



Road Safety Audits/ Assessments



ROAD SAFETY AUDITS:

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Making Your Roads Safer

Ground Rules

- Please Mute Line
- Schedule
- Participate through the Chat or Raised

Outline of Briefing

1. Why RSAs?
2. Basic Concepts
3. RSA Procedures
4. Common Issues and Challenges
5. Examples

Goals and Objectives

- introduce road safety audits as a useful tool to reduce traffic injuries and fatalities



Dead Rat Theory





Theory of the Dead Rat

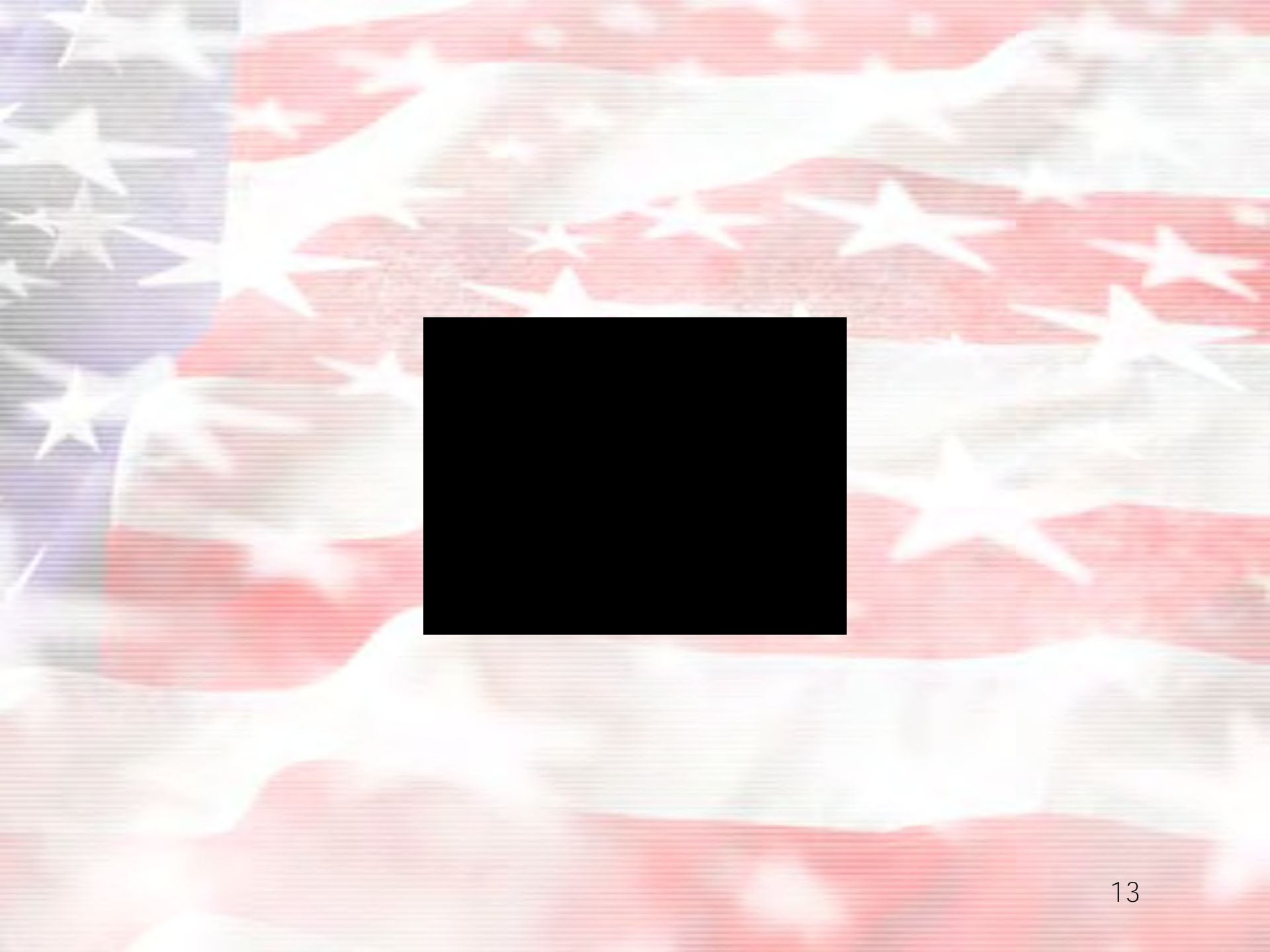
1. Smell It

2. Find It

3. Fix It

S W I M

- Say What It Means



ADT

- An Alarm Company
- Average Daily Travel/Traffic
- Atomic Demolition Tech

Warrant

- Going to see the Judge/Jail
- Meeting the Criteria

Safety



An aerial photograph of a starburst road intersection, where multiple roads radiate from a central point. The roads are paved in grey and have white dashed lines. The surrounding area is green grass. The word "Safety" is written in a light blue, sans-serif font in the center of the intersection. The image is framed by a red and white decorative border at the top and bottom.

Safety

Basic Concepts

- What is a road safety audit?
- Why do we need RSAs?
- When do we conduct RSAs?

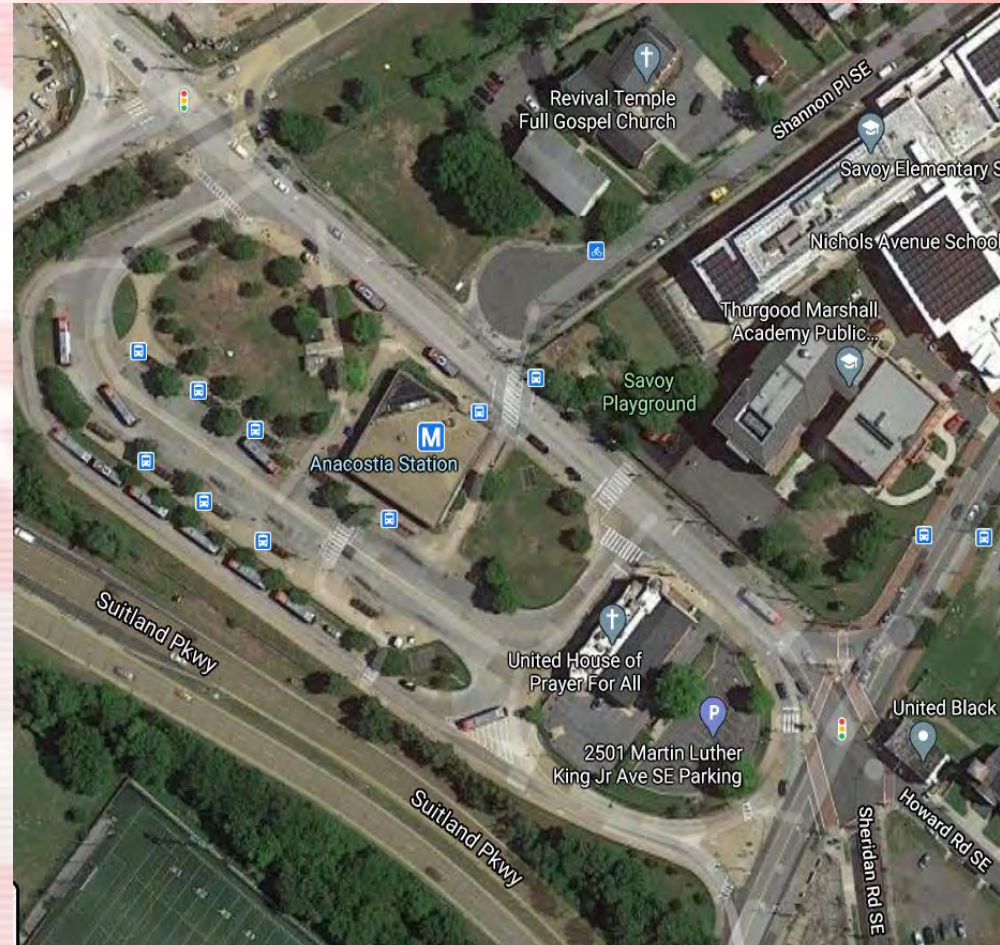
Why RSAs?

- Consistent & Comprehensive Approach to Design Process
- Stewardship
- Cost Effective
- Vital Few



Road Safety Audits (RSAs)

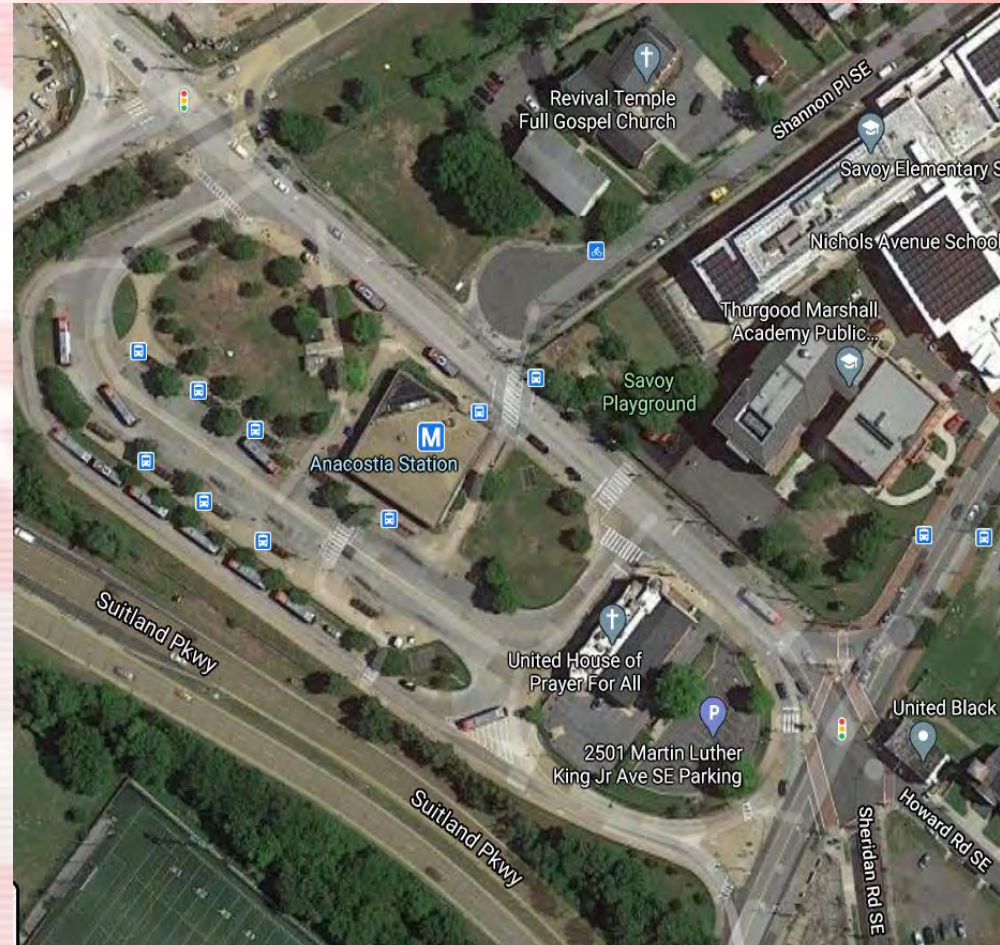
- Formal safety performance examination
- Existing or Future Road Segment or Intersection
- Independent, multidisciplinary team





Road Safety Audits (RSAs)

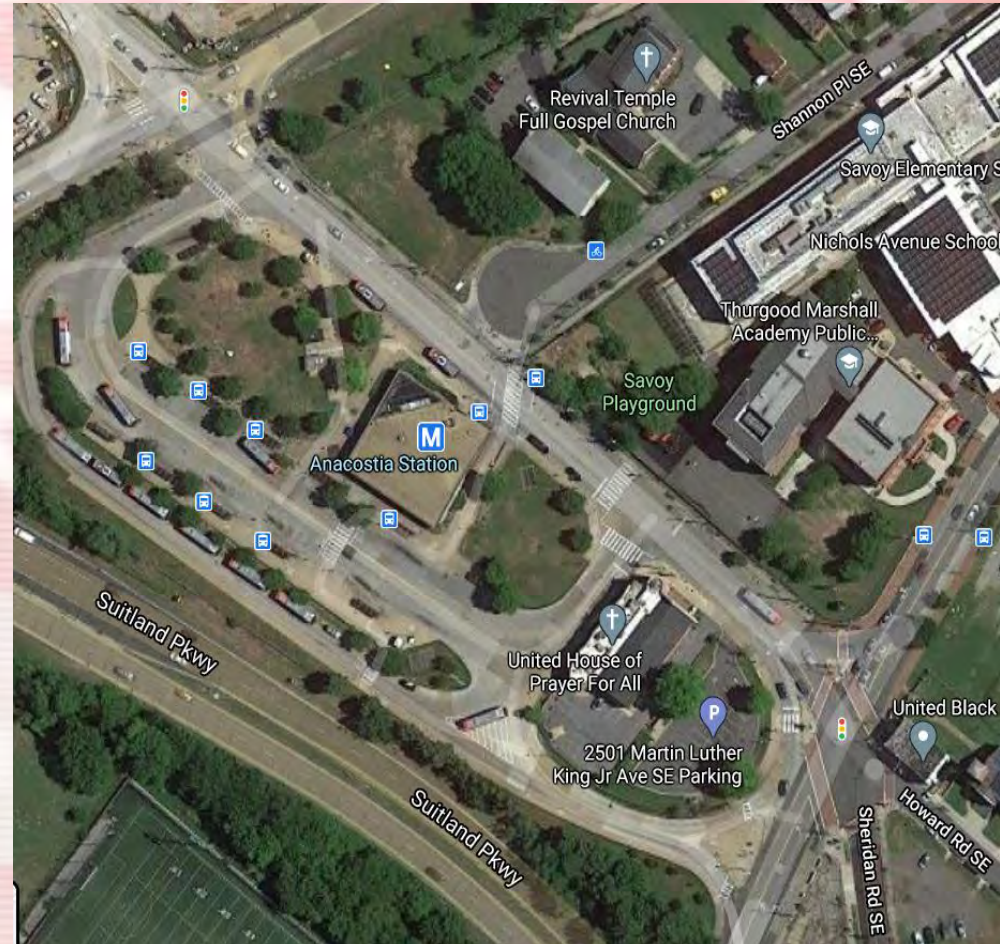
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- Existing or Future Road Segment or Intersection
- Independent, multidisciplinary team





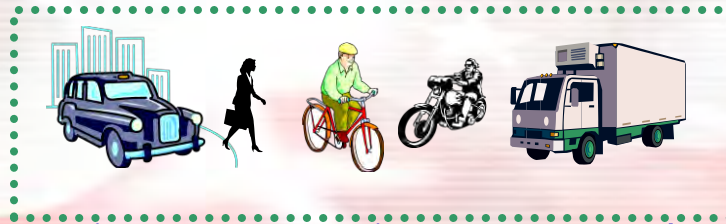
Road Safety Audits (RSAs)

- Formal safety performance examination
- Existing or Future Road Segment or Intersection
- Independent, multidisciplinary
- team



A road safety audit also...

- considers the safety of all road users



- considers interactions at the borders or limits of the project
- examines the interaction of project elements
- may proactively consider mitigation measures

The background of the slide is a blurred American flag, showing the stars and stripes in shades of red, white, and blue.

A road safety audit is NOT....

... a simple standards check for adherence to design guidelines.

... an opportunity to redesign the project.

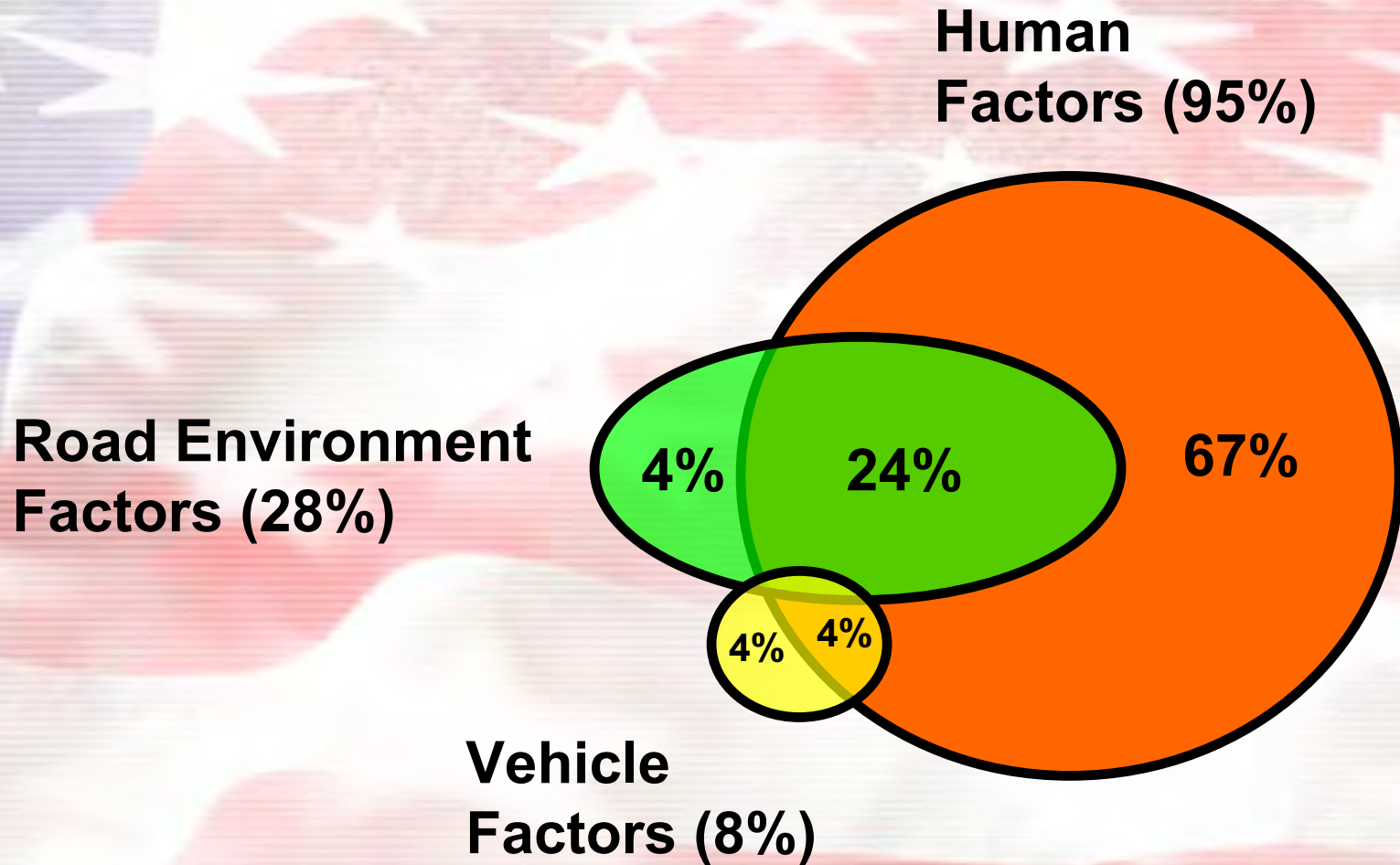
Human Factor

Vehicle Factor

Road Factor

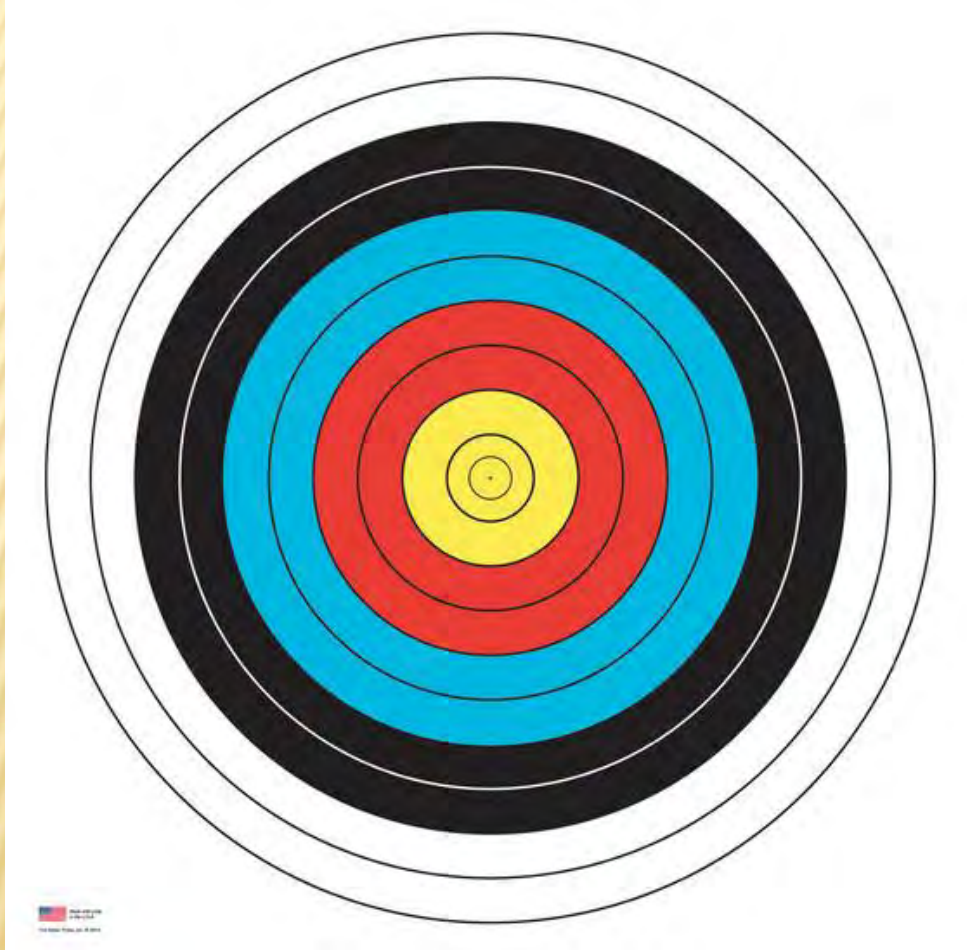


Why do we need RSAs?



TYPICAL REPORTED CRASH CAUSES

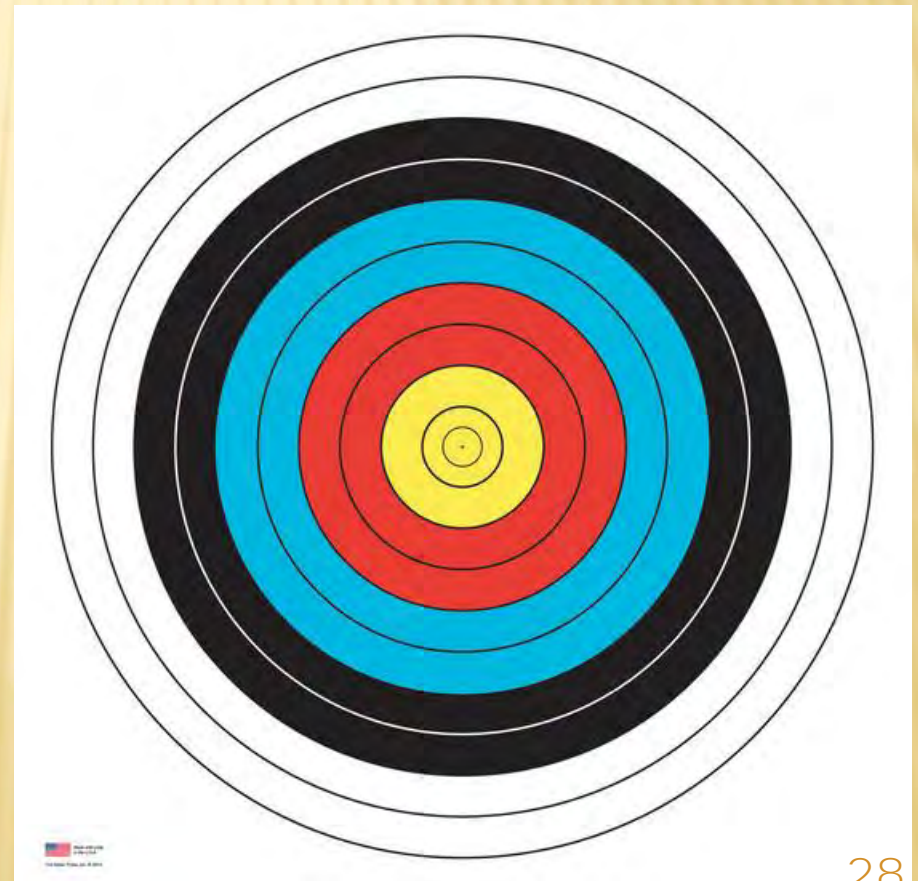
Clusters/Hot Spots

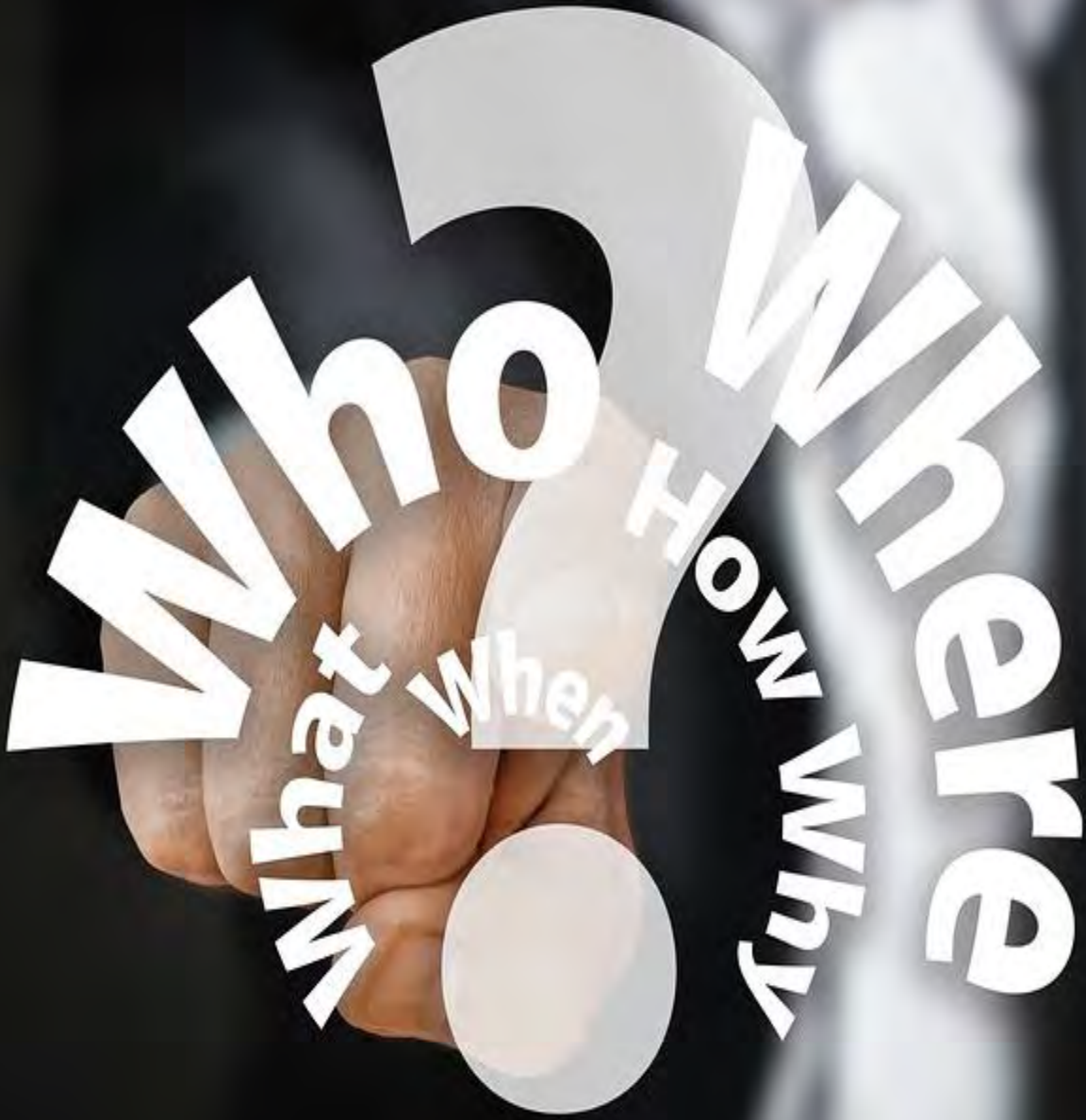


- ✘ A Lot of Stupid People
- ✘ Road Issues or Challenges

ALMOST CORRECT

Th!\$@tp@\$





Who

What

When

How
Why

Where

LOCAL VS NON-LOCAL

Locals

- + Tend to be more aggressive
- + Know the area
 - × Problems
 - × Law Enforcement

× Non Locals

- + Tend to drive slower
 - × Sight seeing
 - × Unsure of area (confused)
 - × My be the 1st and last time in the area

LOCAL VS NON-LOCAL

Locals

- + Education?
- + Enforcement?
- + Engineering?
- + EMS?

+ Non-Locals

- + Education?
- + Enforcement?
- + Engineering?
- + EMS?

RSA Benefits

- Reduce the number and severity of crashes
- Promote awareness of safe practices
- Process to identify and address problems
- Considers human factors and multimodal issues
- Low cost









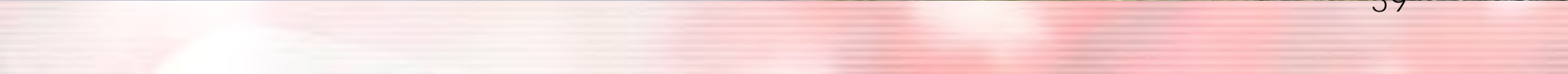








HIKERS and BIKERS
Move to the side of
the road when a
vehicle approaches







Proven Safety Countermeasures

These nine countermeasures address crashes that occur in the focus areas of intersections, pedestrians, and roadway departure.



Roundabouts



Corridor Access Management



Backplates with Retroreflective Borders



Longitudinal Rumble Strips and Stripes on Two-Lane Roads



Enhanced Delineation and Friction for Horizontal Curves



Safety Edges



Medians and Pedestrian Crossing Islands in Urban and Suburban Areas



Pedestrian Hybrid Beacon



Road Diet





IMMANUEL
BAPTIST














YOU
CAN'T
FIX
STUPID

T











Why do we need RSAs?

There are many competing interests at play in road projects:

- cost
- right of way
- environment
- topographic and geotechnical conditions
- socio-economic issues
- capacity / efficiency
- politics
- safety

Why do we need RSAs?

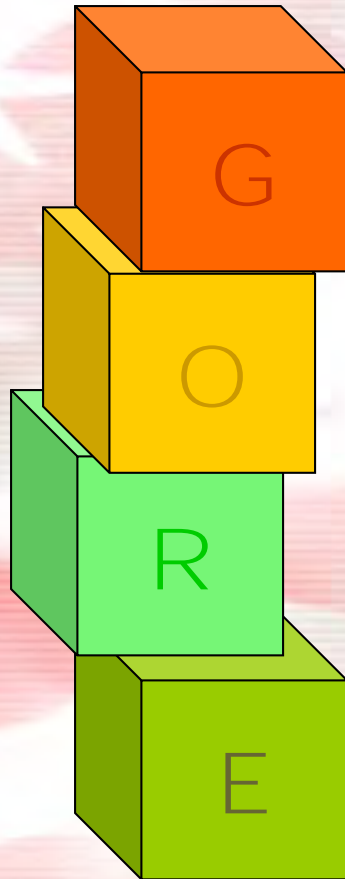
- Compromises and constraints are a normal part of transportation budgeting.
- RSAs demonstrate the safety implications of roadway elements.
- RSAs ensure that safety is an explicit consideration, and that safety does not “fall through the cracks”.

When do we conduct RSAs?

- pre-construction:
 - planning / feasibility
 - preliminary (draft) design
 - detailed design
- construction:
 - work zones
 - pre-opening
- post-construction/operational:
 - existing roads

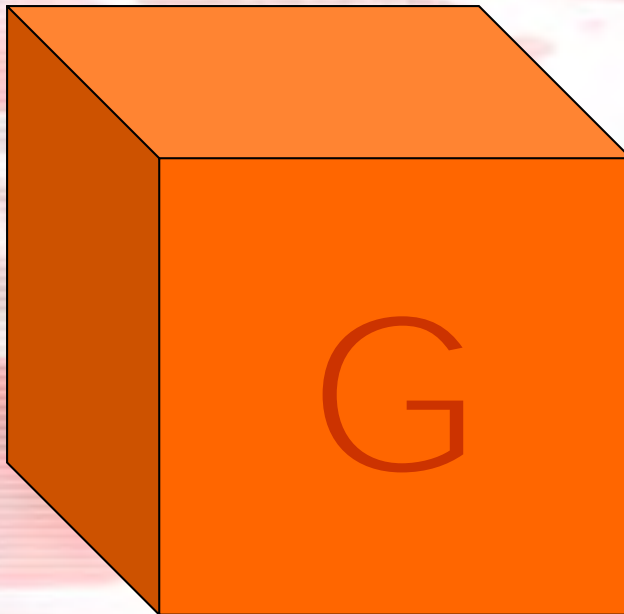


Road Safety: Gore



- **Geometry**
- **Operations**
- **Road Users**
- **Environment**

Road Safety: Geometry



- **Curve**
- **Gradient**
- **Cross Section**
- **Clearance**
- **Sight distance**
- **Clear zone**

Road Safety: Geometry Example 1



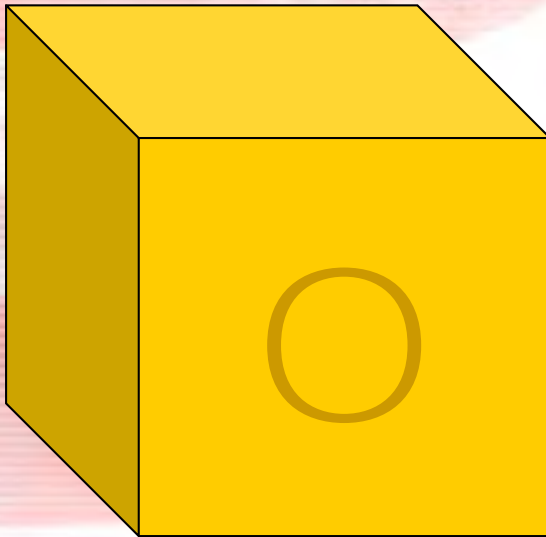
Road Safety: Geometry Example 2



Road Safety: Geometry Example 3



Road Safety: Operations

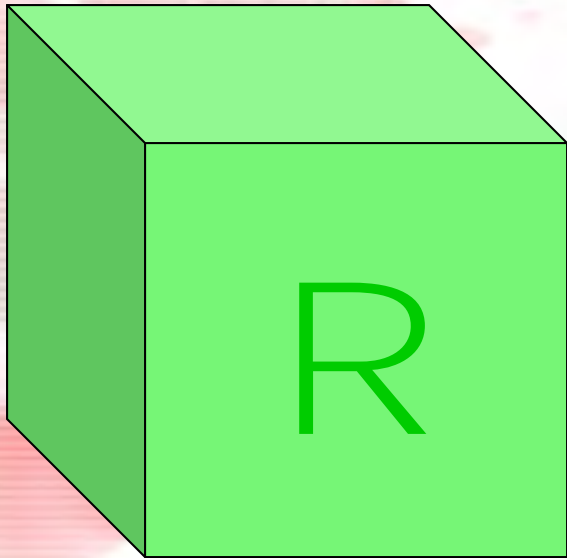


- **Congestion**
- **Signal operation**
- **Speeding**
- **Queuing**
- **Turning movements**

Road Safety: Operations Example 1

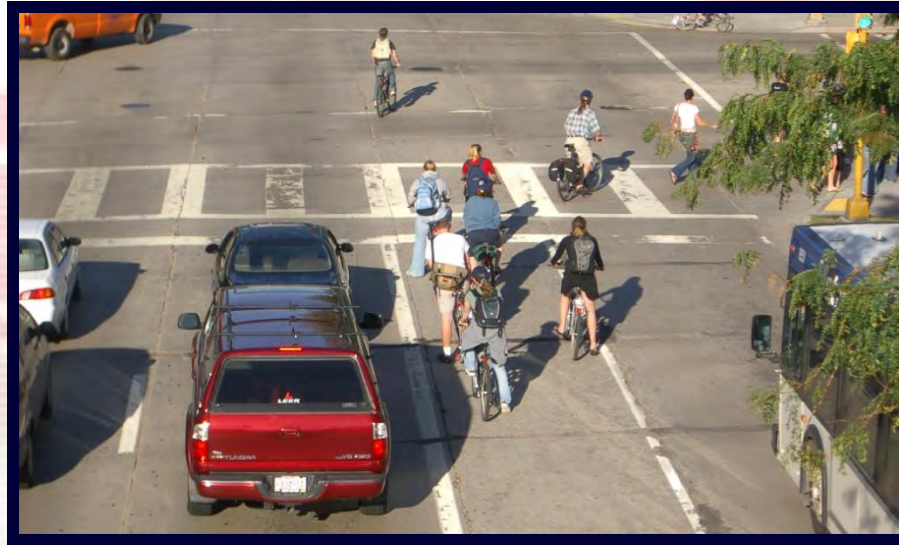


Road Safety: Road Users/Human Factor



- **Motorists**
- **Bicyclists**
- **Pedestrians**

Road Safety: Motorists



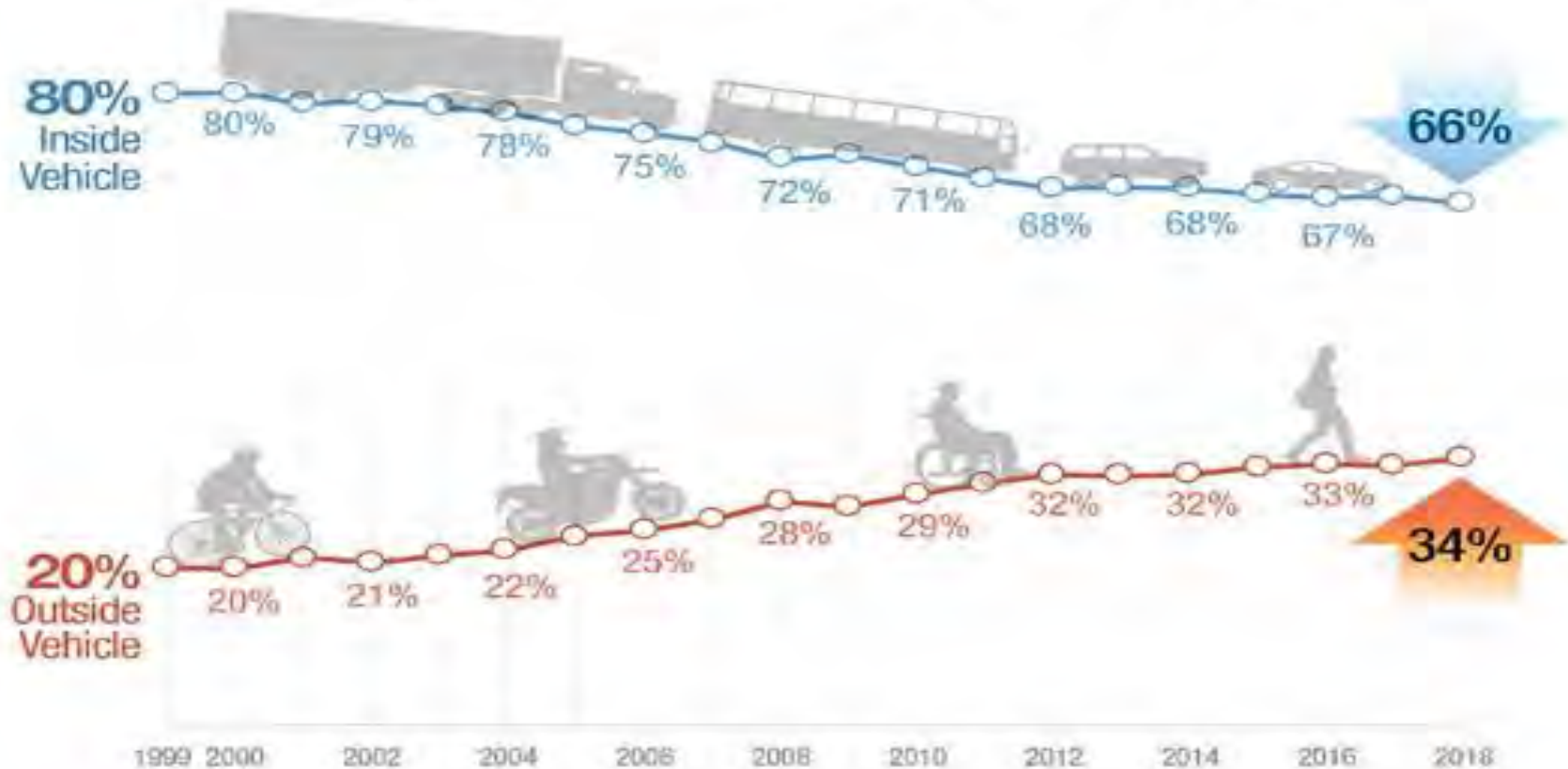
Road Safety: Bicyclists



ROADWAY USERS OUTSIDE OF VEHICLES ACCOUNT FOR AN INCREASING SHARE OF ROADWAY FATALITIES

Over the last two decades, the percentage of roadway fatalities occurring outside the vehicle – including pedestrians, pedalcyclists, and motorcyclists – has risen from 20% to 34%.

Percentage of fatalities inside/outside vehicle, 1999 – 2018



Note: People inside the vehicle includes occupants of cars, light trucks, large trucks, buses, and other vehicles.
Roadway users outside the motor vehicle include pedestrians, pedalcyclists, motorcyclists, and other "nonoccupants."

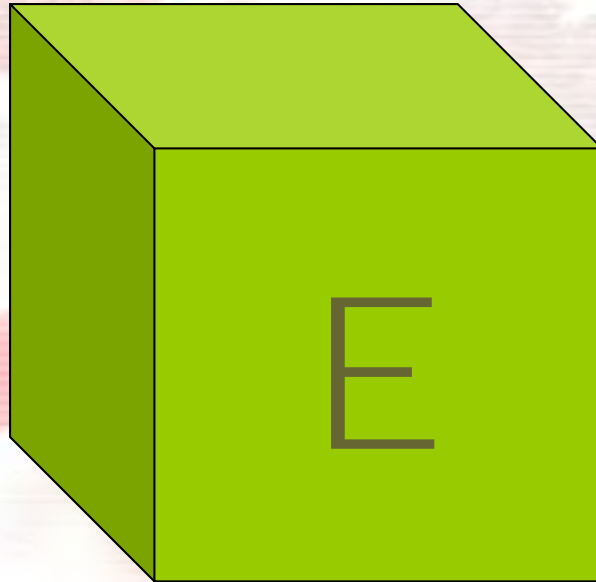
Source: National Highway Traffic Safety Administration (NHTSA), Fatality Analysis Reporting System (FARS) 1999-2017 Final Files; 2018 Annual Report File (ARF)

For more information on the Safety Data Initiative, visit: <https://www.transportation.gov/SafetyDataInitiative>

Road Safety: Road Users



Road Safety: Environment

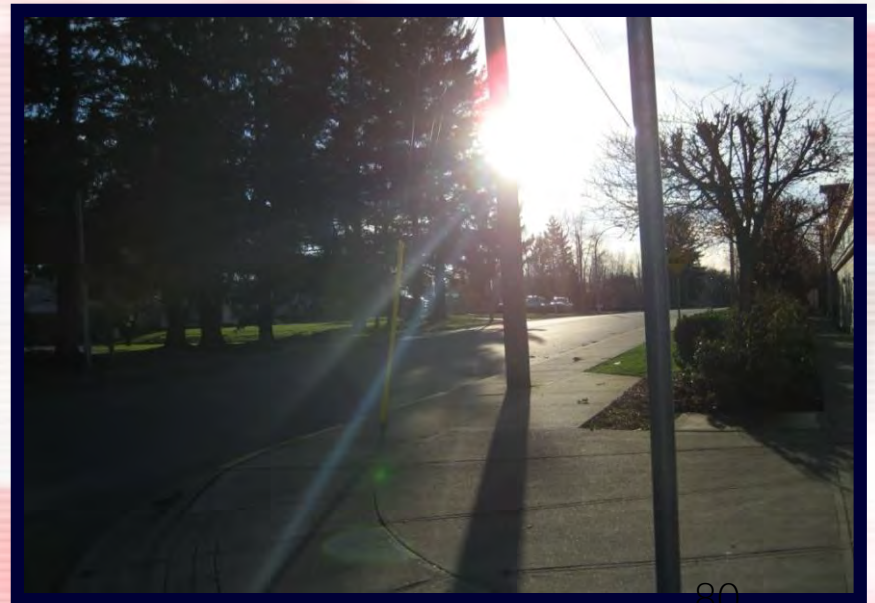


Road Safety: Environment

Weather



Lighting Conditions



Procedures

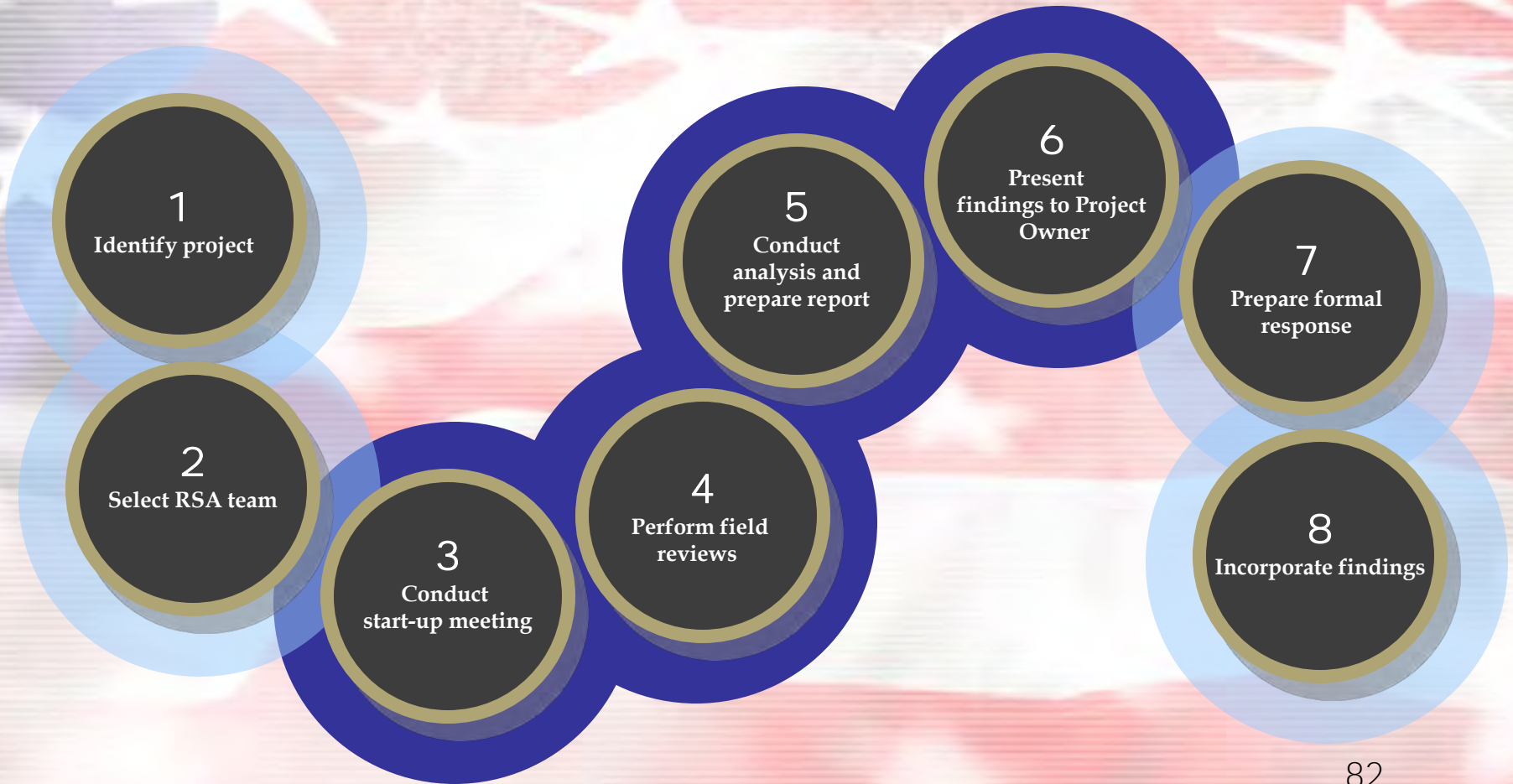
The Eight Step
RSA Process

Responsibilities



RSA Team

Design Team / Project Owner

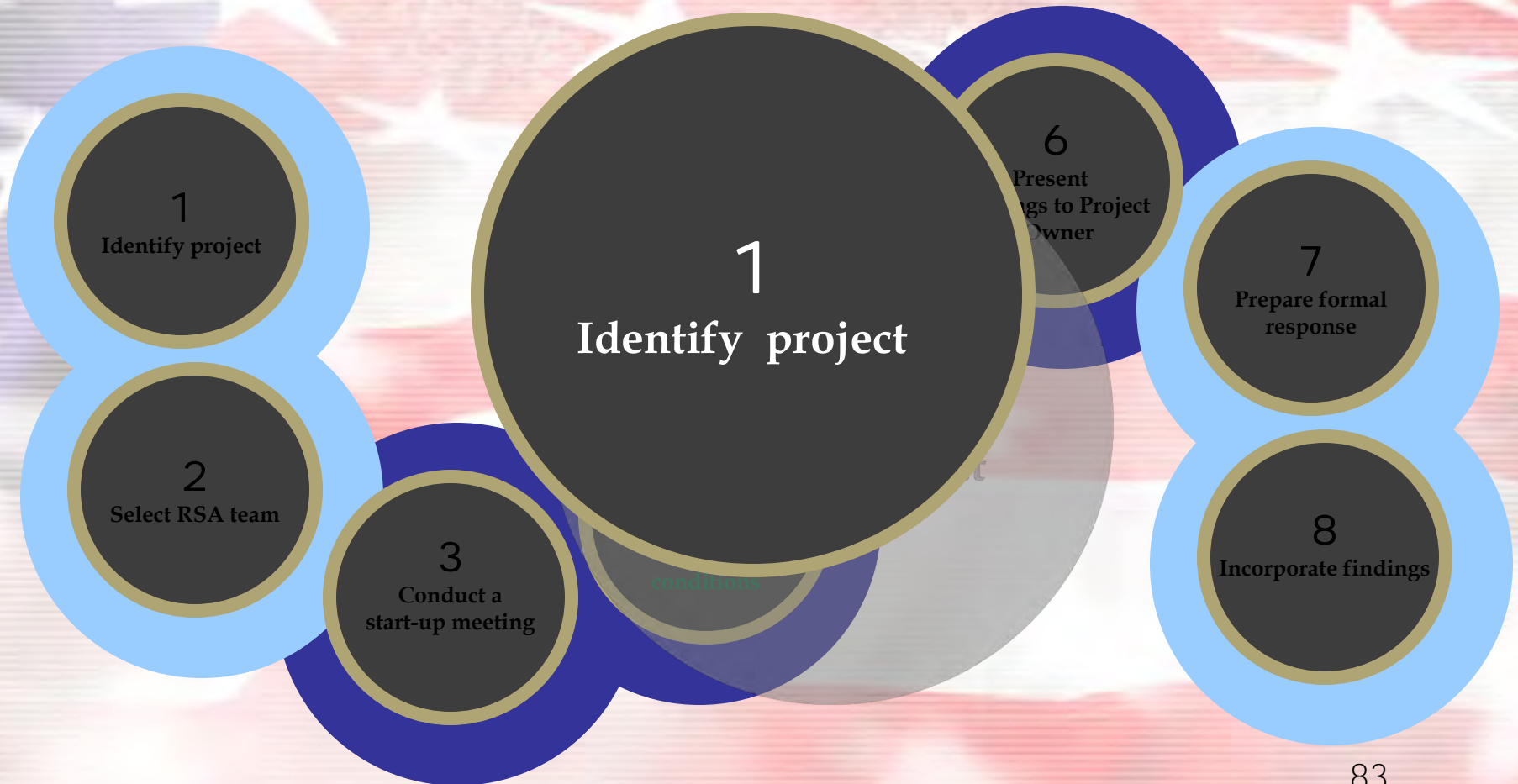


Responsibilities



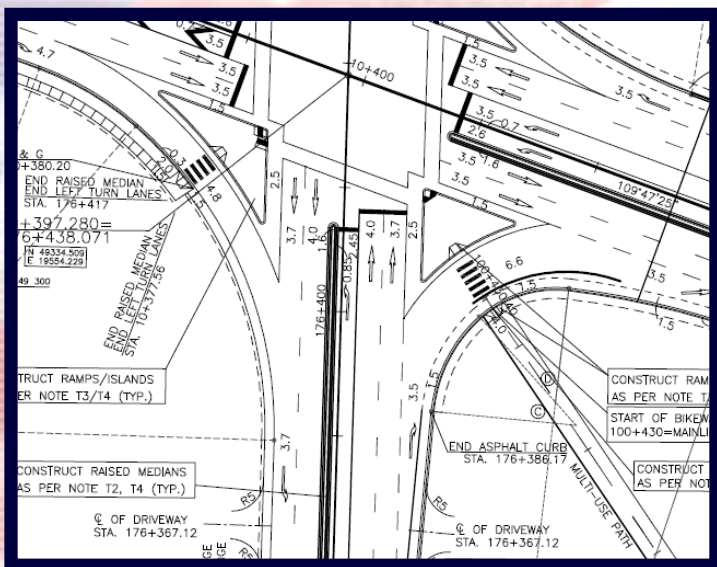
RSA Team

Design Team / Project Owner

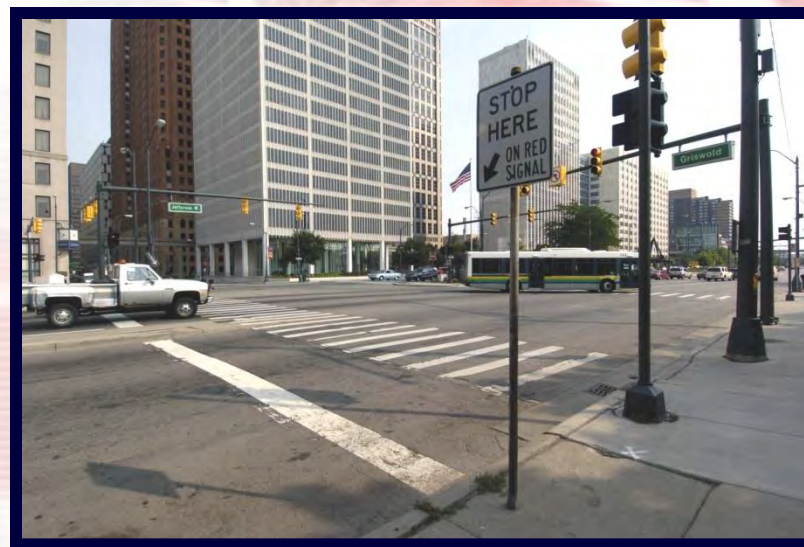


Step 1: Identify the Project

Step
1



Design stage project

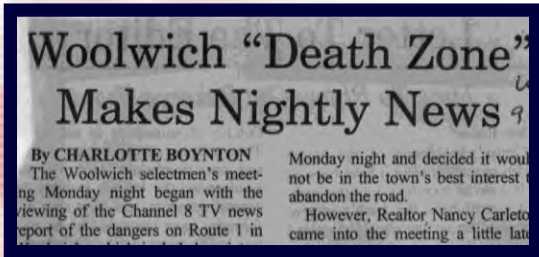


In-service project

Candidates for In-service RSAs



High-crash sites



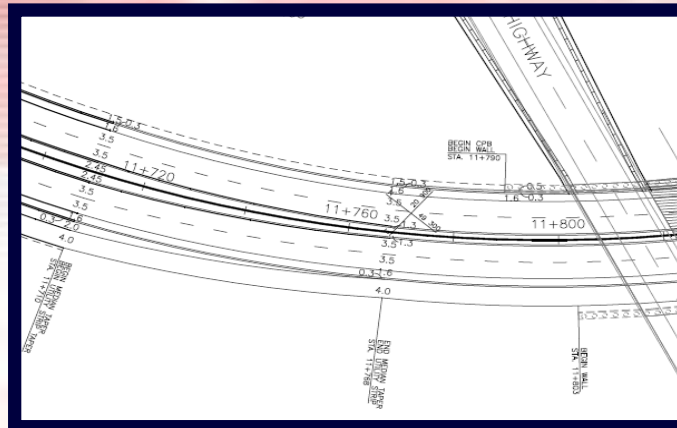
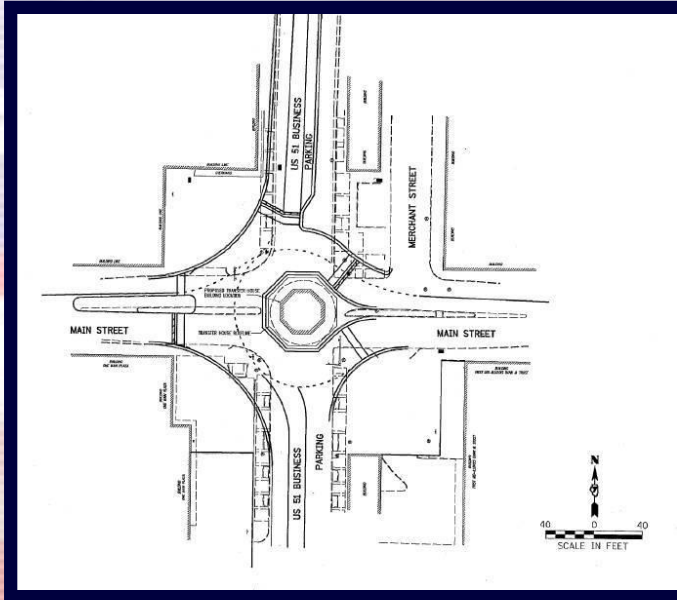
High-profile sites

Development
Construction

Changed traffic
characteristics

Candidates for Design-stage RSAs

Step
1



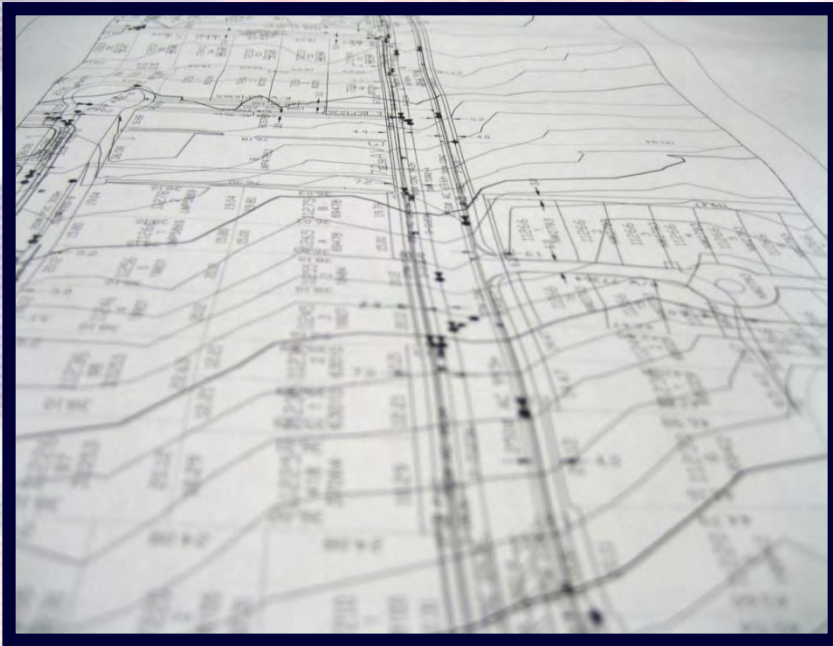
- Safety-oriented
- High-profile
- Complex design

RSAs: Design Stage

"I believe that [RSAs] are an excellent tool for evaluating and improving the safety of our highway system. In the projects we've done, we've seen *the most benefit in doing an RSA during conceptual and preliminary design, when any improvements can be incorporated into our project estimates and final design.*"

Beth Wright
District Engineer
Missouri DOT

RSAs: Design Stage



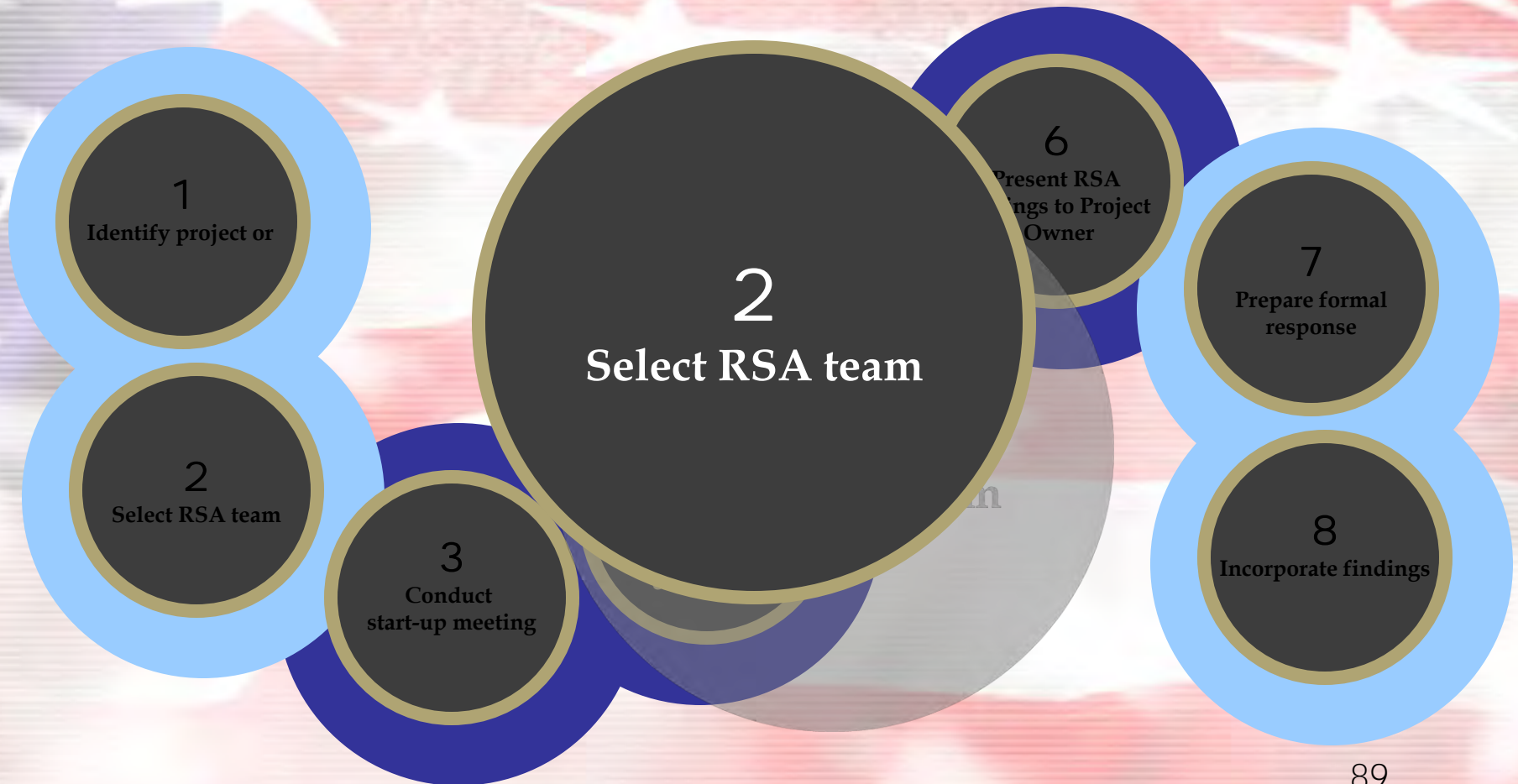
- Make structural changes on paper instead of in concrete.
- Optimize crash and conflict prevention.

Responsibilities



RSA Team

Design Team / Project Owner



Select RSA Team

Step
2



- Independent
- Experienced
- Multi-disciplinary

Select the RSA Team: Core Skills

Step
2

Operations



Geometric



Road users/human factors

Select RSA Team: Supplementary Skills

Step
2

- Human factors
- Specialists
- Enforcement
- Maintenance



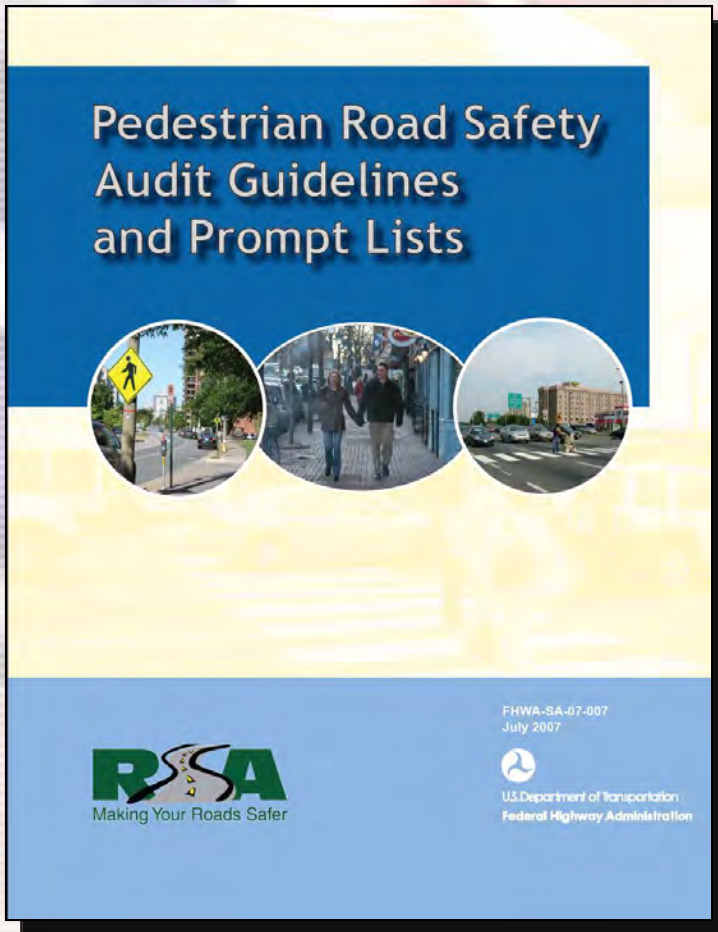
Interdisciplinary RSA Team: Composition and Size

- local agency staff
- exchange staff from another local agency
- consultants
- combination of above



Focused RSAs

Step
2



- Pedestrians
- Cyclists
- Older/younger drivers
- Special situations

Select the RSA Team: Team Planning

Step
2

- Meet informally or by phone
- Discuss RSA schedule
- Communicate schedule to project owner

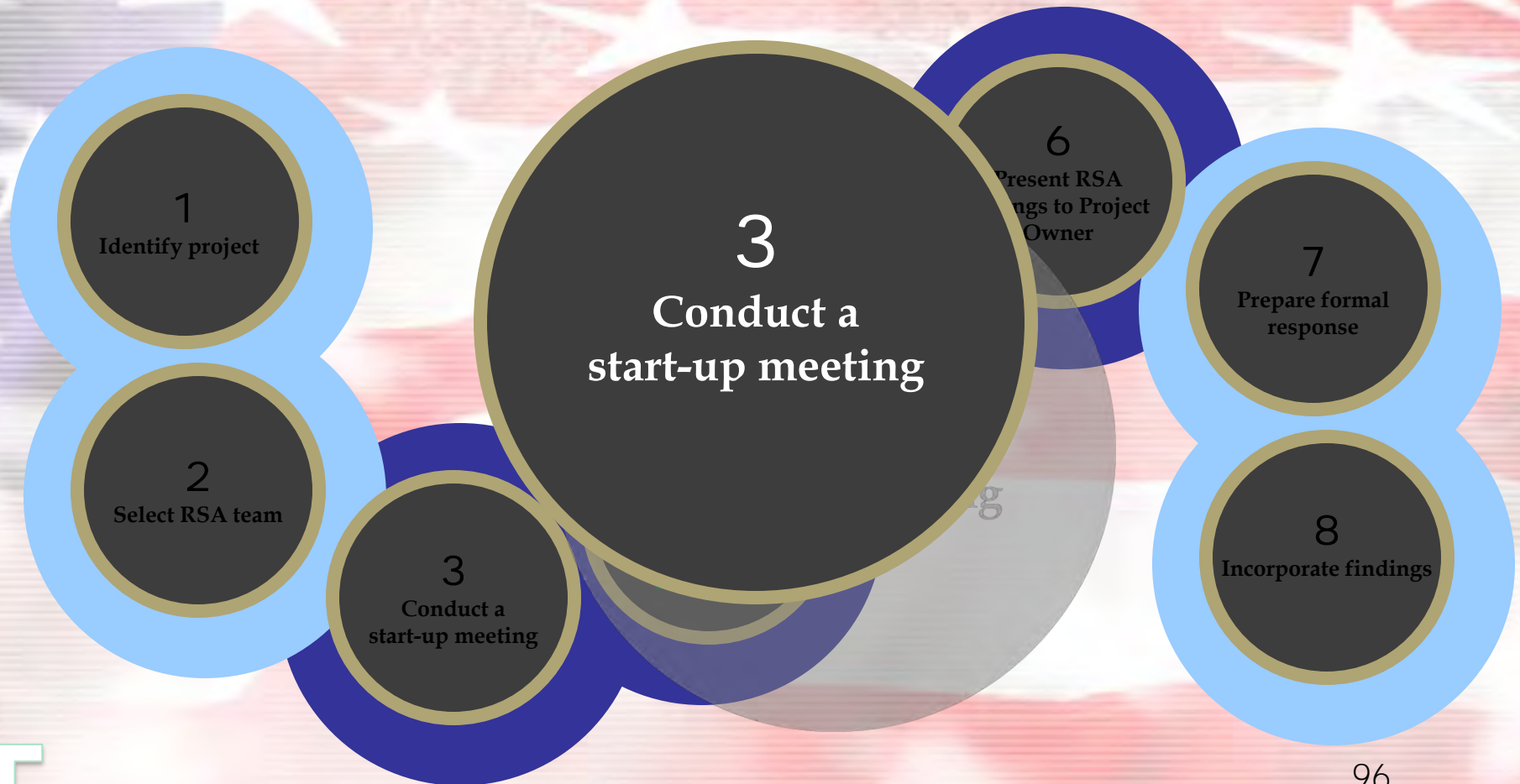


Responsibilities



RSA Team

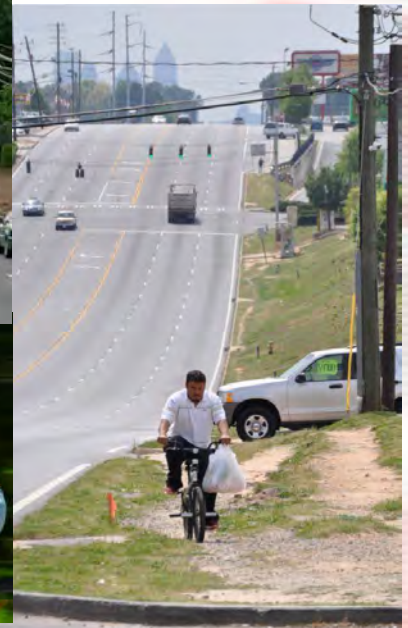
Design Team / Project Owner



The Start-up Meeting

Step
3

- Identify individual roles
- Communicate information
- Communicate RSA process
- Discuss constraints and limitations



The Start-up Meeting: Provide Project Information

Step
3

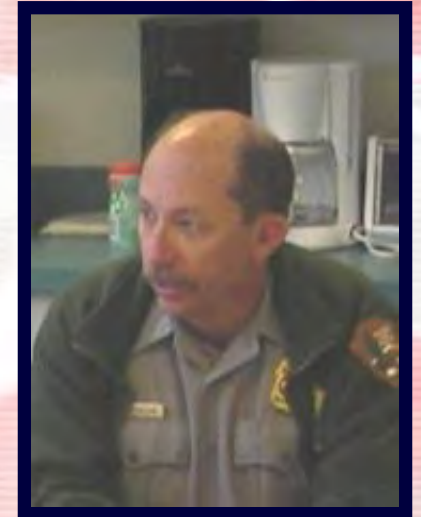


- Crash history
- Traffic volumes
- Aerial photographs
- Design drawings
- Background reports
- Design criteria

The Start-up Meeting

Step
3

- Communicate project concerns
- Review steps in RSA
- Review safety concerns with similar projects
- Discuss schedule
- Provide contact info



Responsibilities



RSA Team

Design Team / Project Owner



Step 4: Perform Field Reviews

Step
4



- Design-stage
- In-Service

Team in One Vehicle



Perform Field Review: Preparation for the Field Review

Step
4



- Review available crash data
- Arrange transportation
- Designate a secretary and photographer

(2) Field Reviews

- Observe road user characteristics.
- Observe surrounding land uses.
- Observe link points to the adjacent transportation network.



Perform Field Review: Common Items to Look For

- **Sight distance obstructions**
- **Pedestrian and cyclist conflicts**
- **Visual clutter**





MILHORN ST

Colonial Cyclesports

ALL POLARIS
ATV & UTV
SALES PER MI

Milhorn St 2600

1135 →

SPEED
LIMIT
45





1135 →

FUND
...BACK
...igate
... 10





FOR INFO
CONTACT THE
CITY OF
COLUMBIA
SC

SIDEWALK
CLOSED





The background of the slide is a blurred American flag, showing the stars and stripes in a soft, out-of-focus manner.

18 Fataals ?????

18 Months

50 Foot Length of Road











Pedestrian/Bicycle Counts

- Pedestrian Counts Conducted at Nine Locations
 - Zones Determined by Observations
 - Weekday & Weekend
 - 2 Hours AM Peak
 - 2 Hours PM Peak

	ZONE NUMBER								
	1	2	3	4	5	6	7	8	9
Total	161	280	487	19	1,390	343	326	90	759



Pedestrian/Bicycle Counts



of Pedestrian/Bicycle Counts

Qualitative Assessment

- During Peak Hours During Harvest Season
 - January 16th & 18th
 - 5:00 AM – 8:00 AM
 - 4:00 PM – 7:00 PM
- Summarize Observations & Recommendations
 - Improve Pedestrian & Bicyclist Safety



Recommendations

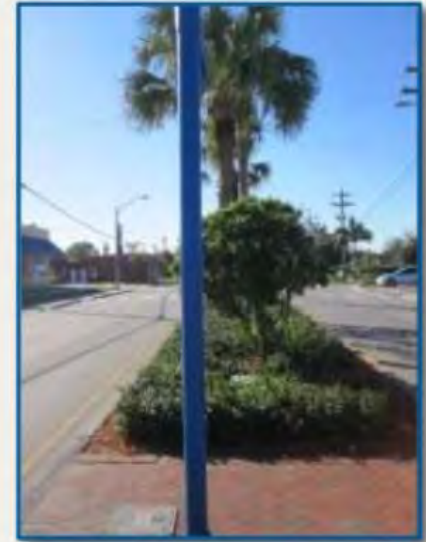


RECOMMENDATION

- Install Fence/Railing in Median to Direct Pedestrians to Crosswalk/Median Openings



Qualitative Assessment



OBSERVATION

- Street Planters & Trees Limit Motorists Visibility of Pedestrians

Lighting and Pedestrian Channelization

- Install new LED lighting through corridor
- Install pedestrian channelization in the median



ADA, Signing, and Pavement Markings

- High Emphasis Crosswalks
- ADA upgrades
- RRFBs (Rectangular Rapid Flashing Beacons)











Wendy's

... Celebrating 50 Years
A SIGN OF OUR TIMES

PIES ROLLS BUTTERNUT BREAD CAKE DONUTS

BUTTERNUT BREAD
DOLLY MADISON CAFE

Kmart

(2) Field Review

- Drawing, aerial photographs
- camera still/video
- measuring wheel, stopwatch
- high-visibility vests



(2) Field Review

Look for:

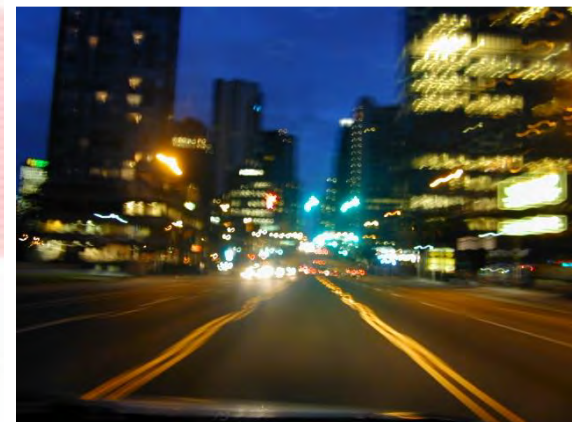
- sight distance obstructions
- roadside hazards
- driveway issues



Perform Field Review: Variable Conditions to Observe

Step
4

- **Peak and off-peak traffic periods**
- **Dry and wet weather conditions**
- **Day and night conditions**



Perform Field Review: Up Close and Personal

Step
4



Walk the site!

Perform Field Review: Note the Positive

- *Good safety design features*
- *Safety mitigation features already in place*



(2) Field Review

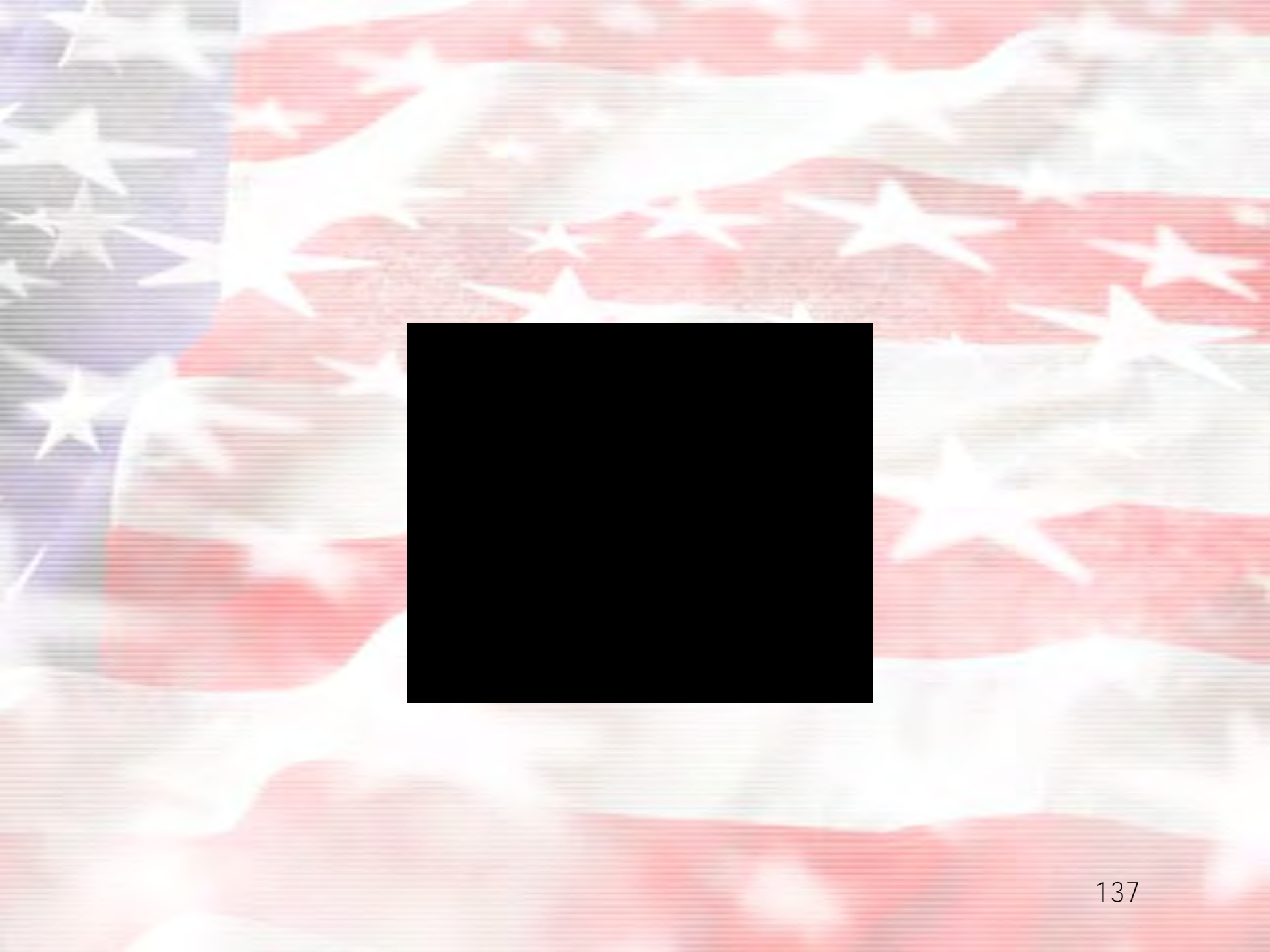
Prompt list:

- may provide structure to the site visit
- remind the team what to look for, and help ensure that nothing is overlooked



The background of the slide is a blurred, close-up view of the American flag, showing the stars and stripes in shades of red, white, and blue.

Five KPH per Hour Difference







NO STOPPING
FOR TRUCKS
OR BUSES
EXCEPT
TO LOAD OR
UNLOAD
PASSENGERS
OR GOODS

1390 E

MEGILL'S
Now Enrolling For
583-669







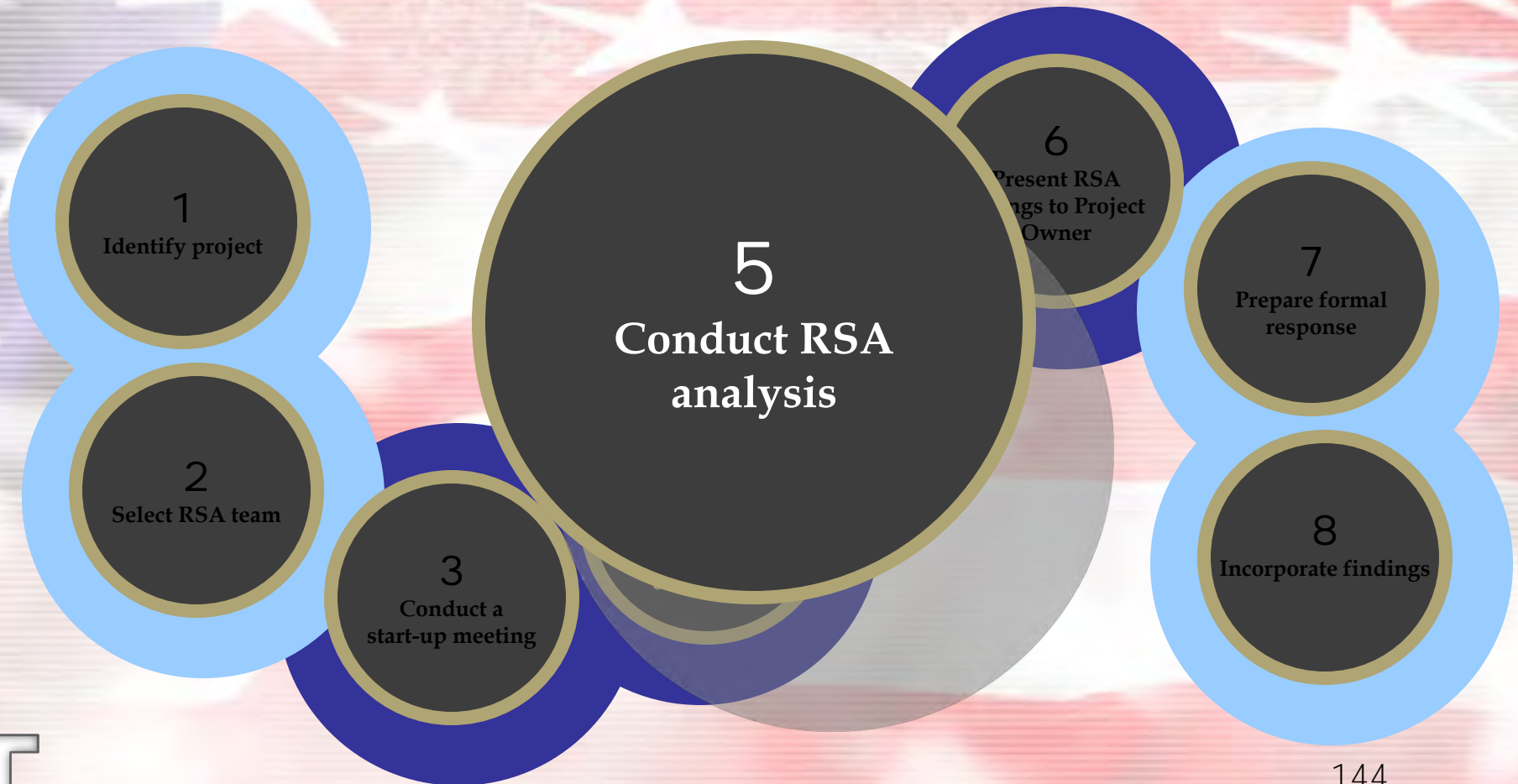


Responsibilities



RSA Team

Design Team / Project Owner





Step 5: Conduct RSA Analysis

Step
5

- Identify and prioritize safety concerns
- Develop suggestions for reducing the degree of risk
- Compose presentation of early findings

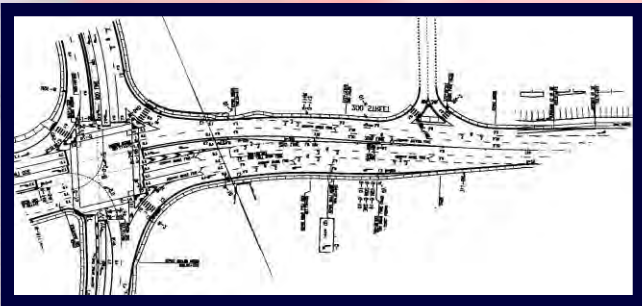


RSA Analysis:

Step
5

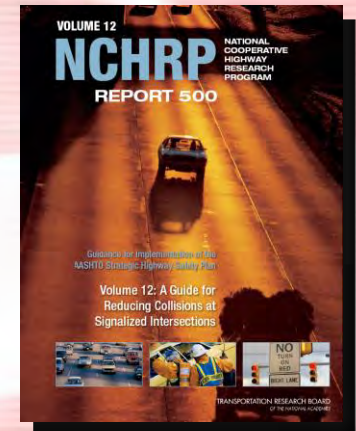
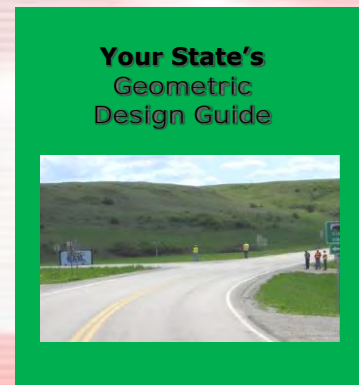
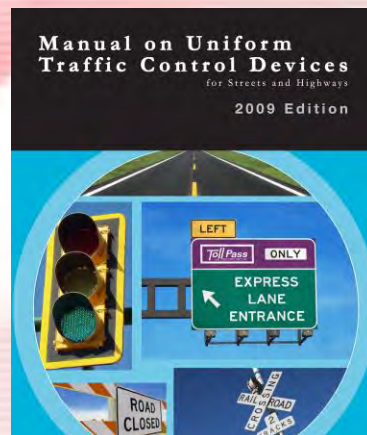
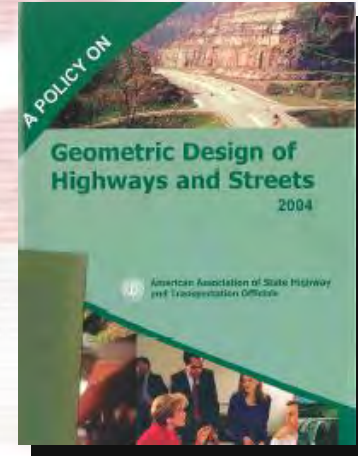
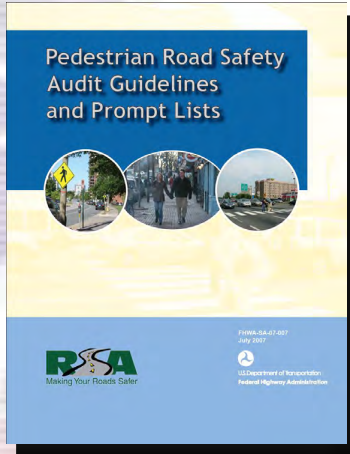


- Schedule work sessions
- Assemble RSA information
- Gather references
- Appoint a coordinator and secretary



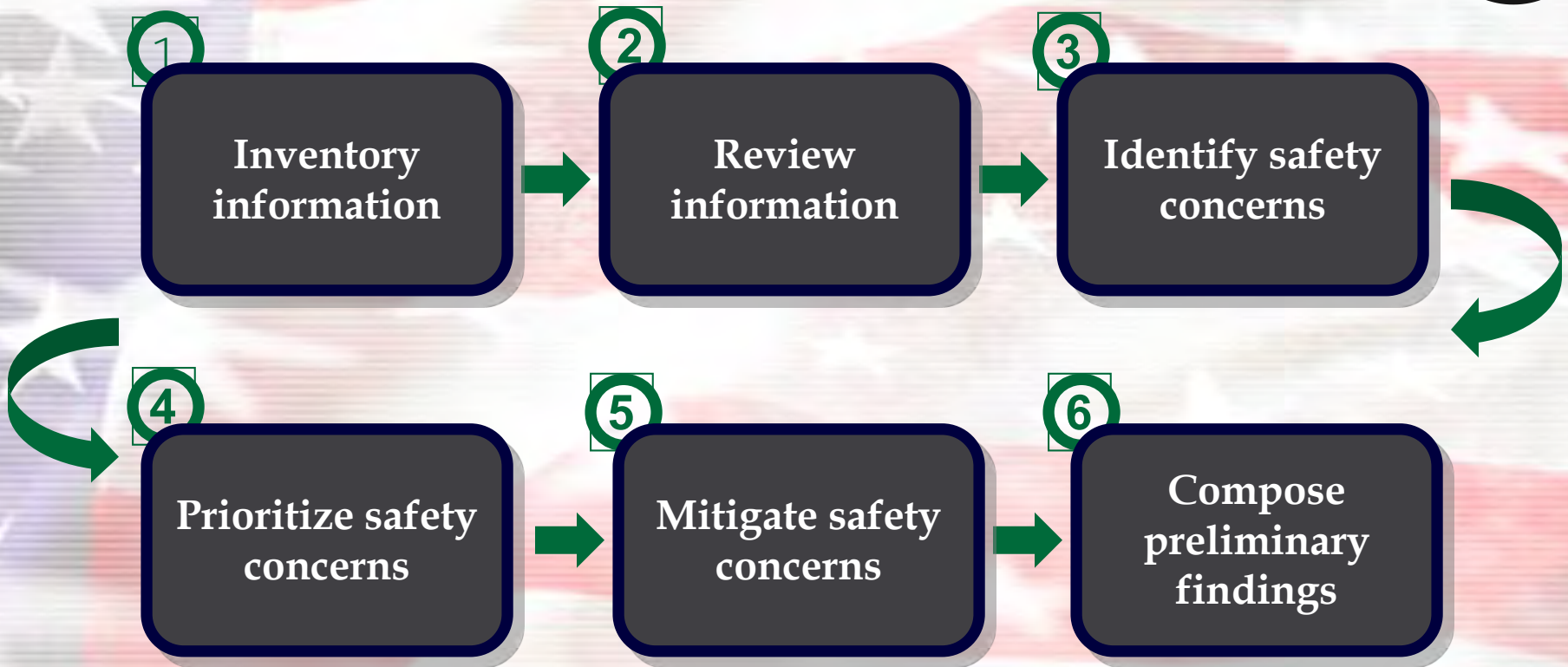
Resources and References

Step
5



Analysis: The Process

Step
5



Analysis: Phase 2

Systematically Review Information

- Thoroughly review all data
- Think in terms of GORE

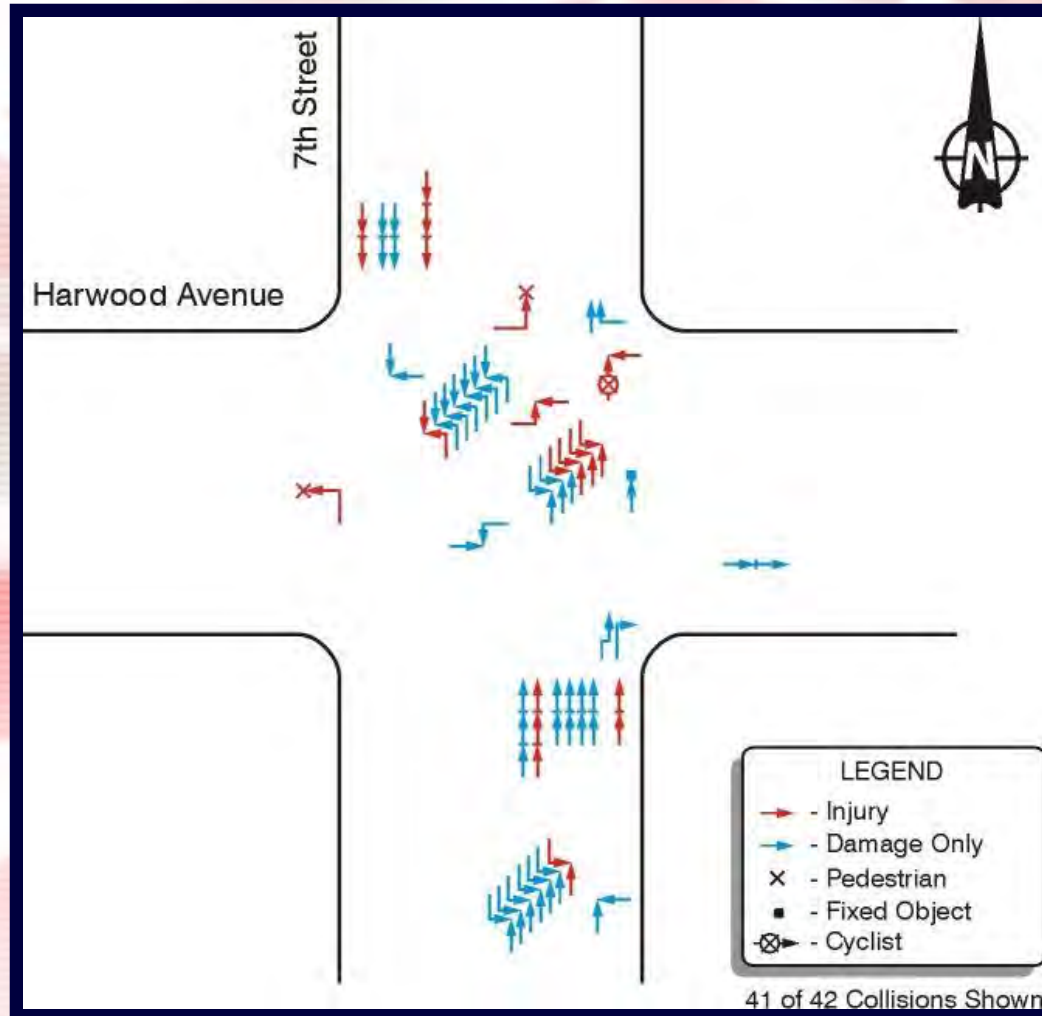


- Crash history (existing roads)
- Expected crashes (design-stage)

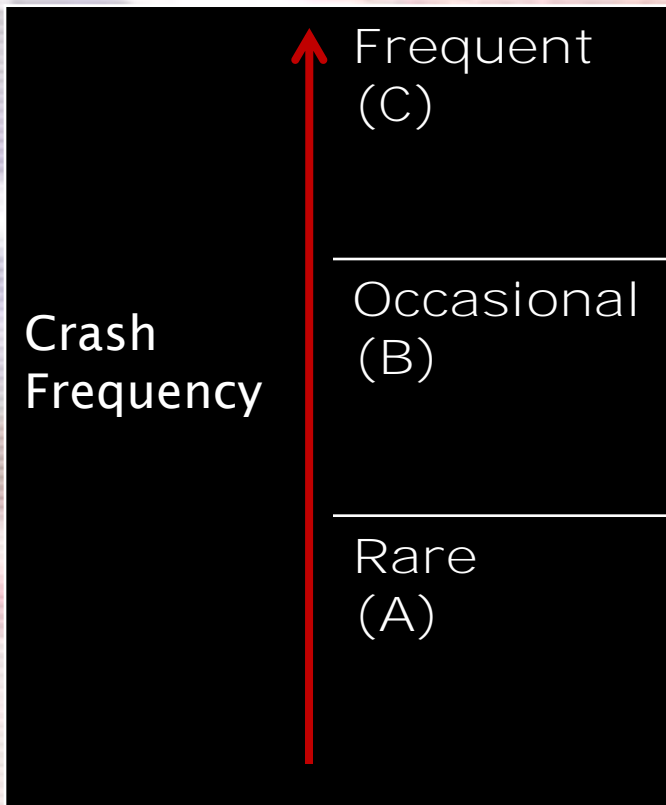


Analysis: Crash History

Step
5



Prioritize Safety Issues: Crash Frequency



The RSA team must ask how often each safety issue may contribute to a crash.

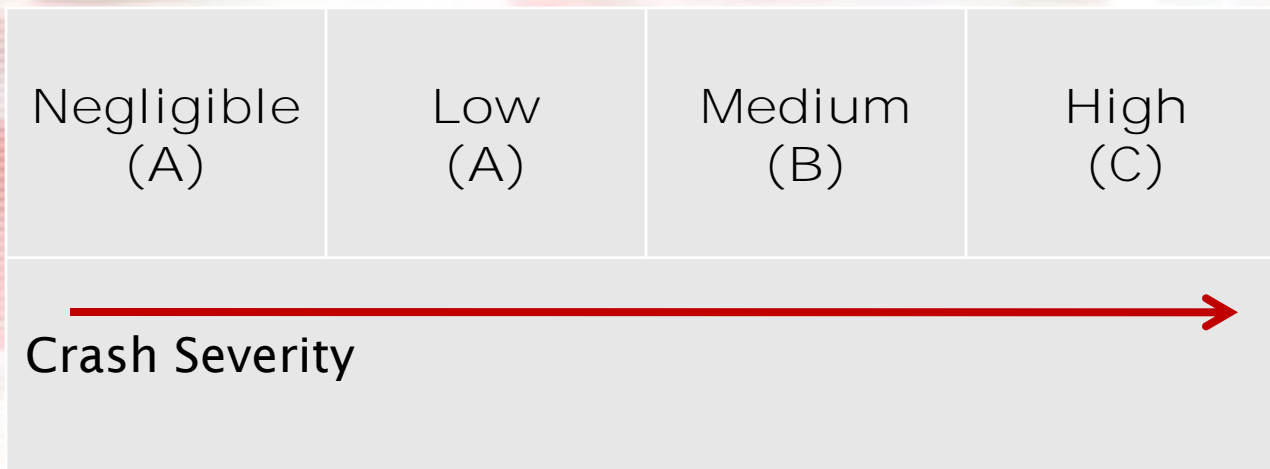
RISK CATEGORY

A = Lowest priority

F = Highest priority

Prioritize Safety Issues: Crash Severity

The RSA team must ask how severe the crashes related to the safety issue may be.



Prioritize Safety Issues: Risk Matrix

Crash Frequency

Frequent

Occasional

Rare

C	D	E	F
B	C	D	E
A	B	C	D

RISK CATEGORY

A = Lowest priority

F = Highest priority

Negligible

Low

Med

High

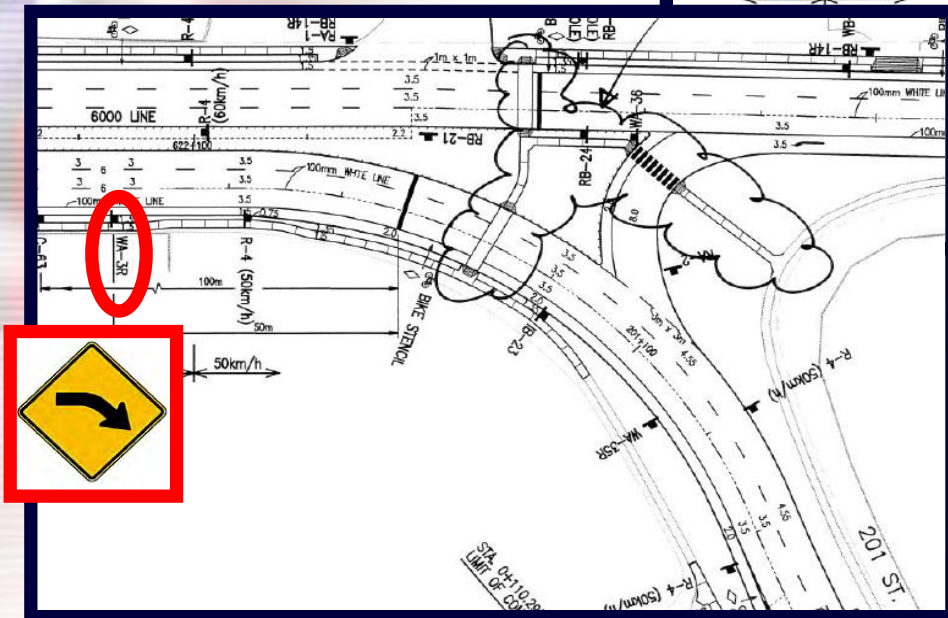
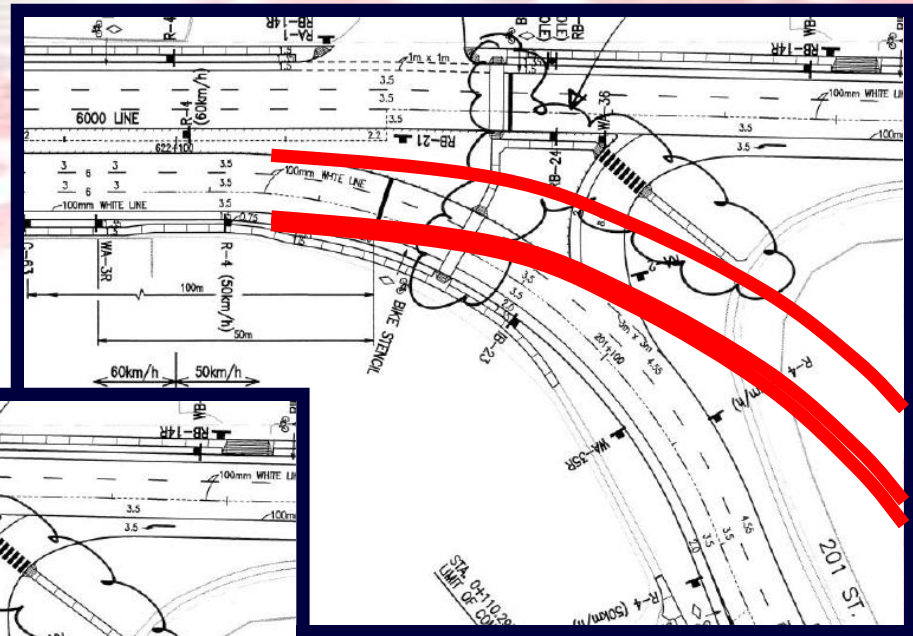
Crash Severity

Mitigate Safety Concerns: Suggestions Appropriate to Project Stage

- *Short term solutions include:*
maintenance, vegetation,
changing signage or pavement
markings, **Enforcement &
Education**
- *Long term solutions include:*
flattening a curve or modifying a
roadway's vertical alignment,
Enforcement & Education

Mitigate Safety Concerns: Design-Stage

Early design stage:
alignment changes



Later design stage:
signing improvements

Prepare Preliminary Findings Presentation

Step
5



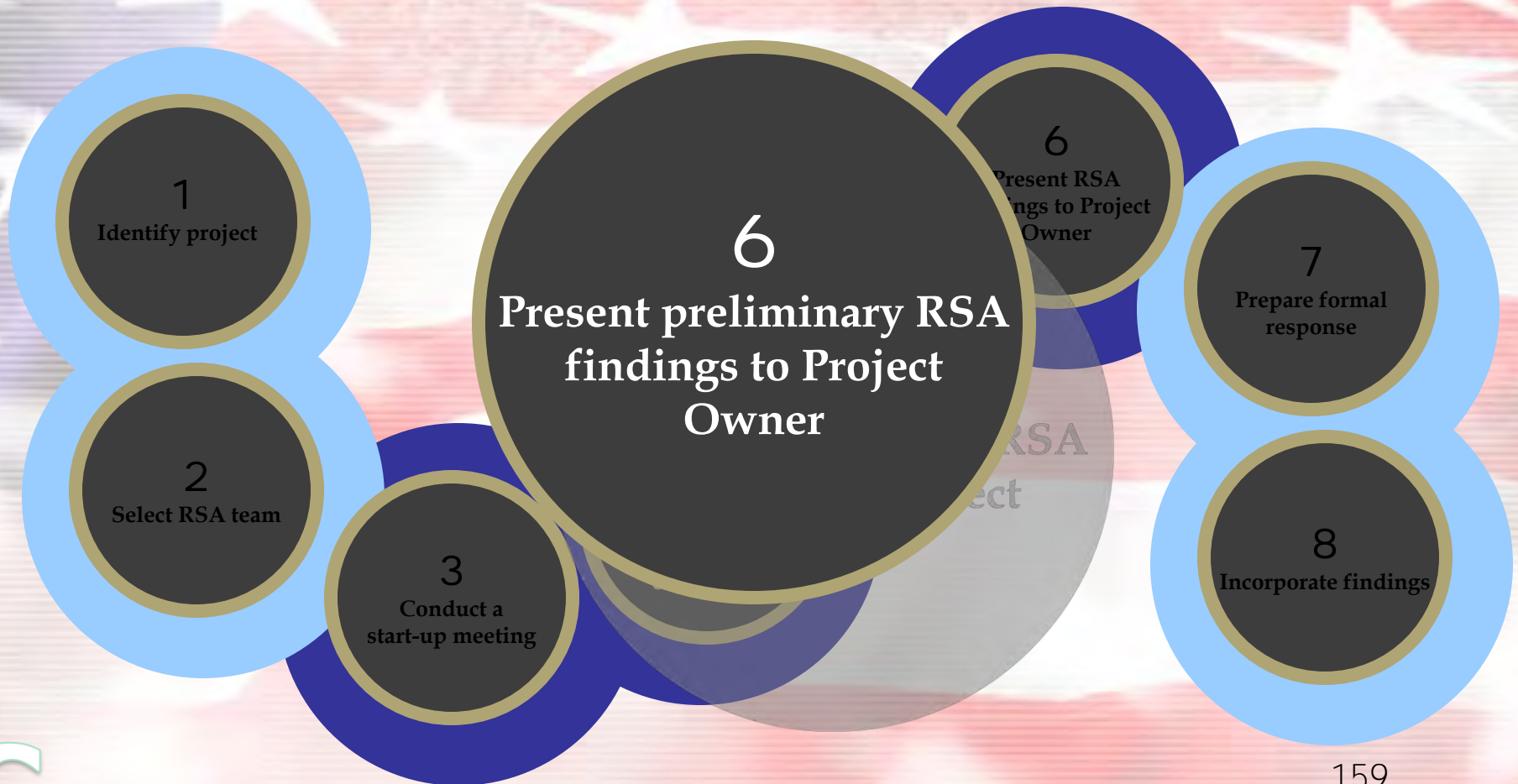
- Identify safety successes
- Briefly describe safety concerns
- Identify potential conflicts
- Suggest mitigation

Responsibilities



RSA Team

Design Team / Project Owner



The RSA Findings Presentation

Step
6

- Discuss safety concerns
- Discussion of safety concerns
- Clarify findings and suggestions
- Assist project owner in making best choices



The RSA Findings Presentation: Factor in the Feedback

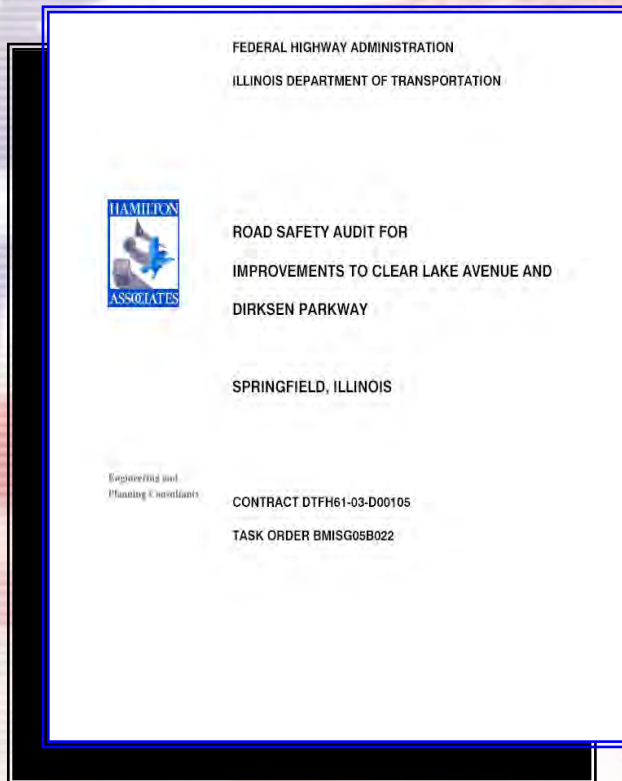
Step
6



- **Review and revise findings where appropriate**
- **Initiate formal report**

The RSA Findings: Formal Report

Step
6



- Summarizes the project
- Identifies team
- Documents site visits
- Documents results
- Identifies and prioritizes safety concerns
- May include suggestions for improvements

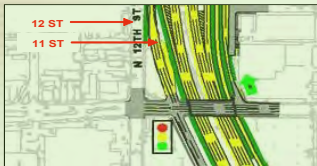
The RSA Findings Presentation: Formal Report

Design-stage Report Layout Sample

Sample Road Safety Audit
Issue 1: Closely-spaced Sample Street Intersections

Safety Issues: During peak periods, left-turn queues may extend into or past adjacent closely-spaced intersections on Sample Street.

Safety Issue Description:
Opposing through and right-turn traffic volumes can be expected to cause peak-period delays to traffic turning left at two intersections:



- Sample Street and the northbound entrance to I-XX, which has limited (70-foot) left-turn storage lane;
- Sample Street and Example Street, which has no left-turn lane.

If left-turn movements experience a long delay, queued left-turn traffic may obstruct through traffic on Sample Street. Queued or obstructed traffic may queue back and affect operations at upstream intersections, increasing the risk of all types of intersection collisions.

Expected Crash Types: intersection (left-turn, rear-end, and crossing)
Expected Frequency: occasional

Expected Severity: medium
Risk Rating: D (moderate-high risk level)

Suggestions: If micro-simulation modelling or post-construction observations show congestion related to left-turn queues, the following measures may be considered:

- Signalize the ramp intersection, and coordinate the ramp signal with those at Sample Street and Example Street to clear traffic when queues approach the adjacent upstream intersection.

Safety concern

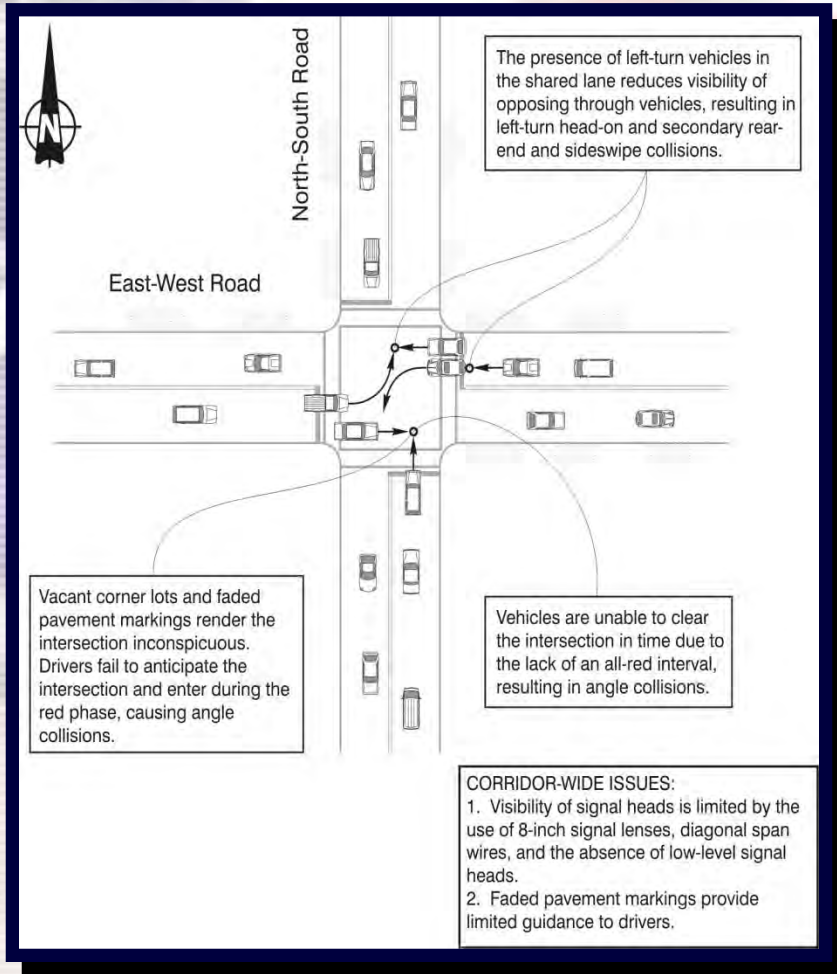
Description

Prioritization (optional)

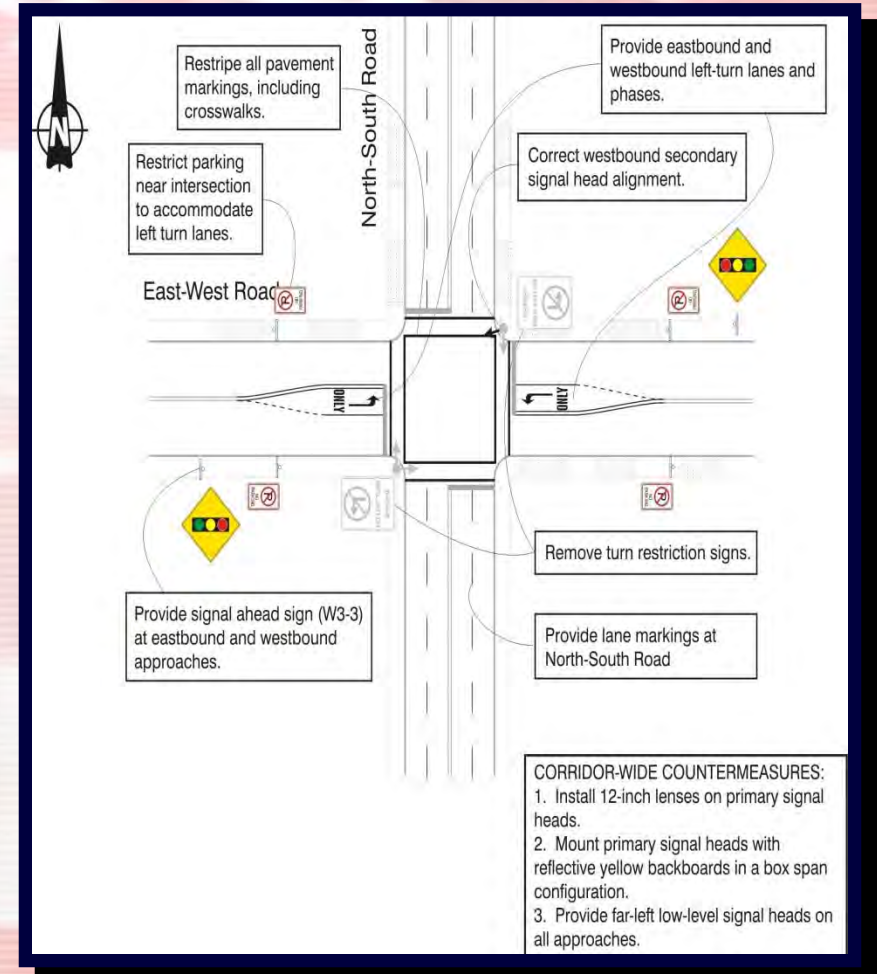
Suggestions (optional)

The RSA Findings Presentation: Formal Report

Step
6



Safety concerns



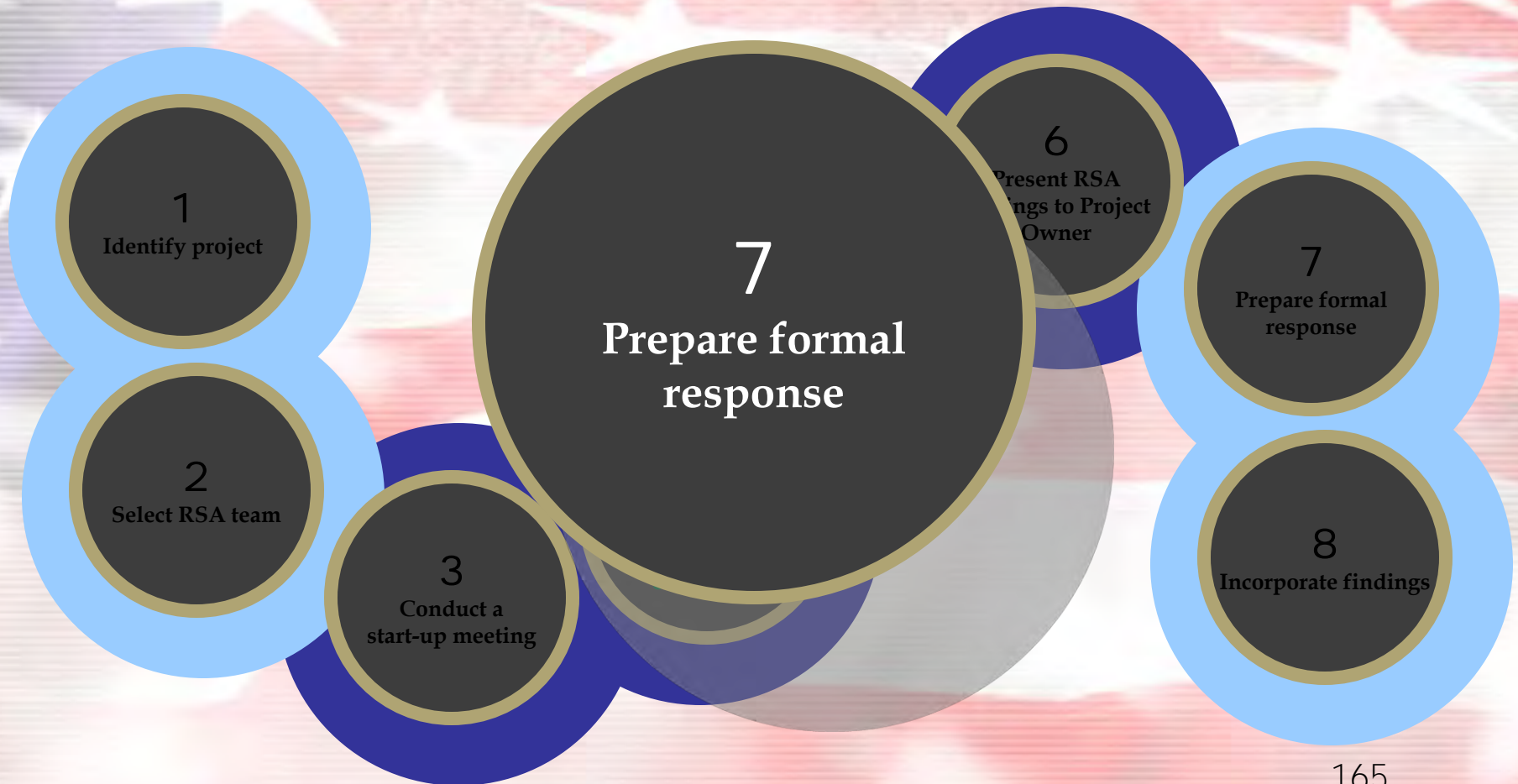
Suggestions

Responsibilities



RSA Team

Design Team / Project Owner



Responses

Step
7

Short Range

Paint, Signage

Mid-Range

Contour Bank

Long-Range

Realign Skewed
Intersection



Responses

Step
7



Inadequate Response

“We will not realign the intersection at Jefferson Road. We do not feel that it is needed.”

Responses

Step
7



Adequate Response

“While we agree with the need to realign the skewed intersection, the realignment cannot be achieved within the existing right-of-way. Realignment will require the purchase of property at a cost of about \$500,000, representing about 15 percent of the total annual transportation budget. The acquisition of the required property may be considered in future budgets.”

Response Letter

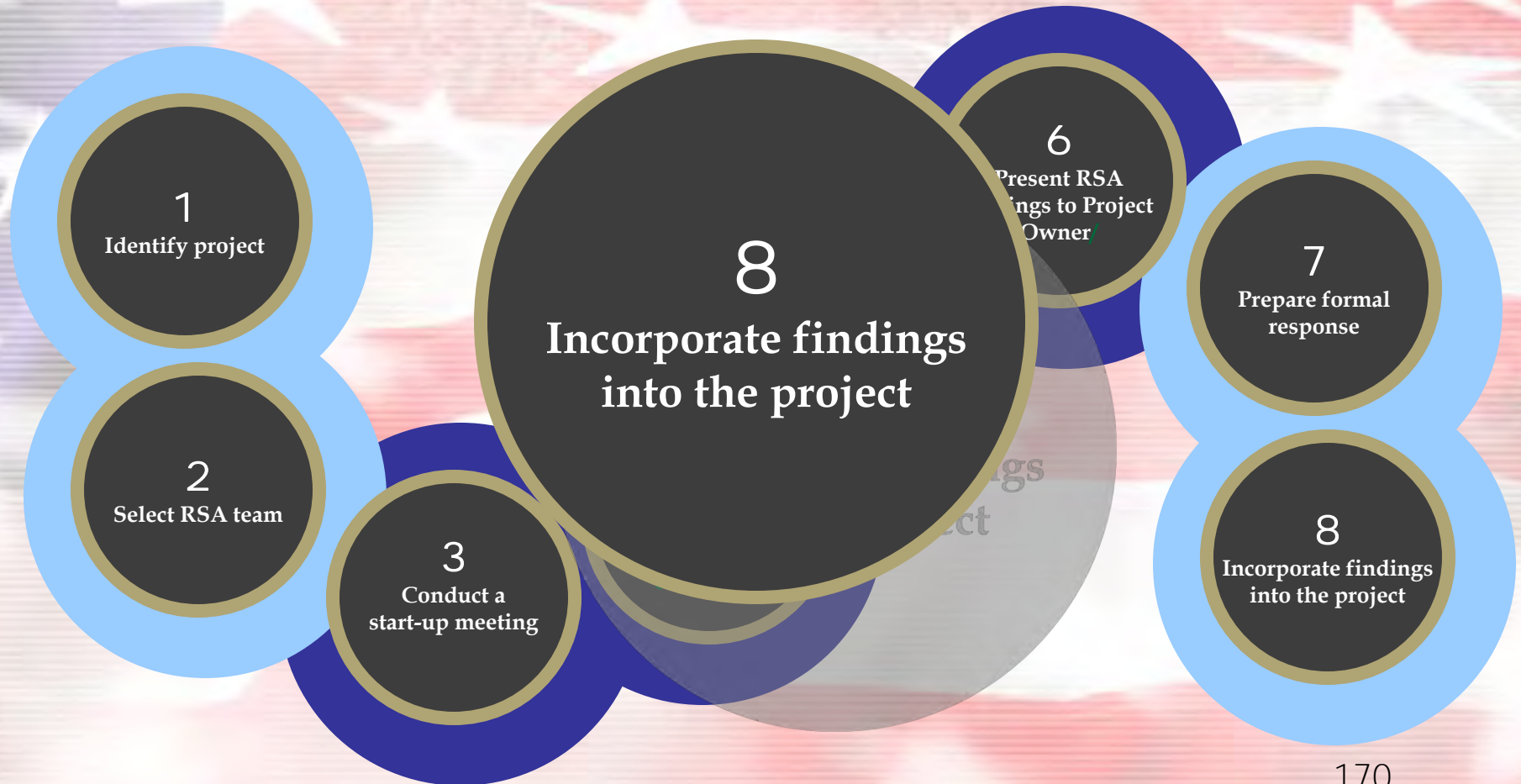
- prepared by the local road agency (with possible input from designer)
- for each audit issue, identifies what action will (or will not) be taken with a brief explanation
- part of the project record

Responsibilities



RSA Team

Design Team / Project Owner



Step 8: Implementation of Improvements

Step
8

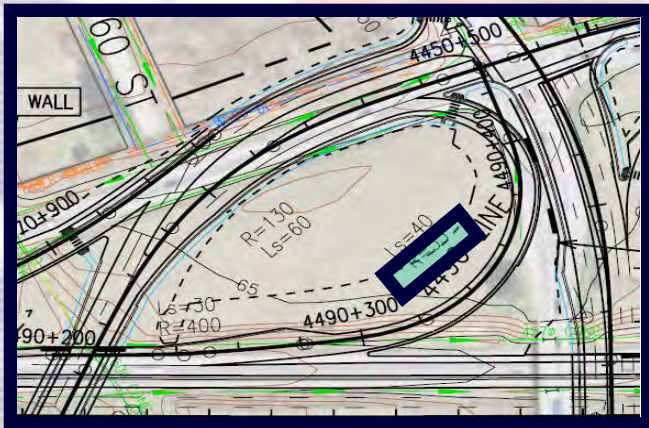


Implementation - may depend on policy, manpower, and/or funding.

Implementation of Improvements

Step
8

Pre-construction



Changes to design drawings

Post-construction RSAs:



Incorporate improvements in
operating budgets or maintenance
programs

RSAs: Conclusions

