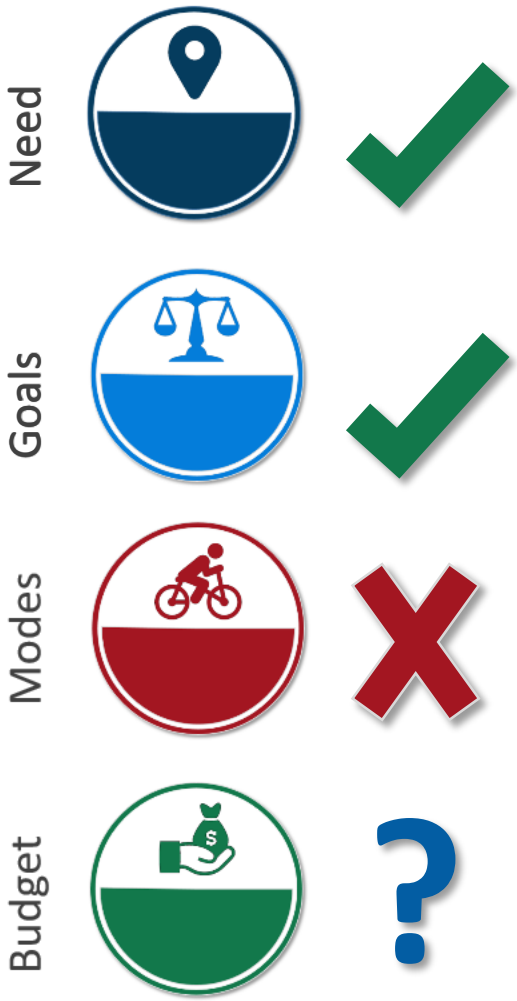
Include All Modes

Establish Budget

GDOT
Georgia Department of Transportation

Scope Conformance

Need & Purpose



The purpose of this project is to improve operations at the intersection of State Route (SR) 81 and SR 138. SR 138 is a principal arterial and SR 81 is a minor arterial. They are both two lane facilities that have intermittent turn lanes, center two-way left turn lanes and sidewalks. This intersection was identified for improvements through a 2015 GDOT Office of Planning review of the SR 81 corridor in Walton County after meeting with County officials. Most of the area nearby the intersection can be characterized as rural or low density suburban. SR 138 is identified on the Atlanta Regional Thoroughfare Network (RTN) and Strategic Truck Route network, which are networks adopted by the Atlanta Metropolitan Planning Organization (MPO) indicating the regional significance of this route.

According to GDOT's GeoCounts 2016 traffic data, the current Annual Average Daily Traffic (AADT) on State Route 81 between Malcom Lane and Robertson Road is 12,650 vehicles per day. The 2016 traffic data shows 9 percent trucks. The corresponding levels of service (LOS) for year 2016, as calculated in the Highway Capacity Software (HCS), is LOS E. The approved Atlanta Regional Commission's travel demand model identifies the 2040 traffic volumes on SR 81 as 14,242. The 2016 AADT on State Route 138 between Cannon Farm Road and Youth Jersey Road is 13,500 vehicles per day. The 2016 traffic data shows 10 percent trucks. The corresponding LOS for year 2016, as calculated in HCS, is LOS "E.". The approved Atlanta Regional Commission's travel demand model identifies the 2040 traffic volumes on SR 138 as 19,363.

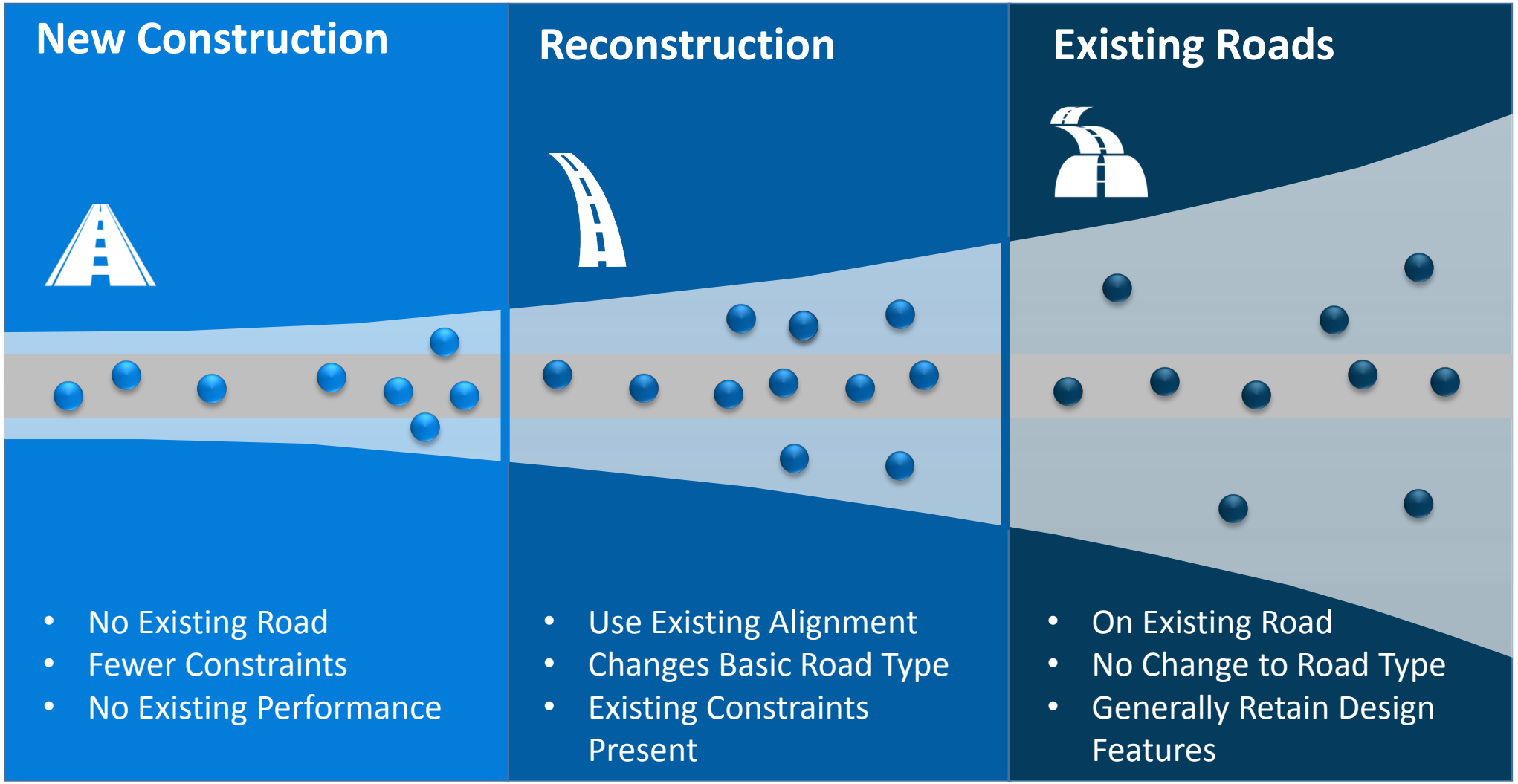
Crash rates for the corridors are compared to the statewide averages for principal and minor arterials. For 2013-2015, crash rates per million vehicle miles (MVM) were 585. 451, and 585 compared to statewide averages of 474, 511, and 478 for principal arterials. The crash rates exceeded the statewide average. Rear ends accounted for 43% of all crashes. Rear ends are commonly associated with congestion. Angle crashes accounted for 20% of the crashes. Angle crashes are commonly associated with turning movements.

Other programmed projects in the vicinity of this project include: widening on SR 138 from Hi Roc Road to SR 81 (P.I. No. 0015575) and widening on SR 81 from SR 138 to SR 10/US 78 (P.I. No. 0014125).

This project is justified by the need to address congestion and safety and operational issues. These improvements will address the major performance goal of reducing crashes with the secondary benefit of addressing capacity issues.

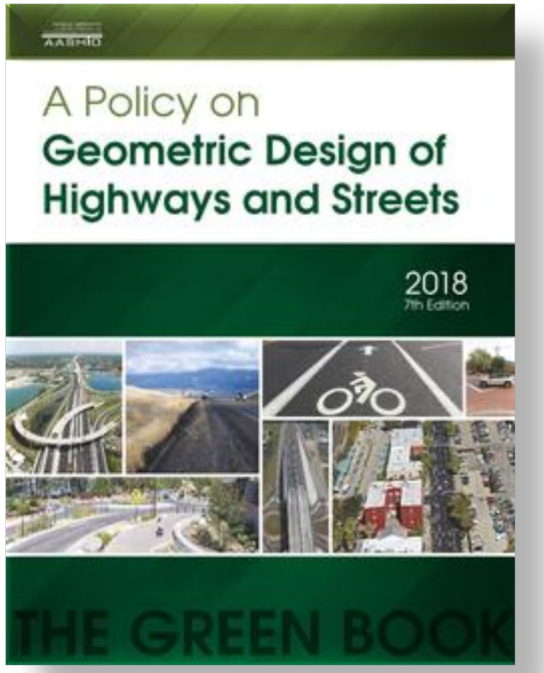
Design Features

Selection of Alternatives



GDOT
Georgia Department of Transportation

Design Features
Selection of Alternatives



- AASHTO Greenbook 1.7.2

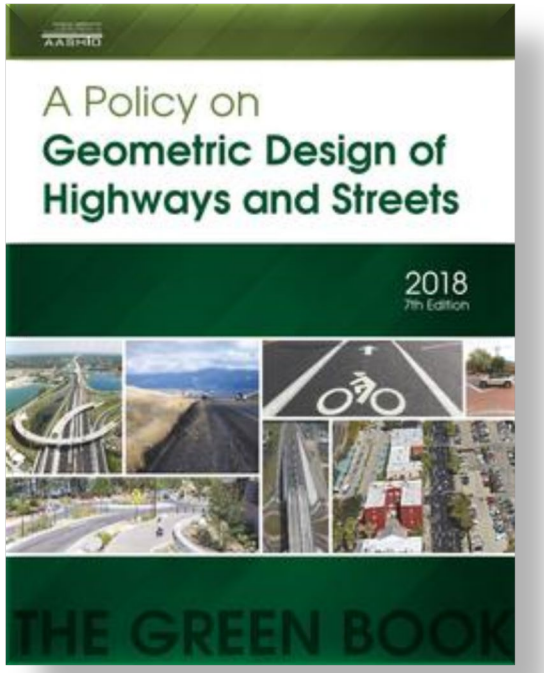
1.7.2 Reconstruction Projects

Reconstruction projects are projects that utilize an existing roadway alignment (or make only minor changes to an existing alignment), but involve a change in the basic roadway type. Changes in the basic roadway type include widening a road to provide additional through lanes or adding a raised or depressed median where none currently exists, and where these changes cannot be accomplished within the existing roadway width (including shoulders). The change in the basic roadway type means that performance measures for the existing roadway may not be relevant to forecasting the performance of the future reconstructed roadway. However, retaining the existing alignment means that existing constraints in the current roadway environment will influence design decisions. Chapters 2 through 10 of this policy should be consulted for applicable geometric design guidance in reconstruction projects but, even more than for new construction, reconstruction projects need a flexible, performance-based approach to adapt the design to fit the roadway context and meet multimodal needs.

Reconstruction projects often create the most difficult design decisions because a new facility type is being adapted to an existing alignment and needs to fit within the existing community context. While applying the design criteria for new construction in Chapters 2 through 10 of this policy to reconstruction projects is desirable, it may be impractical in many cases because of existing constraints in the corridor and the need to fit the roadway into the community context. Priorities need to be established and decisions made about how best to meet the needs of all transportation modes. Designers may find that adding some additional geometric elements (e.g., additional lanes or a median) may be feasible only if some design criteria (e.g., lane or shoulder widths) are changed. Such decisions should consider the likely effects of potential changes on future performance.

Design Features

Selection of Alternatives



- *AASHTO Greenbook 1.7.3*

The revised design process described above is intended to encourage greater flexibility in design for all projects, particularly for projects on existing roads, so that the design process is oriented toward addressing identified performance issues, roadway context, and community and multimodal needs, rather than toward improving geometric design features simply because they do not meet today's criteria applicable to new construction. Geometric design improvements should be made where the forecast performance of the existing road indicates that improvement is needed. But improving geometric design features simply for improvement's sake, when the existing road is performing well and anticipated to continue performing well, is a potential waste of the limited funds available for transportation improvements that could be better spent addressing identified problems on other roads. Every dollar spent on a road that is performing well and anticipated to continue performing well is a dollar that is not available to be spent on a road that is performing poorly. The TRB *Highway Capacity Manual* (25), the AASHTO *Highway Safety Manual* (4, 7), and other tools provide procedures to identify which roads are performing well and which are performing poorly. Section 1.9 suggests alternative approaches to performance-based design that can be implemented.

Documentation
Safety Analysis

Need & Purpose

- Identify Need(s)
- Establish Goals
- Encompass All Modes (Context)

Exceptions / Variances

- Clearly Meets Dept. Priorities
- Balances Multiple / Competing Goals

Engineering Studies

- Recommendations Balance Project / Program Priorities

Challenges

Potential Obstacles

Increased Project-Level Risk

Leverage small project level risk(s) to reduce large program level risk(s)

Increased Risk to Designer

Design Exception / Variances necessary to document flexibility sometimes take considerable design resources to complete

Lack of Research

Research in some areas is still needed to determine the total affect of flexible design particularly when used in concert with multiple features

Inconsistent Application

State priorities should be clearly established so that designers and other SMEs can make consistent project level decisions and avoid rework

Lack of Adoption by Staff

Success Measures should be established to promote adoption of policy

Expectations
Measures of Success

Safety

- Increased System-Wide Safety

Costs

- Reduced Project Costs
- Greater Benefit-Cost Ratio
- Reduced Design Phase Cost Swings

Design Effort

- Increased Design Duration/Cost
- Increased Number of DEs/DVs

Schedules

- Reduced Schedule Durations
- Reduced Letting Delays

GDOT
Georgia Department of Transportation

Implementing Practical Design

Christopher Rudd, PE

Asst. State Roadway Design Engineer