

# Using the New Roadside Safety Analysis Program (RSAPv3)



Malcolm H. Ray, P.E., Ph.D.  
Christine Carrigan, P.E., Ph.D.  
Chuck Plaxico, Ph.D.

# *Let's introduce ourselves...*



Malcolm Ray  
Presenter



Christine Carrigan  
Presenter



Chuck Plaxico  
Moderator

# Introduction

What does RSAPv3 do and how does it do it?



Malcolm H. Ray, P.E., Ph.D.

# How do we decide what the best roadside safety treatment at a particular site?

- ▶ Example – let's say we have a divided highway.
  - What is the best median barrier to use?
  - What does *best* mean?

*The roadside treatment that gives the largest crash cost reduction for the money invested to construct and maintain the treatment.*

# How do we decide what the best roadside safety treatment is at a particular site?

## ► Options:

- No median barrier.
- Cable median barrier.
- W-beam median barrier.
- TL4 concrete median barrier.
- TL5 concrete median barrier.



# How do we decide what the best roadside safety treatment is at a particular site?

## Options:

- No median barrier.
- Cable median barrier.
- W-beam median barrier.
- TL4 concrete median barrier.
- TL5 concrete median barrier.

More Effective

## BENEFIT COST RATIO

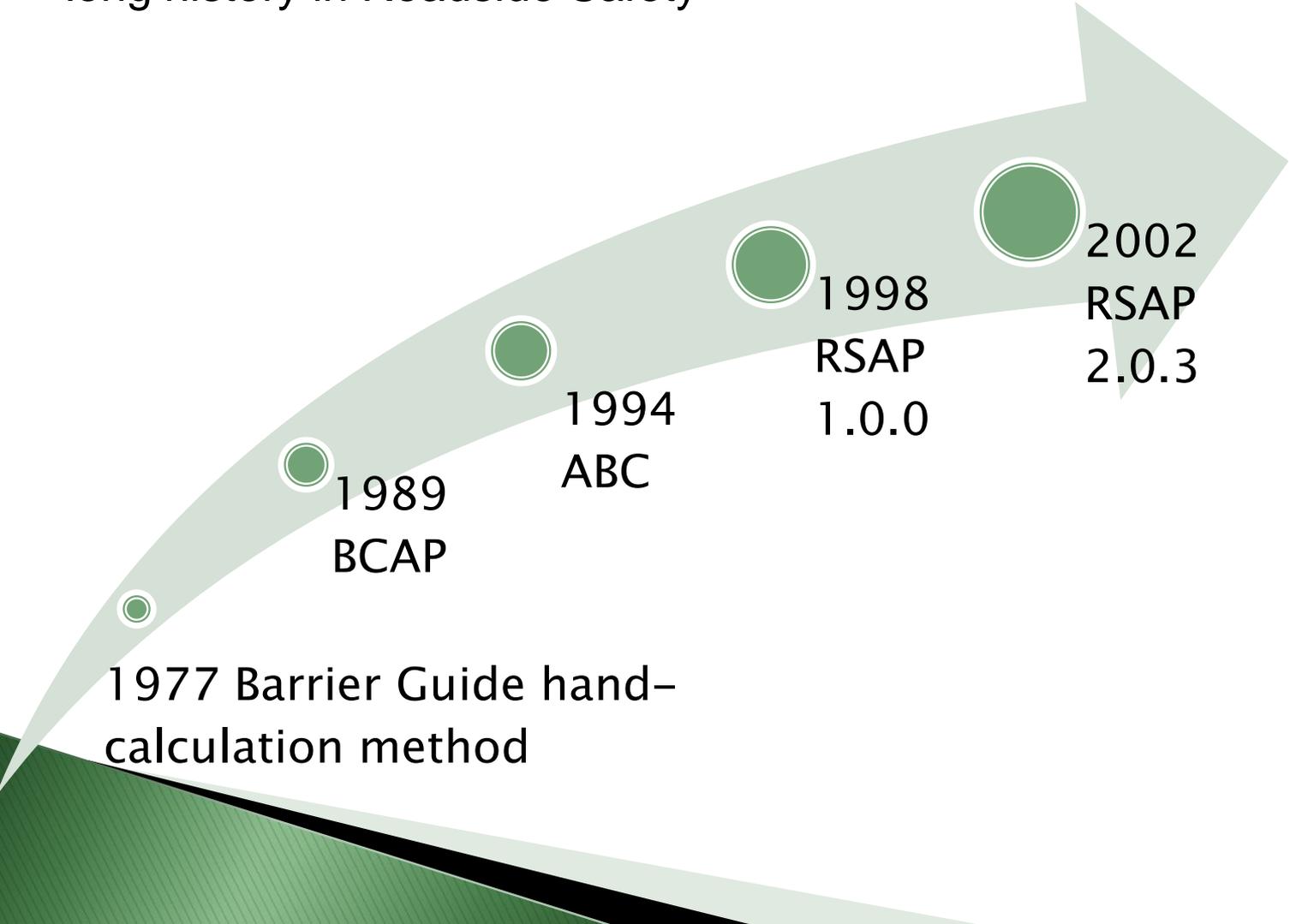
$$\text{BCR} = \frac{\text{Reduction in crash costs}}{\text{Cost of the Improvement}}$$

Costs Less

RSAPv3 calculates and ranks the BCR of alternatives to find the “best” roadside treatment option.

# History

Encroachment-Based Benefit-Cost Methods have a long history in Roadside Safety



1977 Barrier Guide hand-calculation method

1989 BCAP

1994 ABC

1998 RSAP 1.0.0

2002 RSAP 2.0.3

NCHRP 22-27 completely updated the algorithms and rewrote RSAP

# Where can I get RSAPv3?

<http://www.rsap.roadsafellc.com/>

http://www.rsap.roadsafellc.com/#Installation Tip

RSAP UPDATE PAGE

Google Search Share Check More

Sign In

Transportation Engineering Software Development

## RSAP v 3.0.0 Download Page

RSAP v 3.0.0 (Release 121024)

[INSTALL FROM WEB](#) [DOWNLOAD ZIP FILES](#) [EMAIL COMMENT](#)

[RoadSafe LLC](#)  
P.O. Box 312  
12 Main Street  
Canton, Maine 04221  
[rsap@roadsafellc.com](mailto:rsap@roadsafellc.com)

### Requirements

RSAPv3 is written as a series of Microsoft Excel macros. RSAPv3 will run on any Windows computer running Excel 14 or better and will run on both 32 and 64 bit computers. RSAPv3 has been successfully tested with Windows7, Windows XP and Vista.

### RSAP Information

- [User Manual](#)
- [Engineer's Manual](#)
- [Programmer's Manual](#)
- [TR News Article about RSAPv3](#)  
(posted with permission of NAS/TRB)

### Resources

- Go to the RSAP Support [Facebook](#) page for questions and answers.
- See the [Release Notes](#).
- [Installation Tips](#)
- [Tip #1](#) — Dire warnings when downloading using the "Install from Web" button.
- [Tip #2](#) — Security message when opening the workbook for the first time.
- [Tip #3](#) — I don't have administrative privileges on my computer. Can I still install RSAP?

### Example Case Workbooks

These are the Excel macro-enabled workbooks for the cases described in the [User's Manual](#). It may take some time to open up Excel over the internet so you should save these locally and open them on your computer.

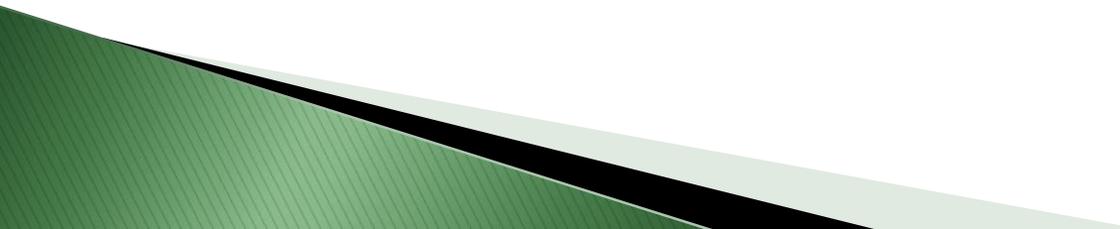
- [NJTA Concrete Median Barrier](#)
- [WSDOT Cable Median Barrier](#)
- [RDG Culvert Example](#)

### User Submitted Examples

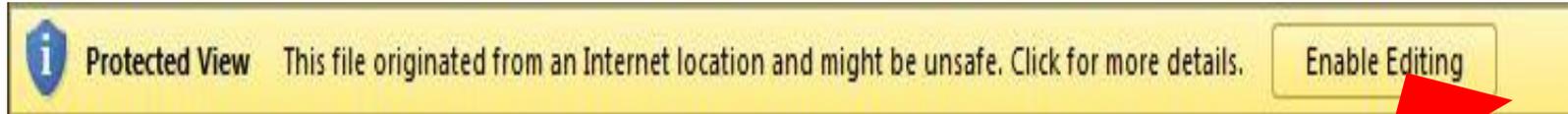
If you have an example that you would like to share, please email it to the project team using the button at the top of the page. We will post it here.

100%

# Current Version

- ▶ RSAPv3 is actually a group of Excel Macros → Excel must be installed on your computer.
  - ▶ Current release is RSAP 3.0.1 release 130304.
  - ▶ Release 121024 and later run on either 32 or 64 bit computers.
  - ▶ Same code runs on both architectures regardless of whether you have the 32 or 64 bit version of excel installed.
  - ▶ If you have Excel 12 (i.e., Windows 2007) you need a slightly different version → contact the development team.
  - ▶ Register your copy so you are notified about updates, changes and training opportunities.
- 

# Remember: Enable editing after download



# Example Problem

Median Barrier Alternatives on a High-Speed,  
High-Volume Divided Highway



Christine E. Carrigan, P.E., Ph.D.

RSAP Controls

- PROJECT: Start a New Project
- TRAFFIC: Open Existing Project
- HIGHWAY: Clear User Information
- ALTERNATIVES: Restore RSAP Defaults
- X-SECTION
- ANALYZE
- RESULTS
- SETTINGS
- HAZARDS

Concrete Barrier Example Problem

RSAPv3\_130304\_concrete.xlsm

### RSAP PROJECT INFORMATION

#### BASIC INFORMATION

Today's date (i.e., run date) 3/5/2013

Title Concrete Barrier Example Problem

Units USCU (only USCU units at this time)

Design Life 25 YRS

Construction Year 2003

Rate of Return 4 %

Notes: See User's Manual Page 85 for a description of this example problem.

Microsoft Excel

 The cell or chart that you are trying to change is protected and therefore read-only. To modify a protected cell or chart, first remove protection using the Unprotect Sheet command (Review tab, Changes group). You may be prompted for a password.

OK

Change the default values in the yellow or rose cells or proceed to the next step by selecting Traffic Info.

Help

Save SaveAs

Exit

Departmental Analyses -- 2009 Annual Revision," U.S. DOT, March 18,2009.

see <http://regs.dot.gov>

RSAP Root Directory: C:\Program Files\RSAPv3

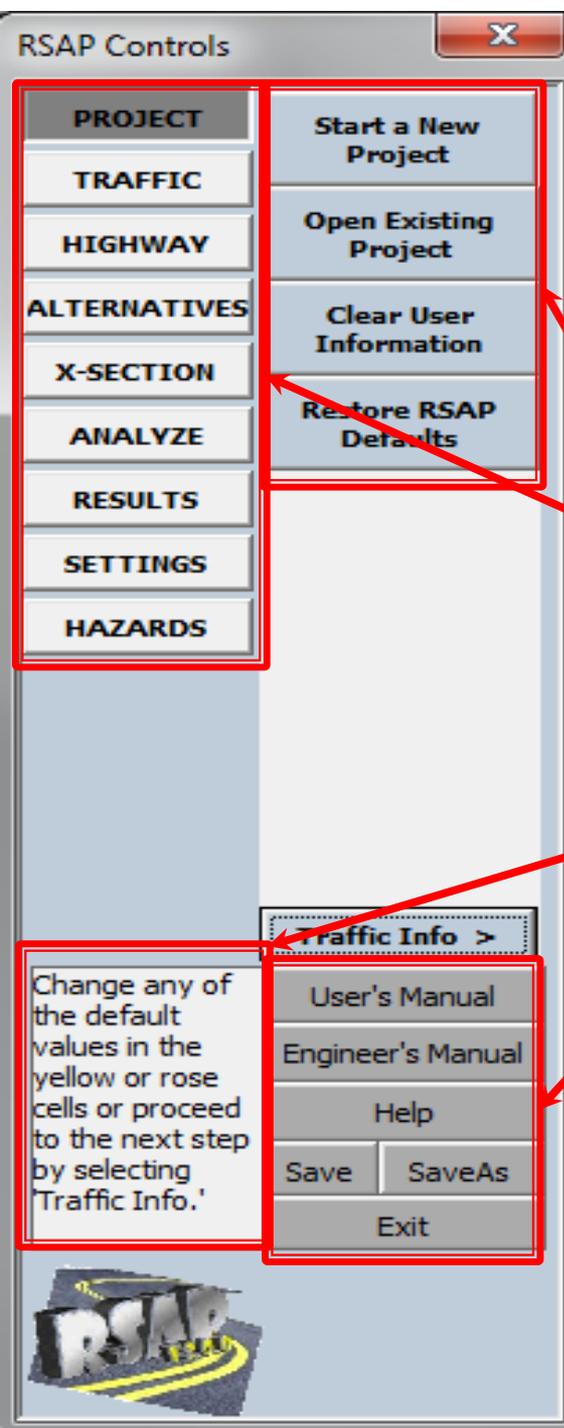
Project Information Traffic Information Road Segments Alternatives Severity Cross-Section Encr Pref and Adj

**YELLOW:** User entered information.

**ROSE:** Default data, can be edited.

**WHITE:** Calculated values.

**Note:** Each term and input cell is defined in the User's Manual.

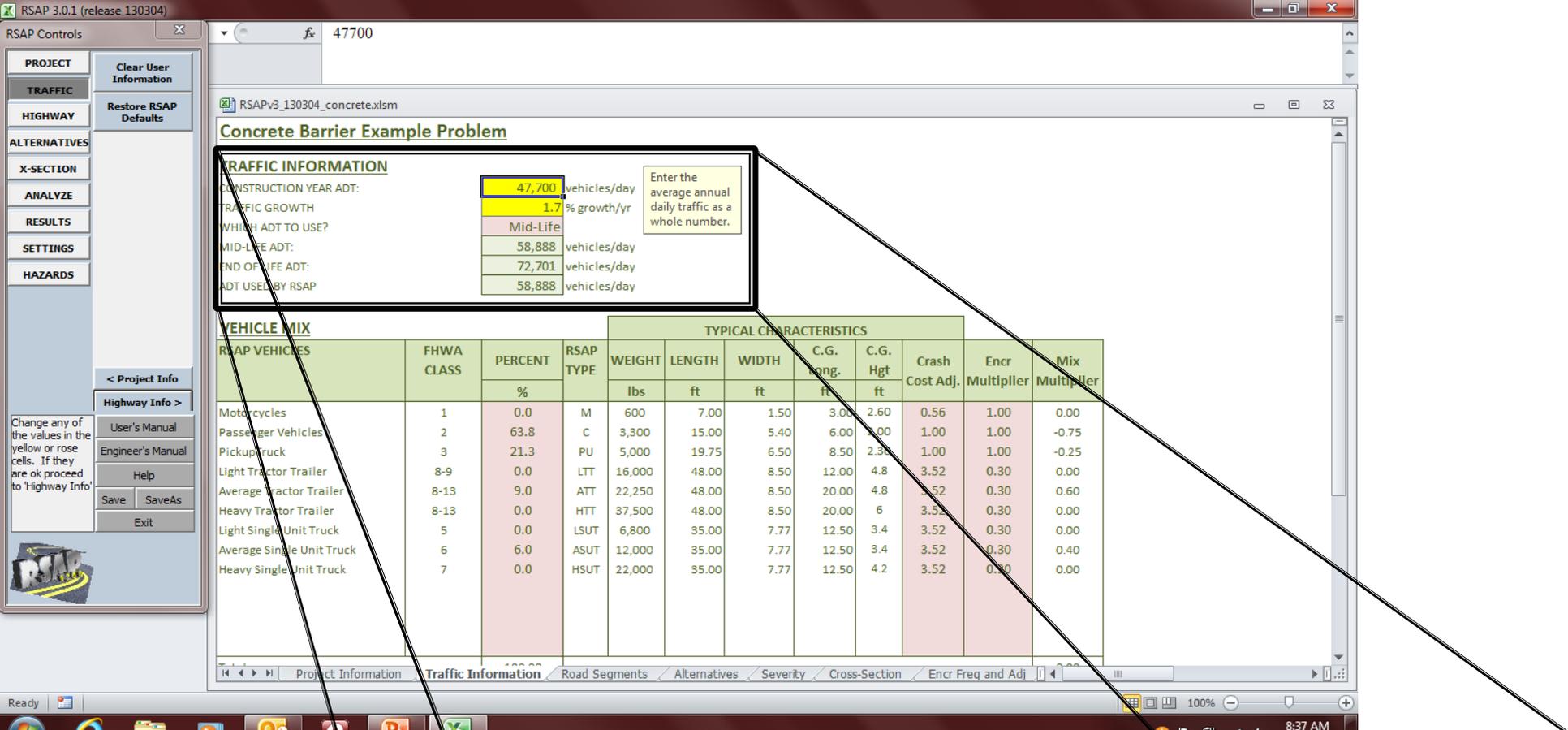


## ▶ RSAP Controls

- Always on the left side of screen.
- Work flows from:
  - Top to bottom
  - Left to right
- Correspond to each worksheet.
- Button options change with the context of the worksheet.
- Hints about what to do next.
- General purpose buttons – available all the time.

# Our Focus: Example Problem

- ▶ **Entry of Project Data**
  - Traffic characteristics
  - Highway types
  - Highway characteristics
  - Properly locating data
  - Roadside cross-section
- ▶ **Analysis Settings**
- ▶ **Results**



## Concrete Barrier Example Problem

### TRAFFIC INFORMATION

CONSTRUCTION YEAR ADT:

47,700

vehicles/day

TRAFFIC GROWTH

1.7

% growth/yr

WHICH ADT TO USE?

Mid-Life

MID-LIFE ADT:

58,888

vehicles/day

END OF LIFE ADT:

72,701

vehicles/day

ADT USED BY RSAP

58,888

vehicles/day

Enter the average annual daily traffic as a whole number.

RSAP Controls

PROJECT: Enter Highway Characteristics

TRAFFIC: See Road Characteristics

HIGHWAY: See Road Characteristics

ALTERNATIVES: Restore RSAP Defaults

X-SECTION: Edit Whole Project Info

ANALYZE: Recalculate Encroachments

RESULTS: Recalculate Encroachments

SETTINGS: Recalculate Encroachments

HAZARDS: Recalculate Encroachments

< Traffic Info

Alternative Info>

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

Change any values in the rose colored cells or select 'Enter Highway Characteristics' to define segment information.



RSAPv3\_130304\_concrete.xlsm

### Concrete Barrier Example Problem

**WHOLE ROADWAY CHARACTERISTICS**

PERCENT OF TRAFFIC IN PRIMARY DIRECTION: 50 %

PERCENT OF TRAFFIC ENCROACHING RIGHT: 50 %

HIGHWAY TYPE: D

TERRAIN: F

POSTED SPEED LIMIT: 65 mi/hr

USER ENROACHMENT ADJUSTMENT: 1

**PROJECT LIMITS**

Min Sta	0+00. ft
Max Sta	52+80.00 ft
Max Offset	200.00 ft

SEG	ROAD SEGMENT DATA			EXPECTED PASSENGER VEHICLE ENCROACHMENTS						EXPECTED TRUCK		
	START STA	END STA	SEGMENT LENGTH	TOTAL	PRIMARY DIRECTION	OPPOSING DIRECTION	TOTAL	PRIMARY D				
			ft	BASE ENCR RATE	MODIFIED ENCR RATE	PRIMARY RIGHT ENCR	PRIMARY LEFT ENCR	OPPOSING RIGHT ENCR	OPPOSING LEFT ENCR	BASE ENCR RATE	MODIFIED ENCR RATE	PRIMARY RIGHT ENCR
1	0+00.	52+80.	5,280.00	encr/yr 10.1948	encr/yr 10.1948	0.2500	0.2500	0.2500	0.2500	encr/yr 0.6198	encr/yr 10.1948	0.2500

Project Information | Traffic Information | Road Segments | Alternatives | Severity | Cross-Section | Encr Freq and Adj

### WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION: 50 %

PERCENT OF TRAFFIC ENCROACHING RIGHT: 50 %

HIGHWAY TYPE: D

TERRAIN: F

POSTED SPEED LIMIT: 65 mi/hr

USER ENROACHMENT ADJUSTMENT: 1

# Highway Types

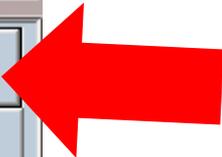
- ▶ Undivided
- ▶ Divided
- ▶ One way



RSAP 3.0.1 (release 130304)

RSAP Controls

PROJECT	Enter Highway Characteristics
TRAFFIC	
HIGHWAY	See Road Characteristics
ALTERNATIVES	Restore RSAP Defaults
X-SECTION	
ANALYZE	Edit Whole Project Info
RESULTS	Recalculate Encroachments
SETTINGS	
HAZARDS	
	< Traffic Info
	Alternative Info>
Change any values in the rose colored cells or select 'Enter Highway Characteristics' to define segment information.	User's Manual
	Engineer's Manual
	Help
	Save SaveAs
	Exit



**RSAP Controls**

**PROJECT** Segment Project

**TRAFFIC**

**HIGHWAY** See Road Characteristics

**ALTERNATIVES**

**X-SECTION**

**ANALYZE** Clear User Information

**RESULTS**

**SETTINGS**

**HAZARDS**

< Traffic Info

Alternative Info>

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

Enter the road characteristics in the yellow cells. When finished select 'Segment Project.'



fx 0

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### Concrete Barrier Example Problem

#### WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION:	50	%
PERCENT OF TRAFFIC ENCROACHING RIGHT:	50	%
HIGHWAY TYPE:	D	
TERRAIN:	F	
POSTED SPEED LIMIT:	65	mi/hr
USER ENROACHMENT ADJUSTMENT:	1	

PROJECT	
Min Sta	
Max Sta	5
Max Offset	

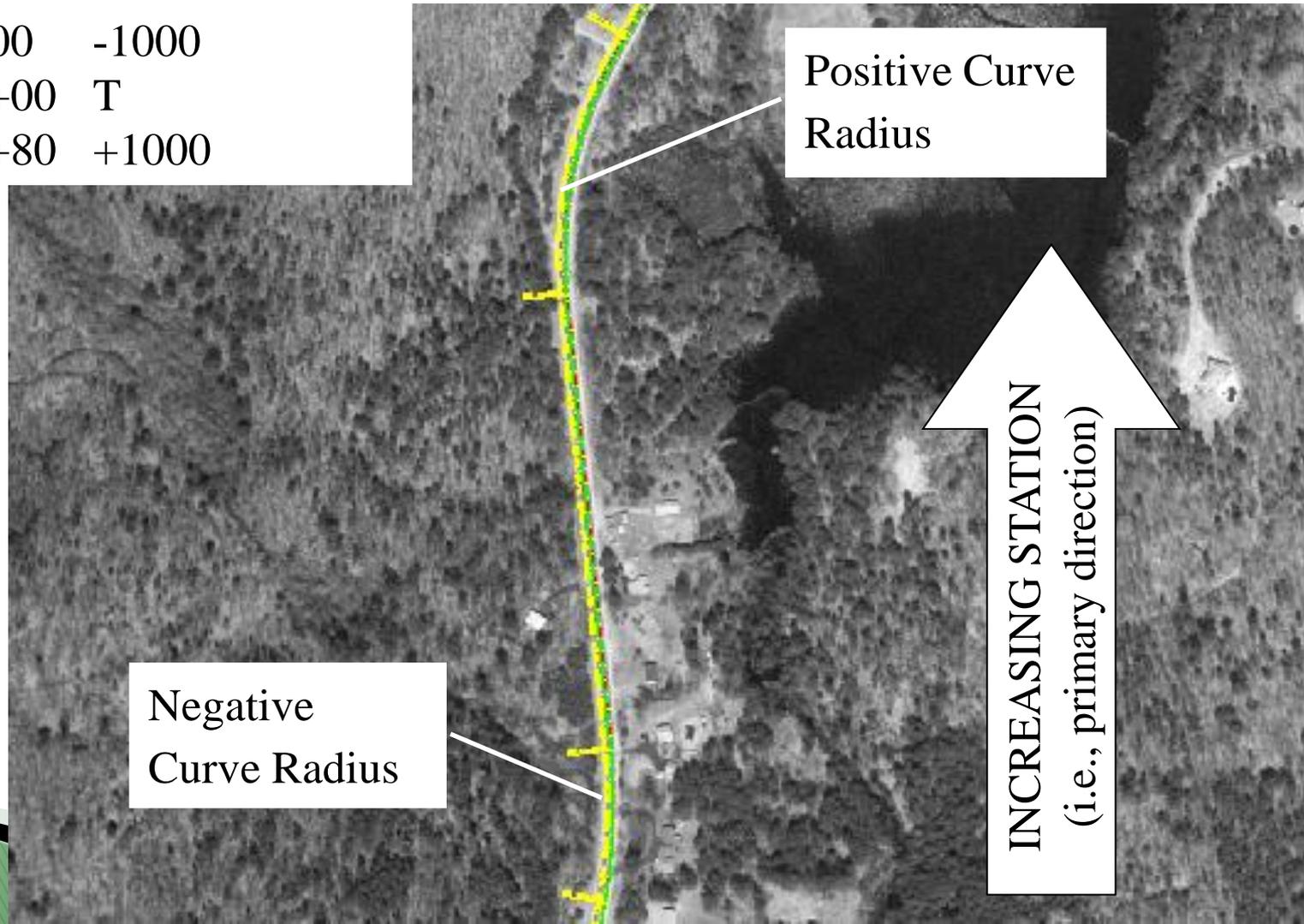
#### USER-ENTERED CHARACTERISTICS

Total segments =					RSAP DEFAULT HIGHWAY CHARACTERISTICS		
START STATION	END STATION	KEYWORD	VALUE	SEG.	DIVIDED HIGHWAYS		
0+00.	52+80.	LANES TOTAL	4		ACCESS DENSITY	0	point
0+00.	52+80.	LANES TOTAL	2		LANES TOTAL	4	
0+00.	52+80.	LNWIDTH	27		LNWIDTH	12	
		MED_SHLR_WIDTH			MED_SHLR_WIDTH	10	
		MED_WIDTH			MED_WIDTH	30	
		PRM_CURV_RAD			PRM_CURV_RAD	T	
		PRM_GRADE			PRM_GRADE	0	
		PRM_NUM_LNS			PRM_NUM_LNS	2	
		RMBLSTRIP			RMBLSTRIP	FALSE	TRUE
					RT_SHLR_WIDTH	6	

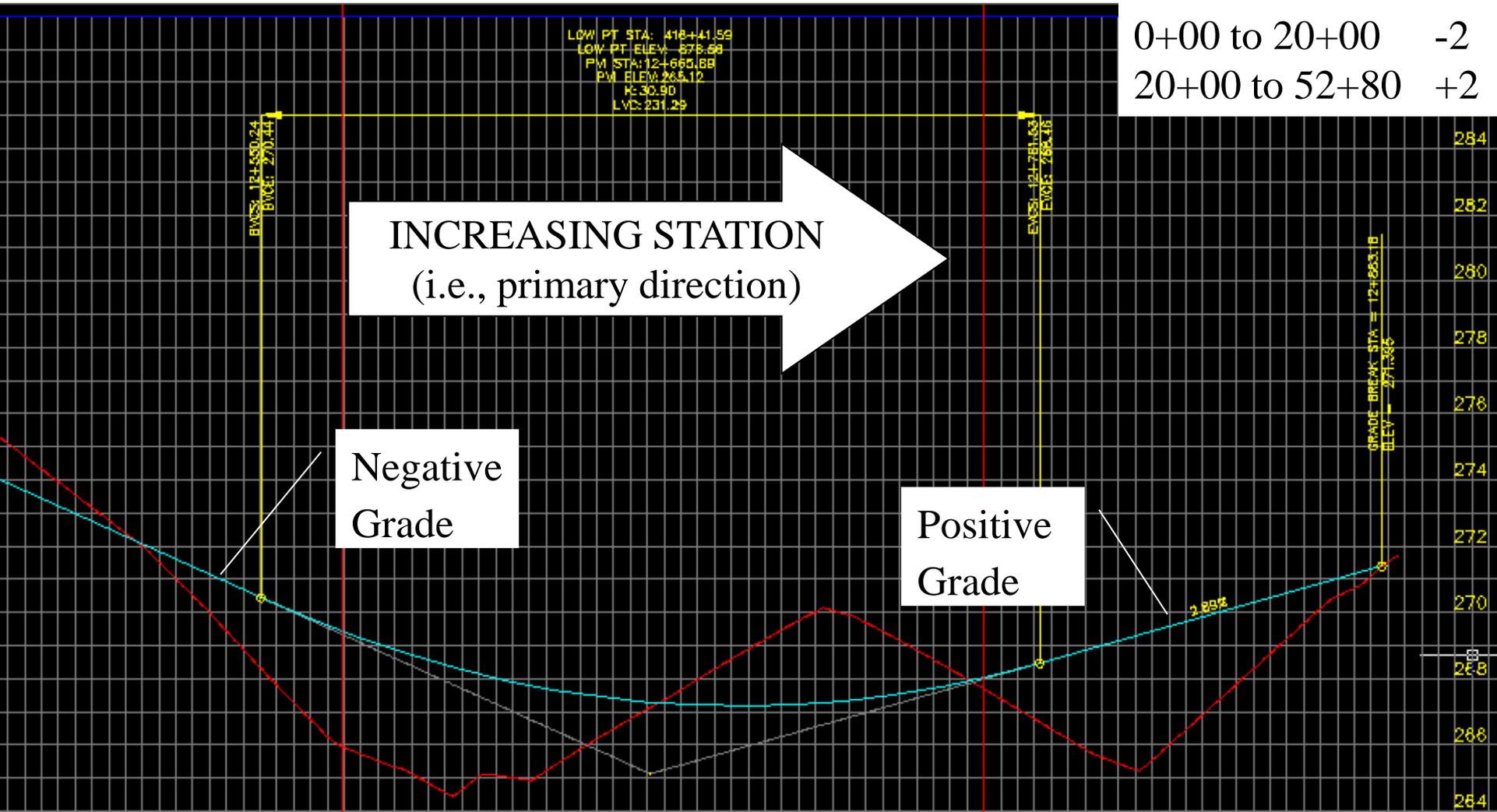
RSAPv3 includes many dropdown menus that provide the appropriate input options.

# Highway Characteristics: prm\_curv\_rad (feet)

0+00 to 30+00	-1000
30+00 to 45+00	T
45+00 to 52+80	+1000



# Highway Characteristics: prm\_grade (percent)



**RSAP Controls**

PROJECT: **Segment Project** (indicated by a red arrow)

TRAFFIC: See Road Characteristics

HIGHWAY: See Road Characteristics

ALTERNATIVES

X-SECTION

ANALYZE: Clear User Information

RESULTS

SETTINGS

HAZARDS

< Traffic Info

Alternative Info>

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

Enter the road characteristics in the yellow cells. When finished select 'Segment Project.'



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### Concrete Barrier Example Problem

#### WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION:	50	%
PERCENT OF TRAFFIC ENCROACHING RIGHT:	50	%
HIGHWAY TYPE:	D	
TERRAIN:	F	
POSTED SPEED LIMIT:	65	mi/hr
USER ENROACHMENT ADJUSTMENT:	1	

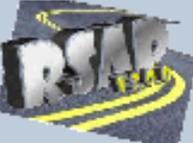
PROJECT	
Min Sta	
Max Sta	5
Max Offset	

#### USER-ENTERED CHARACTERISTICS

Total segments =					RSAP DEFAULT HIGHWAY CHARACTERISTICS		
START STATION	END STATION	KEYWORD	VALUE	SEG.	DIVIDED HIGHWAYS		
0+00.	52+80.	LANES TOTAL	4		ACCESS DENSITY	0	point
0+00.	52+80.	PRM_NUM_LNS	2		LANES TOTAL	4	
0+00.	52+80.	MED_WIDTH	27		LNWIDTH	12	
					MED_SHLR_WIDTH	10	
					MED_WIDTH	30	
					PRM_CURV_RAD	T	
					PRM_GRADE	0	
					PRM_NUM_LNS	2	
					RMBLSTRIP	FALSE	TRUE
					RT_SHLR_WIDTH	6	



PROJECT	4 ALTS DEFINED
TRAFFIC	Clear All Alternative Data
HIGHWAY	Copy Alt 1
ALTERNATIVES	Delete Alt 2
X-SECTION	Sort Alternatives in Station Order
ANALYZE	View/Edit
RESULTS	<input checked="" type="radio"/> Alternative 1
SETTINGS	<input type="radio"/> Alternative 2
HAZARDS	<input type="radio"/> Alternative 3
	<input type="radio"/> Alternative 4
	<input type="radio"/> Alternative 5
	Hazard Info >
	< Highway Info
	X-Section Info >
Complete the information in the yellow cells. Use buttons to add, edit or delete alternatives.	User's Manual
	Engineer's Manual
	Help
	Save SaveAs
	Exit

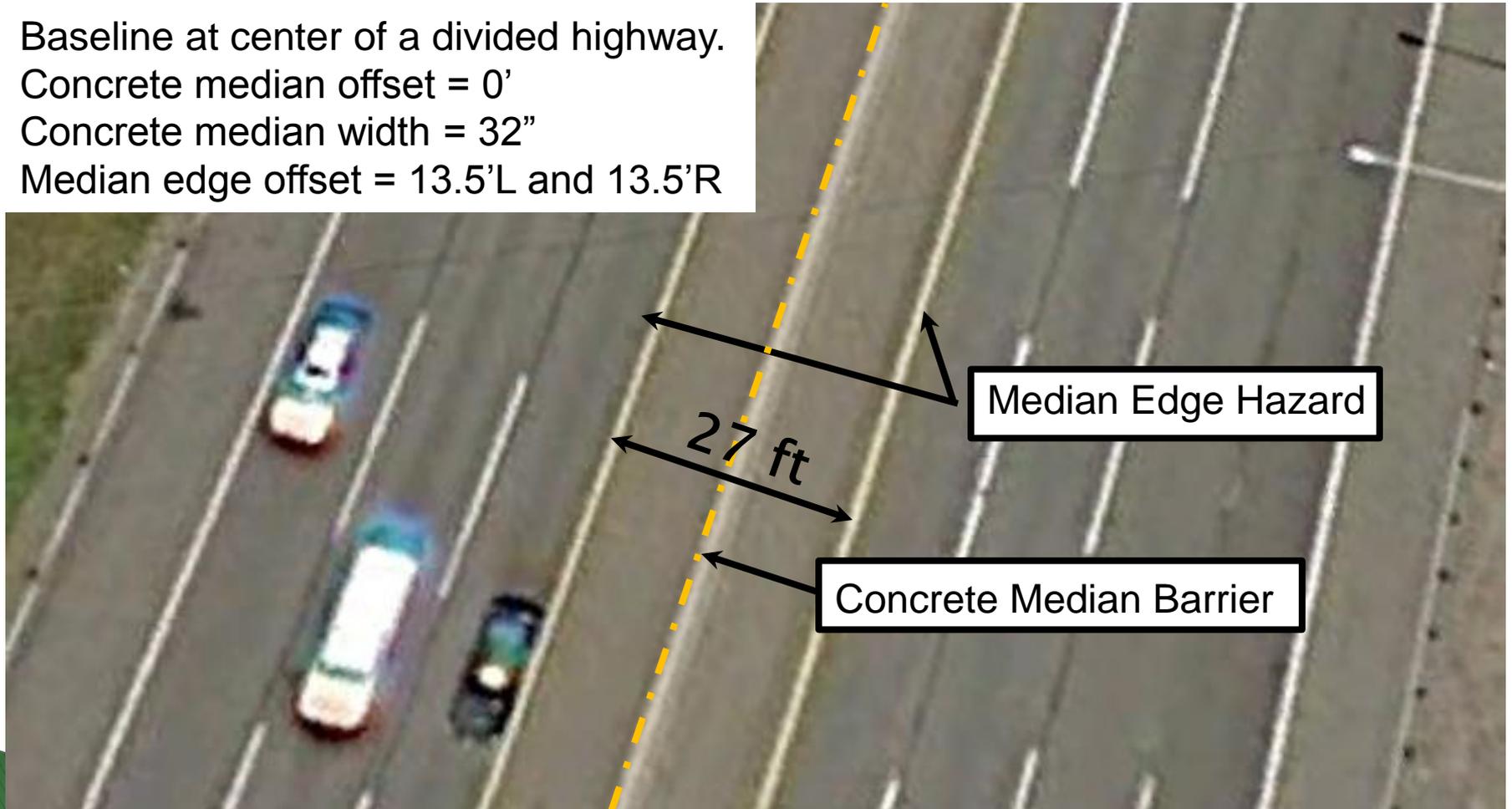


# Roadside Alternatives

- ▶ RSAPv3 will evaluate up to five alternatives with up to 25 segments at one time.
- ▶ Enter from lowest to highest construction cost.
  - Alternative 1: Unprotected median
  - Alternative 2: W-beam median
  - Alternative 3: TL-3+ concrete median
  - Alternative 4: TL5 NJ Shape median

# Locating Hazards

Baseline at center of a divided highway.  
Concrete median offset = 0'  
Concrete median width = 32"  
Median edge offset = 13.5'L and 13.5'R



RSAP Controls

**PROJECT** 4 ALTS DEFINED

**TRAFFIC** Clear All Alternative Data

**HIGHWAY** Copy Alt 1

**ALTERNATIVES** Delete Alt 2

**X-SECTION** Sort Alternatives in Station Order

**ANALYZE**

**RESULTS** View/Edit

**SETTINGS** Alternative 1

**HAZARDS** Alternative 2  
Alternative 3  
Alternative 4  
Alternative 5

Hazard Info >

< Highway Info

X-Section Info >

Complete the information in the yellow cells. Use buttons to add, edit or delete alternatives.

User's Manual  
Engineer's Manual  
Help  
Save SaveAs  
Exit



RSAPv3\_130304\_concrete.xlsm

**ROADSIDE FEATURES FOR ALTERNATIVE NUMBER: 1**

ALTERNATIVE NAME		Unprotected Median				DEFAULT X-SECTION		All Flat	
CONSTRUCTION COST		\$ -		ANNUAL MAINTENANCE COST		\$ -			
GENERAL HAZARD TYPE	SPECIFIC HAZARD TYPE	START STATION	START SIDE	START OFFSET	END STATION	END SIDE	END OFFSET	PARAMETER	VALUE
		STATIONS		ft	STATIONS		ft		
SpecialEdge	EdgeOfMedian	0+00.	R	R	52+80.00	R	13.5		
SpecialEdge		0+00.	L	13.5	52+80.00	L	13.5		

Guardrails\_Rigid  
Guardrails\_SemiRigid  
MedianBarriers\_Flexible  
MedianBarriers\_Rigid  
MedianBarriers\_SemiRigid  
PoleTreeSign  
SpecialEdge  
TerminalEnds

BridgeEdge\_HighHaz  
BridgeEdge\_LowHaz  
BridgeEdge\_MedHaz  
ClearZoneFence  
EdgeOfMedian  
GenericRigidWall  
Rock Ledge

Station Format Error

Enter the offset as a decimal number from 0 to 200.

Retry Cancel Help

[Was this information helpful?](#)

Menu options are context sensitive.

Most input cells include error checking and will notify you if you enter invalid information

RSAP Controls

PROJECT 4 ALTS DEFINED

TRAFFIC Clear All Alternative Data

HIGHWAY Copy Alt 1

ALTERNATIVES Delete Alt 2

X-SECTION Sort Alternatives in Station Order

ANALYZE

RESULTS View/Edit

SETTINGS Alternative 1

HAZARDS Alternative 2

Alternative 3

Alternative 4

Alternative 5

Hazard Info >

< Highway Info

X-Section Info >

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

Complete the information in the yellow cells. Use buttons to add, edit or delete alternatives.



RSAPv3\_130304\_concrete.xlsm

ALTERNATIVE NAME								W-Beam Median Barrier		DEFAULT X-SECTION	2
CONSTRUCTION COST								\$ 281,878.00		\$ 500.00	All Flat
GENERAL HAZARD TYPE	SPECIFIC HAZARD TYPE	START STATION	START SIDE	START OFFSET	END STATION	END SIDE	END OFFSET	PARAMETER	VALUE		
		STATIONS		ft	STATIONS		ft				
SpecialEdge	EdgeOfMedian	0+00.	R	13.5	52+80.00	R	13.5				
SpecialEdge	EdgeOfMedian	0+00.	L	13.5	52+80.00	L	13.5				
MedianBarriers_SemiRigid	8WbeamMB	0+00.	L	0	52+80.00	L	0	Width (in.)	24		
	Guardrails_Rigid										
	Guardrails_SemiRigid										
	MedianBarriers_Flexible										
	MedianBarriers_Rigid										
	MedianBarriers_SemiRigid										
	PoleTreeSign										
	SpecialEdge										
	TerminalEnds										

**PROJECT** 4 ALTS DEFINED

**TRAFFIC** Clear All Alternative Data

**HIGHWAY** Copy Alt 1

**ALTERNATIVES** Delete Alt 2

**X-SECTION** Sort Alternatives in Station Order

**ANALYZE**

**RESULTS** View/Edit

**SETTINGS**  Alternative 1

**HAZARDS**  Alternative 2

Alternative 3

Alternative 4

Alternative 5

Hazard Info >

< Highway Info

X-Section Info >

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

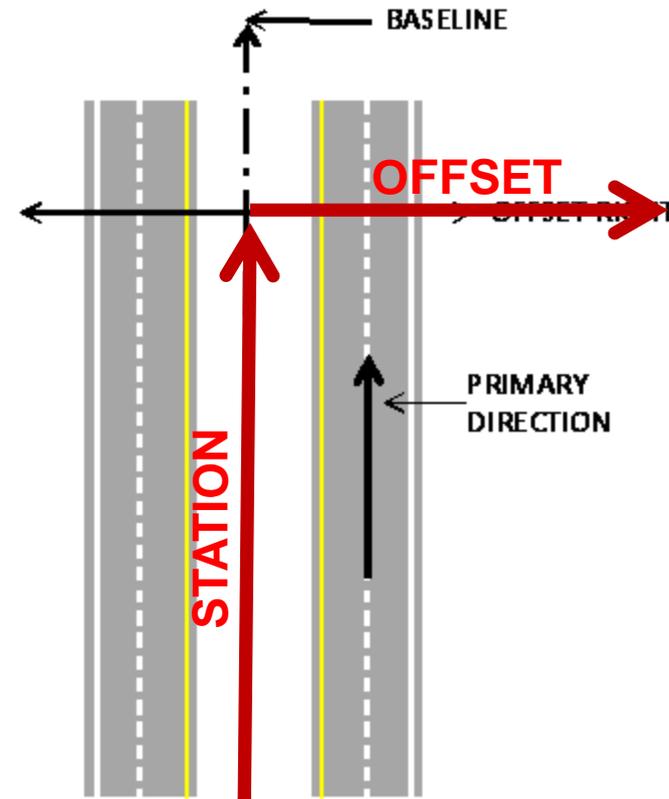
Complete the information in the yellow cells. Use buttons to add, edit or delete alternatives.

ALTERNATIVE NAME		TL5 NJ Shape Barrier					DEFAULT X-SECTION		4
CONSTRUCTION COST		\$ 727,716.00					\$ -		
GENERAL HAZARD TYPE	SPECIFIC HAZARD TYPE	START STATION	START SIDE	START OFFSET	END STATION	END SIDE	END OFFSET	PARAMETER	VALUE
		STATIONS		ft	STATIONS		ft		
SpecialEdge	EdgeOfMedian	0+00.	R	13.5	52+80.00	R	13.5		
SpecialEdge	EdgeOfMedian	0+00.	L	13.5	52+80.00	L	13.5		
MedianBarriers_Rigid	TL5NJshapeMB	0+00.	L	0	52+80.00	L	0	Width (in.)	32
Guardrails_Rigid	TL3+FShapeMB								
Guardrails_SemiRigid	TL3+NJshapeMB								
MedianBarriers_Flexible	TL3FShapeMB								
MedianBarriers_Rigid	TL3NJshapeMB								
MedianBarriers_SemiRigid	TL5FShapeMB								
PoleTreeSign	TL5NJshapeMB								
SpecialEdge									
TerminalEnds									



# Locating Data

- ▶ **Station** → Measured longitudinally in Stations in the Primary Direction.
- ▶ **Offset** → Measured as a distance left or right from the BASELINE.
- ▶ The baseline is different for different highway types.

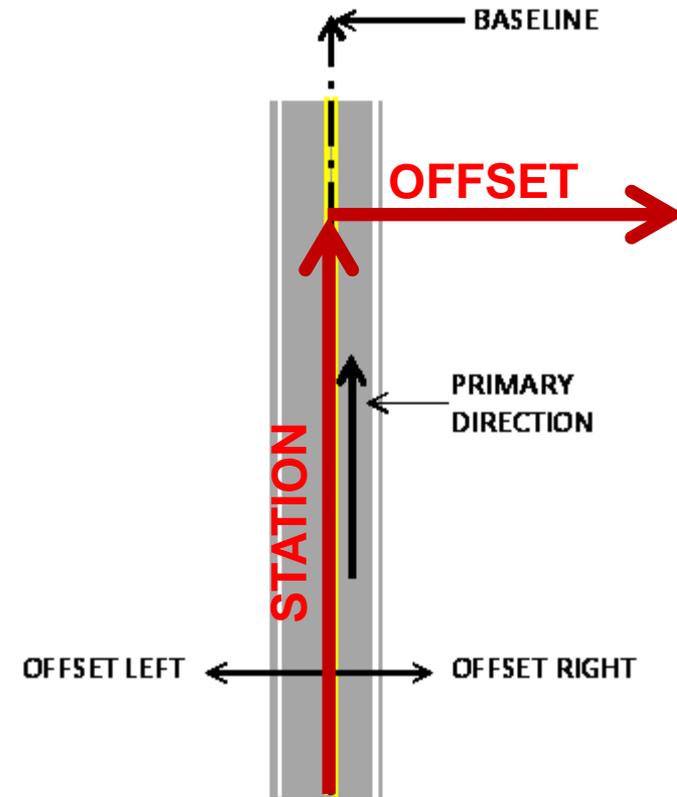


## 4 LANE DIVIDED

The baseline runs along the center-line of the median in the direction of increasing stationing. All objects are located as being a distance to the left or right of the base line.

# Locating Data

- ▶ **Station** → Measured longitudinally in Stations in the Primary Direction.
- ▶ **Offset** → Measured as a distance left or right from the BASELINE.

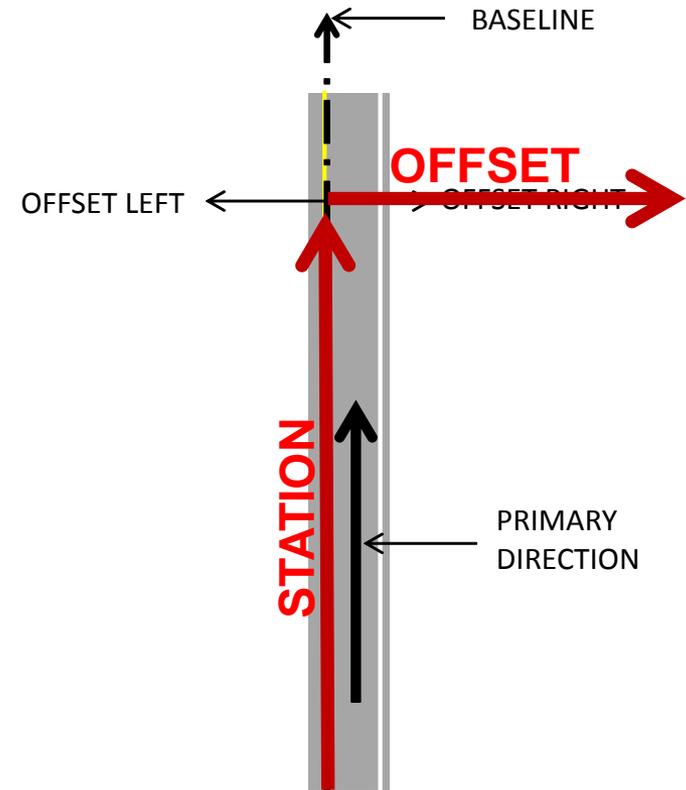


## 2 LANE UNDIVIDED

The baseline runs along the center-line of the undivided highway in the direction of increasing stationing. All objects are located as being a distance to the left or right of the base line.

# Locating Data

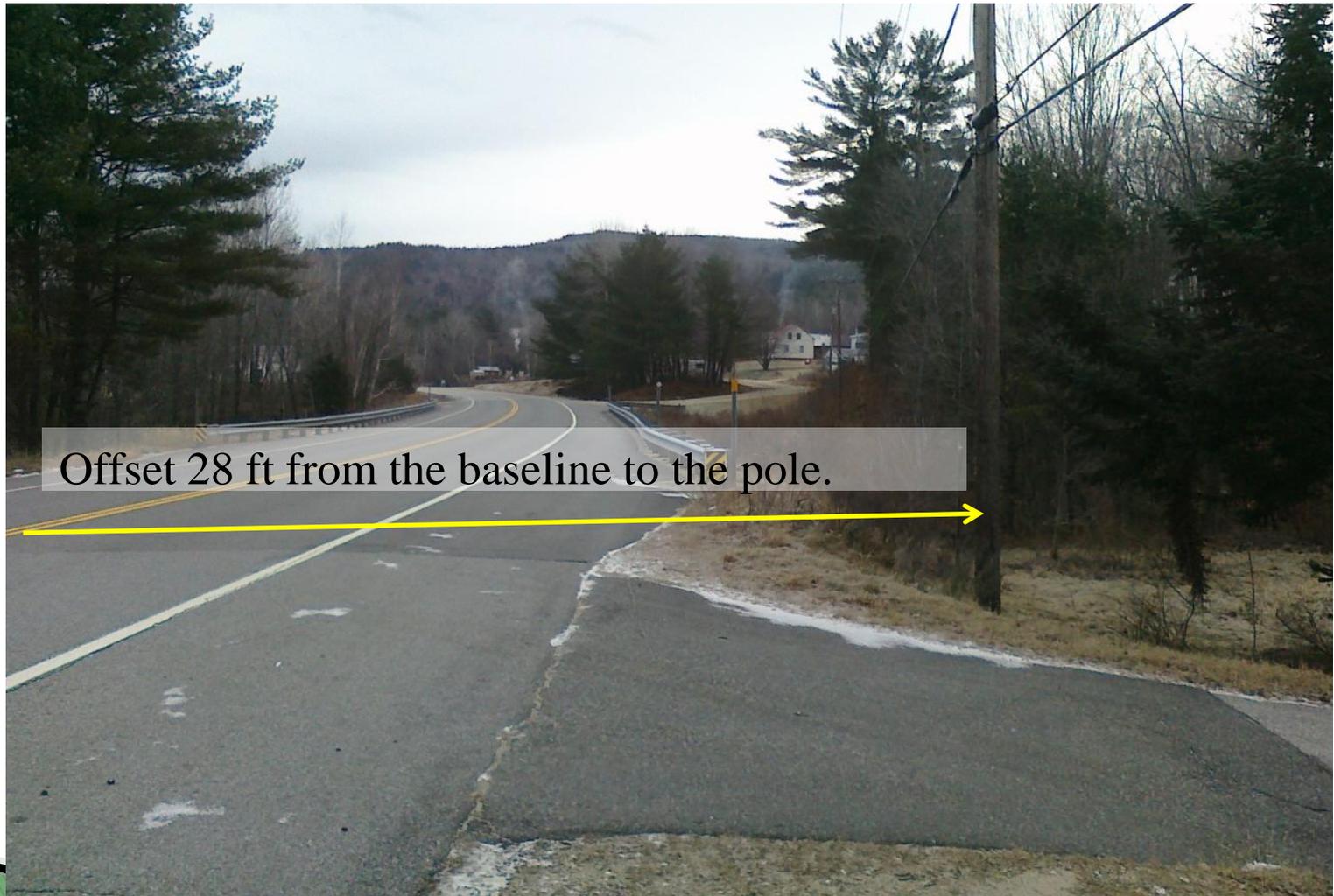
- ▶ **Station** → Measured longitudinally in Stations in the Primary Direction.
- ▶ **Offset** → Measured as a distance left or right from the BASELINE.



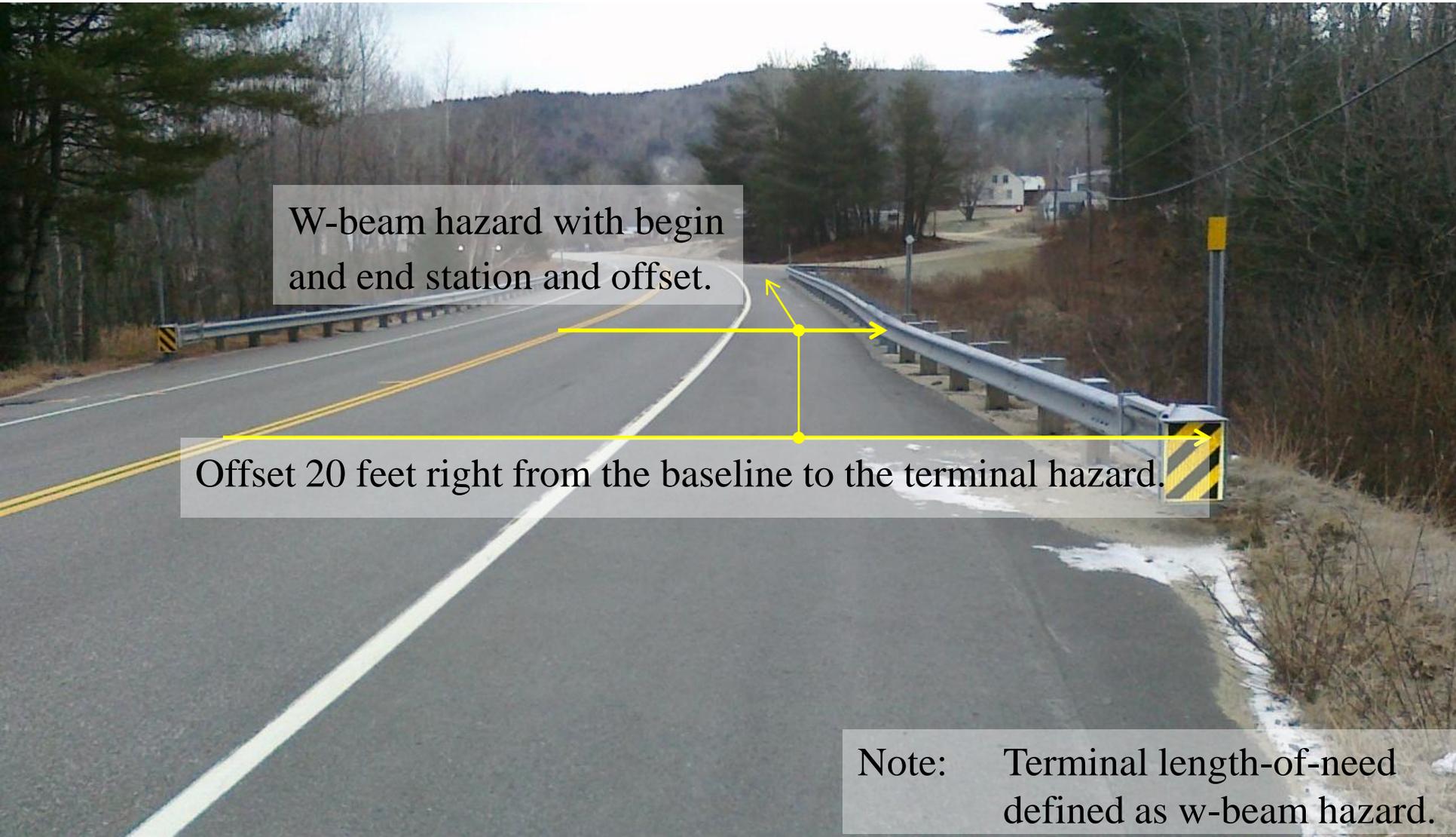
## ONE WAY

The baseline runs along the left lane edge of the one-way road in the direction of increasing stationing. All objects are located as being a distance to the left or right of the base line. Use one-way roads for ramps or divided highways with independent alignments.

# Locating Hazards



# Locating hazards



W-beam hazard with begin and end station and offset.

Offset 20 feet right from the baseline to the terminal hazard.

Note: Terminal length-of-need defined as w-beam hazard.

# Locating Hazards

## Baseline is always in middle of road



RSAP Controls

PROJECT 4 ALTS DEFINED

TRAFFIC Clear All Alternative Data

HIGHWAY Copy Alt 1

ALTERNATIVES Delete Alt 2

X-SECTION Sort Alternatives in Station Order

ANALYZE

RESULTS View/Edit

SETTINGS Alternative 1

HAZARDS Alternative 2

Alternative 3

Alternative 4

Alternative 5

Hazard Info >

< Highway Info

X-Section Info >

User's Manual

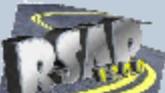
Engineer's Manual

Help

Save SaveAs

Exit

Complete the information in the yellow cells. Use buttons to add, edit or delete alternatives.



RSAPv3\_130304\_concrete.xlsm

ALTERNATIVE NAME		TL5 NJ Shape Barrier				DEFAULT X-SECTION	All Flat
CONSTRUCTION COST		\$ 727,716.00				\$	
GENERAL HAZARD TYPE	SPECIFIC HAZARD TYPE	STATIONS	APPROXIMATE OFFSET	STATIONS	END SIDE	END OFFSET	PARAMETER
SpecialEdge	EdgeOfMedian	0+00	R	13.5	52+80.00	R	13.5
SpecialEdge	EdgeOfMedian	0+00	L	13.5	52+80.00	L	13.5
MedianBarriers_Rigid	TL5NJshapeMB	0+00	L	0	52+80.00	L	0
							Width (in.)
							32

Provide a title for each alternative and the construction cost.

Choose one of the default cross-sections. These can be changed and modified on the next worksheet.

- All 4:1
- All 6:1
- All 8:1
- All Flat
- MedMndinC
- MedMndinFil
- MedMndonF
- Vertical Fill



RSAP Controls

**PROJECT** Copy Defaults to all Segments

**TRAFFIC**

**HIGHWAY** Save X-Section

**ALTERNATIVES** Delete X-Section

**X-SECTION** To edit a x-section, double click on one of the x-sections listed below.

**ANALYZE**

**RESULTS** All 10:1  
All 2:1  
All 3:1  
All 4:1  
All 6:1  
All 8:1  
All Flat

**SETTINGS**

**HAZARDS**

<Alternative Info

Analysis >

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.



RSAPv3\_130304\_concrete.xlsm

DEFAULT X-SECTION			
SEG	START STA	END STA	
1	0+00.	52+80.00	All Flat

SEGMENT CHARACTERISTICS

Total Lanes

Number Lanes Prim

Lane Width (ft) 12.

Project Information Traffic Info

RSAP Controls

**PROJECT** Copy Defaults to all Segments

**TRAFFIC**

**HIGHWAY** Save X-Section

**ALTERNATIVES** Delete X-Section

**X-SECTION** To edit a x-section, double click on one of the x-sections listed below.

**ANALYZE**

**RESULTS** All 10:1  
All 2:1  
All 3:1  
All 4:1  
All 6:1  
All 8:1  
All Flat

**SETTINGS**

**HAZARDS**

<Alternative Info

Analysis >

User's Manual

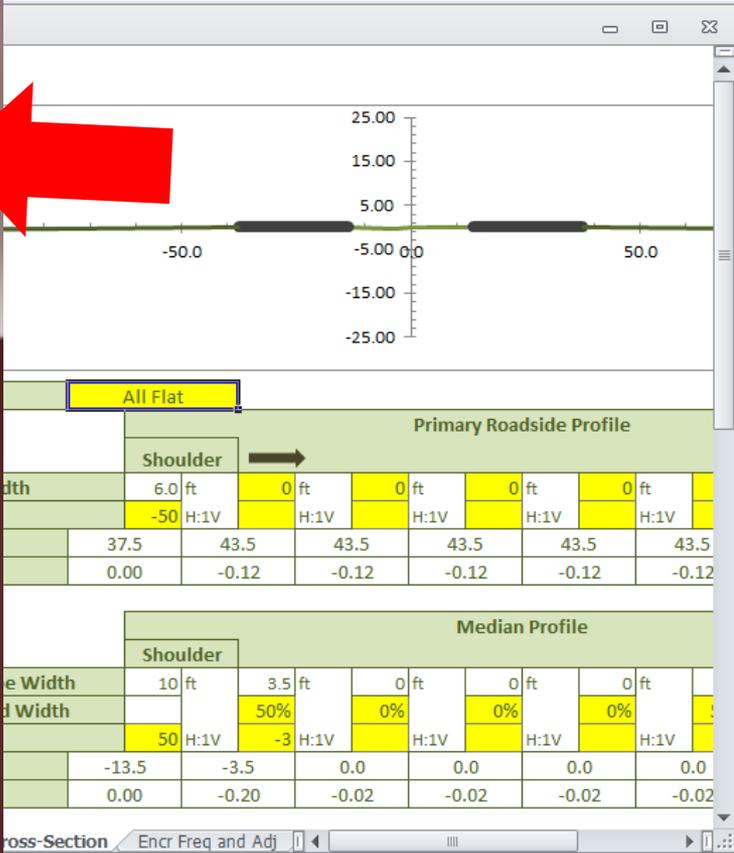
Engineer's Manual

Help

Save SaveAs

Exit

Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.



RSAP Controls

RSAPv3\_130304\_concrete.xlsm

**PROJECT** Copy Defaults to all Segments

**TRAFFIC**

**HIGHWAY** Assign X-Sections to Segs and Alts

**ALTERNATIVES**

**X-SECTION** To edit a x-section, double click on one of the x-sections listed below.

**ANALYZE**

**RESULTS**

**SETTINGS**

**HAZARDS**

All 10:1  
All 2:1  
All 3:1  
All 4:1  
All 6:1  
All 8:1  
All Flat

<Alternative Info

Analysis >

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit

Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.

**SEGMENT CHARACTERISTICS**

DEFAULT X-SECTION		X-SECTION FOR ALTERNATIVE					
SEG	START STA	END STA	1	2	3	4	5
1	0+00.	52+80.00	All Flat	All Flat	All Flat	All Flat	
			All 4:1				
			All 6:1				
			All 8:1				
			All Flat				
			MedMndinCu				
			MedMndinFill				
			MedMndonF				
			Vertical Fill				

Total Lanes 4

Number Lanes Prim 2

Lane Width (ft) 12.0

You can choose a different cross-section for each segment in each alternative.

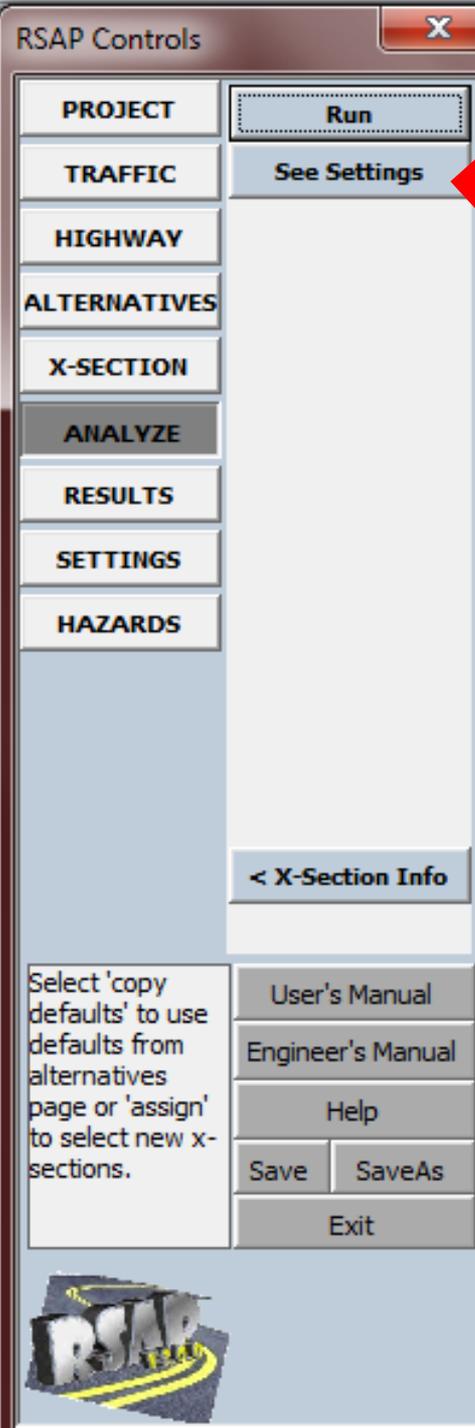
You can also create your own new custom cross-sections and save them in the database.

# Analysis and Results

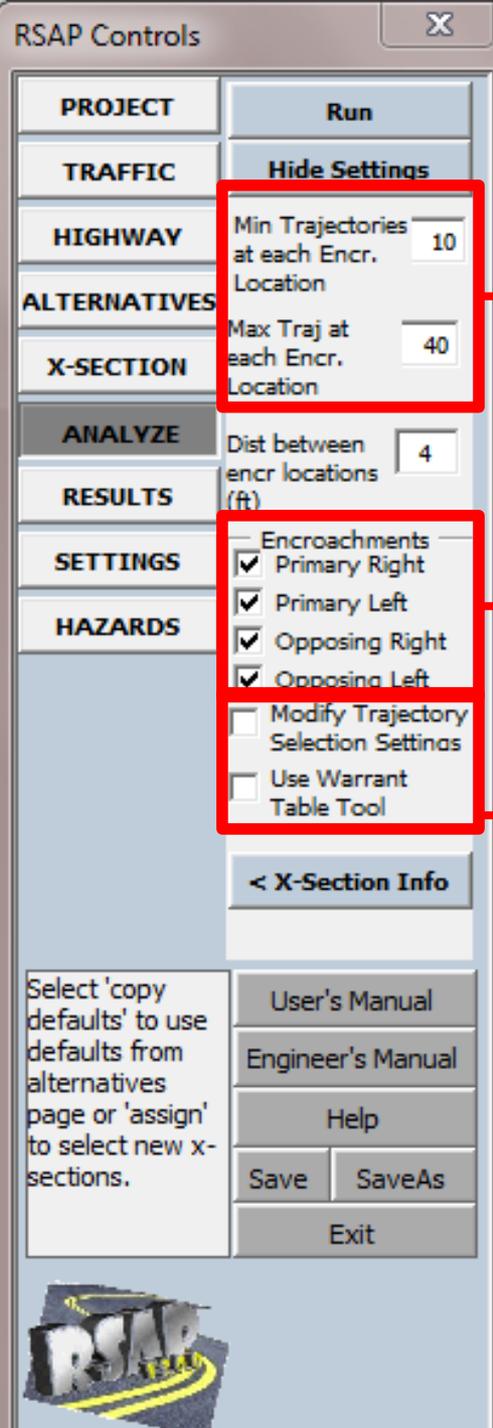
## Median Barrier Alternatives



Malcolm H. Ray, PE, PhD



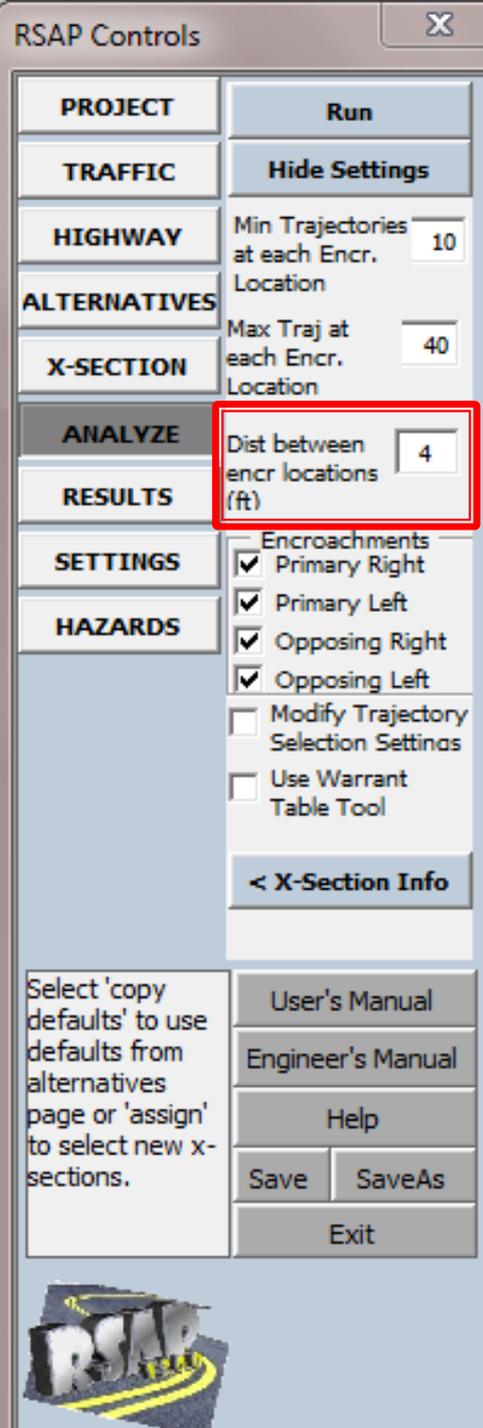
**ANALYZE:**  
How do I pick the best analysis settings?



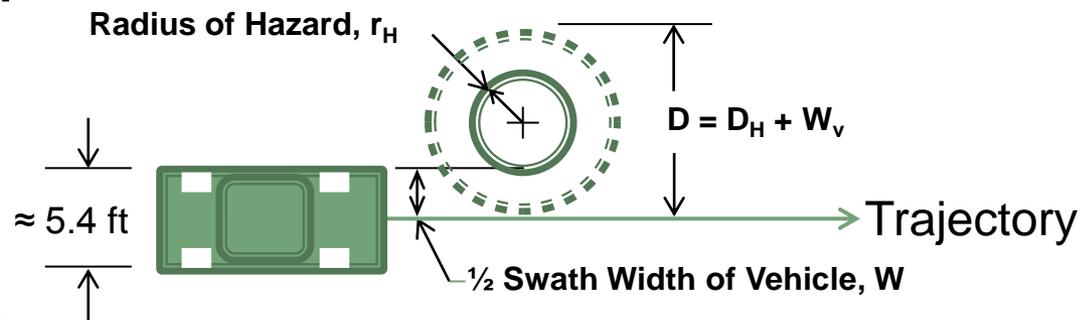
Minimum and Maximum number of trajectories to select.

Select which encroachments you want to include in the analysis.

Outside scope of this course.

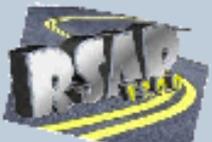


- ▶ Distance between encroachment locations.
- ▶ Default value is 4 ft.
- ▶ If you have point hazards you need a small number like 4 ft to make sure you don't miss any hazards.
- ▶ 1000 ft works well when considering longitudinal hazards like our example problem.



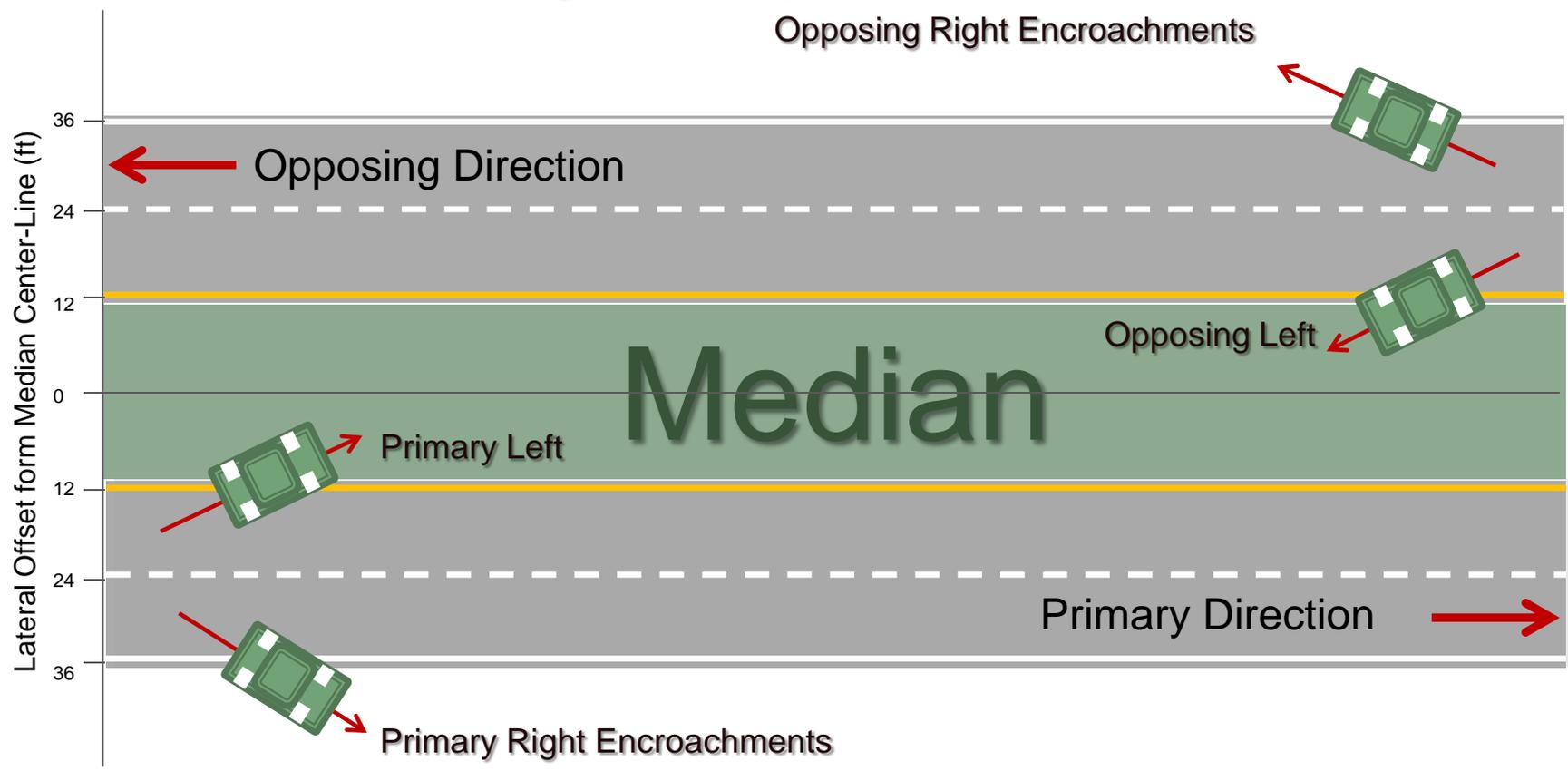
RSAP Controls

PROJECT	Run
TRAFFIC	Hide Settings
HIGHWAY	Min Trajectories at each Encr. Location <input type="text" value="10"/>
ALTERNATIVES	
X-SECTION	Max Traj at each Encr. Location <input type="text" value="40"/>
ANALYZE	Dist between encr locations (ft) <input type="text" value="4"/>
RESULTS	
SETTINGS	<input type="checkbox"/> Encroachments <ul style="list-style-type: none"><li><input checked="" type="checkbox"/> Primary Right</li><li><input checked="" type="checkbox"/> Primary Left</li><li><input checked="" type="checkbox"/> Opposing Right</li><li><input checked="" type="checkbox"/> Opposing Left</li></ul> <input type="checkbox"/> Modify Trajectory Selection Settings <input type="checkbox"/> Use Warrant Table Tool
HAZARDS	
	<input type="button" value=" &lt; X-Section Info"/>
Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.	<input type="button" value="User's Manual"/>
	<input type="button" value="Engineer's Manual"/>
	<input type="button" value="Help"/>
	<input type="button" value="Save"/> <input type="button" value="SaveAs"/>
	<input type="button" value="Exit"/>



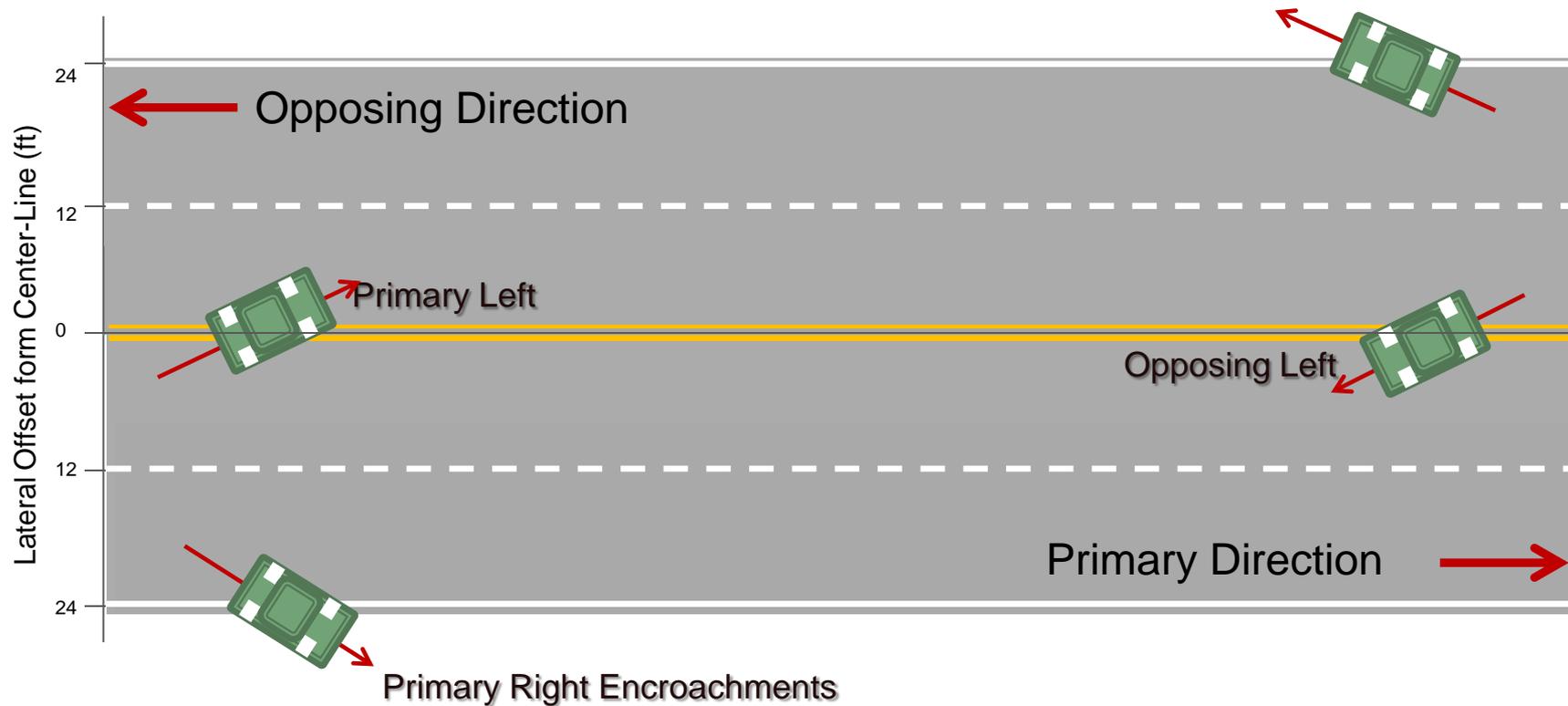
Encroachments to consider.

# Encroachments Divided Highways



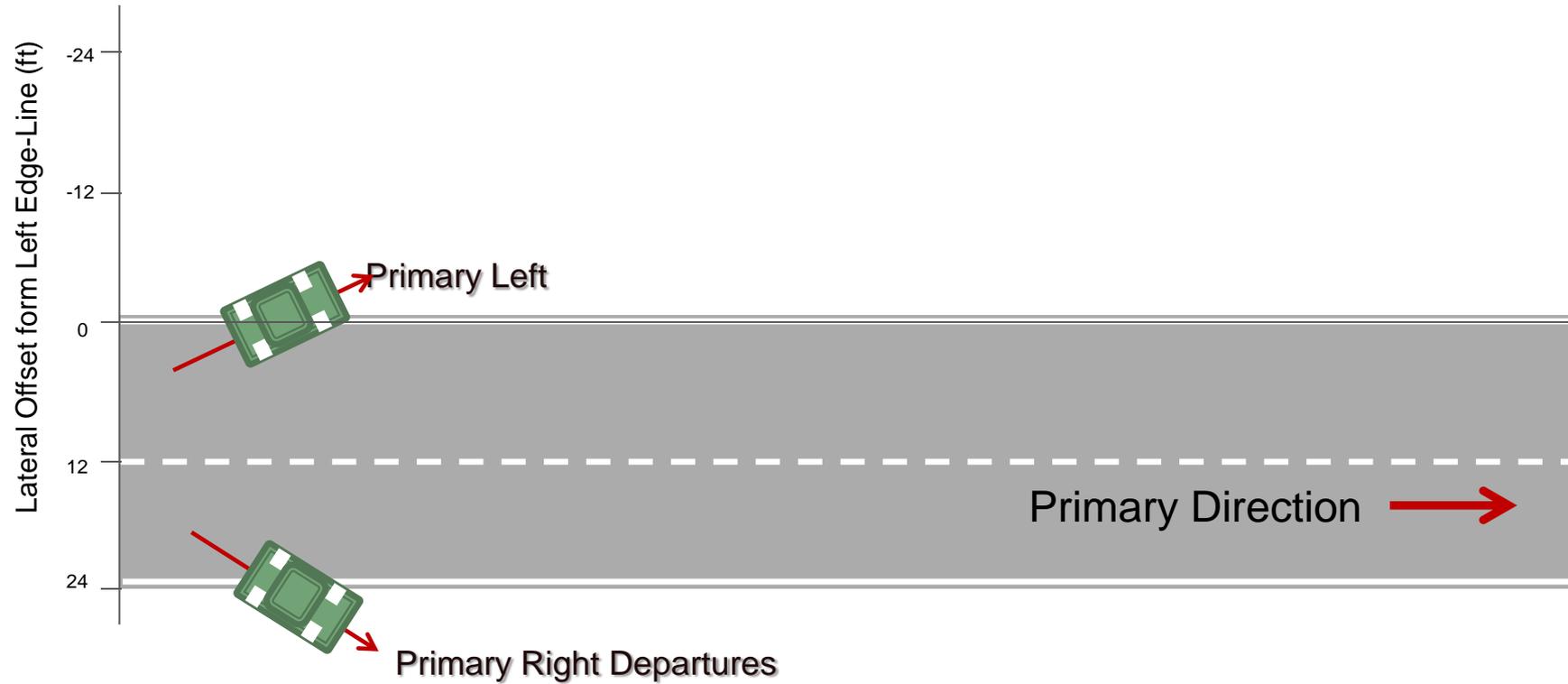
# Encroachments Undivided Highways

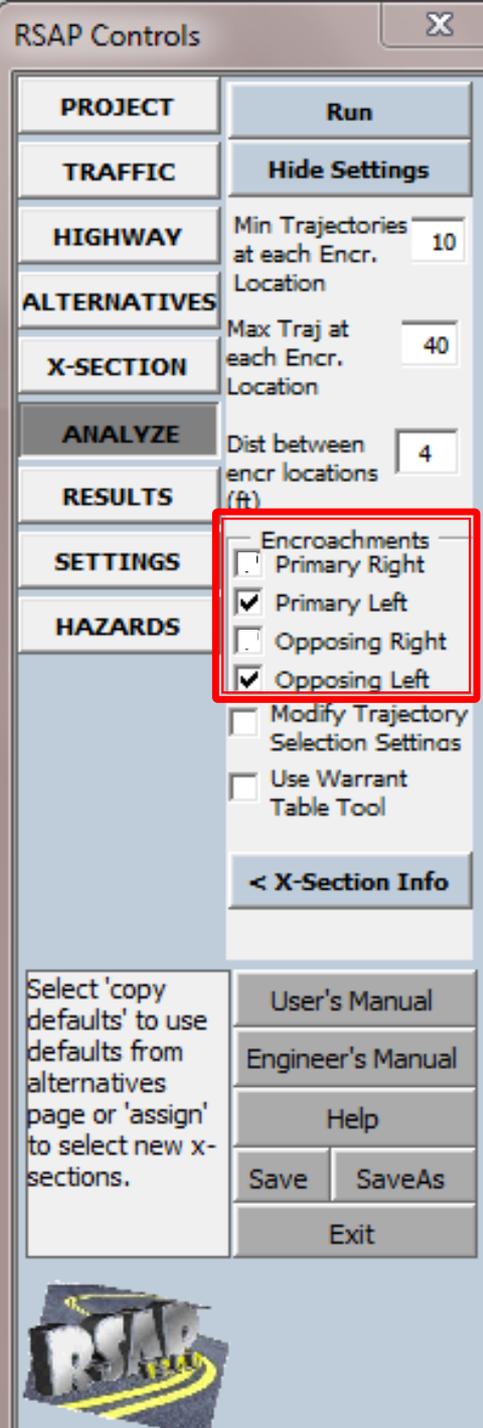
Opposing Right Encroachments



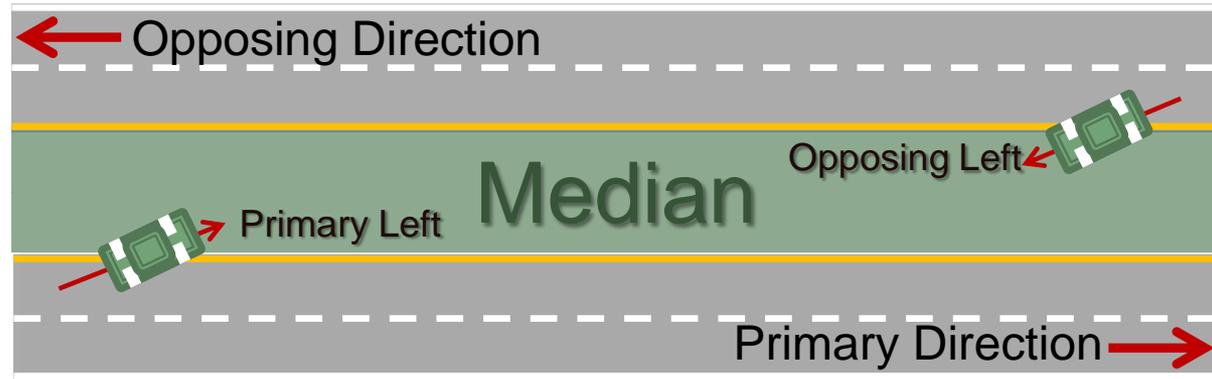
# Encroachments

## One-Way Highways



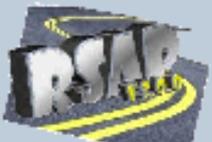


- Only check the boxes for encroachments that you want to consider.
- Our example is evaluating a median barrier so we will consider only:
  - primary left and
  - opposing left.



RSAP Controls

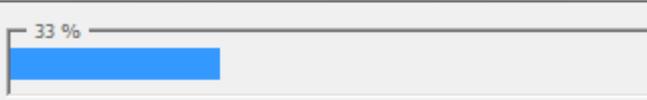
PROJECT	Run
TRAFFIC	Hide Settings
HIGHWAY	Min Trajectories at each Enchr. Location <input type="text" value="10"/>
ALTERNATIVES	Max Traj at each Enchr. Location <input type="text" value="40"/>
X-SECTION	Dist between enchr locations (ft) <input type="text" value="4"/>
ANALYZE	
RESULTS	
SETTINGS	<input checked="" type="checkbox"/> Encroachments <input checked="" type="checkbox"/> Primary Right <input checked="" type="checkbox"/> Primary Left <input checked="" type="checkbox"/> Opposing Right <input checked="" type="checkbox"/> Opposing Left <input type="checkbox"/> Modify Trajectory Selection Settings <input type="checkbox"/> Use Warrant Table Tool
HAZARDS	
	< X-Section Info
Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.	User's Manual Engineer's Manual Help Save SaveAs Exit



Selecting RUN starts the analysis.

Progress

33 %



Cancel

Initializing segment and hazard data.  
Priority set to High  
Segment 1 - Alternative 1 - Primary Left  
number of trajectories selected: 40

minimum trajectory score: 0.96423318275618  
average trajectory score: 0.971787296521959  
(score > 0.9 is considered a good score)  
(0.9 > score > 0.8 is considered acceptable score)  
(0.8 > score > 0.7 is of questionable quality)  
(0.7 > score is unacceptable score. Consider reducing number of trajectories.)

A progress bar will appear during the run to let you know how the run is progressing.

RSAP Controls

PROJECT Segment Report

TRAFFIC B/C Report

HIGHWAY Feature Report

ALTERNATIVES Print Report

X-SECTION

ANALYZE

RESULTS

SETTINGS

HAZARDS

Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit



RSAPv3\_130304\_concrete.xlsm

## FEATURE COLLISION AND COST REPORT

### Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

*RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01*

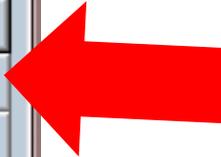
*RSAP Settings: Min No. Traj=10; Max No. Traj=40; Traj Increment=1000 ft*

Alternative	Segment	FEATURE		ANNUAL CRASHES			ANNUAL COST OF CRASHES			
		Feature Number	Feature Type	Encroachment Type	Total Feature Crashes	Penetrated or Vaulted	Rolled Over after Redirection	Annual Feature Crash Cost	Feature Maintenance Cost	Feature Repair Cost
<b>1 Alternative 1</b>										
1	1	1	EdgeOfMedian	PL	0.0000	0.0000	0.0000	\$ 0	\$ 0	\$ 0
1	1	1	EdgeOfMedian	OL	1.7223	1.7223	0.0000	\$ 221,825	\$ 0	\$ 0
1	1	2	EdgeOfMedian	PL	1.7769	1.7769	0.0000	\$ 224,314	\$ 0	\$ 0
1	1	2	EdgeOfMedian	OL	0.0000	0.0000	0.0000	\$ 0	\$ 0	\$ 0
1	1	3	Rollover	PL	0.0520	0.0000	0.0000	\$ 3,674	\$ 0	\$ 0
1	1	3	Rollover	OL	0.0526	0.0000	0.0000	\$ 3,580	\$ 0	\$ 0
<b>2 Alternative 2</b>										
2	1	1	EdgeOfMedian	PL	0.0000	0.0000	0.0000	\$ 0	\$ 0	\$ 0
2	1	1	EdgeOfMedian	OL	0.1610	0.1610	0.0000	\$ 43,262	\$ 0	\$ 0
2	1	2	EdgeOfMedian	PL	0.1427	0.1427	0.0000	\$ 43,287	\$ 0	\$ 0
2	1	2	EdgeOfMedian	OL	0.0000	0.0000	0.0000	\$ 0	\$ 0	\$ 0
2	1	3	TL3WbeamMB	PL	1.9136	0.1481	0.0324	\$ 45,443	\$ 0	\$ 2,296

RSAP Controls



<b>PROJECT</b>	<b>Segment Report</b>
<b>TRAFFIC</b>	<b>B/C Report</b>
<b>HIGHWAY</b>	<b>Feature Report</b>
<b>ALTERNATIVES</b>	<b>Print Report</b>
<b>X-SECTION</b>	
<b>ANALYZE</b>	
<b>RESULTS</b>	
<b>SETTINGS</b>	
<b>HAZARDS</b>	

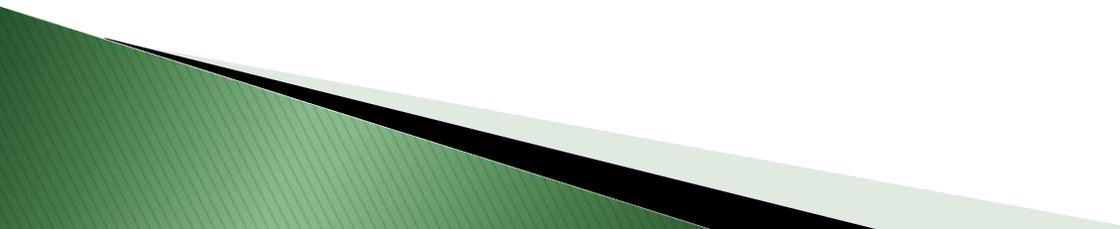


Select 'copy defaults' to use defaults from alternatives page or 'assign' to select new x-sections.

<b>User's Manual</b>	
<b>Engineer's Manual</b>	
<b>Help</b>	
<b>Save</b>	<b>SaveAs</b>
<b>Exit</b>	



What do all those numbers  
in the incremental cost-  
benefit table mean?



# EQUIVALENT ANNUAL INCREMENTAL BENEFIT-COST

## Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

		Decision Point Benefit-Cost Ratio:				1	
		Alternative Choice					
		1	2	3	4		
With Respect to Alternative	ALTERNATIVES	Unprotected Median	W-Beam Median Barrier	TL3+ NJ Shape Barrier	TL5 NJ Shape Barrier		
	1	Unprotected Median	1.00	11.80	11.49	8.18	
	2	W-Beam Median Barrier		0.00	10.58	4.70	
	3	TL3+ NJ Shape Barrier			0.00	<b>1.91</b>	
	4	TL5 NJ Shape Barrier				0.00	

Best Choice is:

**TL5 NJ Shape Barrier**

# The Challenger-Defender Game

		Decision Point Benefit-Cost Ratio: 1				
		Alternative Choice				
		1	2	3	4	
With Respect to Alternative	ALTERNATIVES	Unprotected Median	W-Beam Median Barrier	TL3+ NJ Shape Barrier	TL5 NJ Shape Barrier	
	1	Unprotected Median	1.00	11.80	11.49	8.18
	2	W-Beam Median Barrier		0.00	10.58	4.70
	3	TL3+ NJ Shape Barrier			0.00	1.91
	4	TL5 NJ Shape Barrier				0.00

1.00

Defender



11.80 > 1

Challenger



# The Challenger-Defender Game

		Decision Point Benefit-Cost Ratio: 1				
		Alternative Choice				
		1	2	3	4	
With Respect to Alternative	ALTERNATIVES	Unprotected Median	W-Beam Median Barrier	TL3+ NJ Shape Barrier	TL5 NJ Shape Barrier	
	1	Unprotected Median	1.00	11.80	11.49	8.18
	2	W-Beam Median Barrier		0.00	10.58	4.70
	3	TL3+ NJ Shape Barrier			0.00	1.91
	4	TL5 NJ Shape Barrier				0.00

11.80

Defender



10.58 > 1

Challenger



# The Challenger-Defender Game

		Decision Point Benefit-Cost Ratio: 1				
		Alternative Choice				
		1	2	3	4	
With Respect to Alternative	ALTERNATIVES	Unprotected Median	W-Beam Median Barrier	TL3+ NJ Shape Barrier	TL5 NJ Shape Barrier	
	1	Unprotected Median	1.00	11.80	11.49	8.18
	2	W-Beam Median Barrier		0.00	10.58	4.70
	3	TL3+ NJ Shape Barrier			0.00	1.91
	4	TL5 NJ Shape Barrier				0.00

10.58

Defender



1.91 > 1

Challenger



# EQUIVALENT ANNUAL INCREMENTAL BENEFIT-COST

## Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

		Decision Point Benefit-Cost Ratio:				1	
		Alternative Choice					
		1	2	3	4		
With Respect to Alternative	ALTERNATIVES	Unprotected Median	W-Beam Median Barrier	TL3+ NJ Shape Barrier	TL5 NJ Shape Barrier		
	1	Unprotected Median	1.00	11.80	11.49	8.18	
	2	W-Beam Median Barrier		0.00	10.58	4.70	
	3	TL3+ NJ Shape Barrier			0.00	<b>1.91</b>	
	4	TL5 NJ Shape Barrier				0.00	

Best Choice is:

**TL5 NJ Shape Barrier**

RSAP Controls

PROJECT: Segment Report

TRAFFIC: B/C Report

HIGHWAY: Feature Report

ALTERNATIVES: Print Report

X-SECTION

ANALYZE

RESULTS

SETTINGS

HAZARDS

Change any of the default values in the yellow or rose cells or proceed to the next step by selecting 'Traffic Info.'

User's Manual

Engineer's Manual

Help

Save SaveAs

Exit



RSAPv3\_130304\_concrete.xlsm

## SEGMENT AND ALTERNATIVE COST SUMMARY

### Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

ANNUAL SEGMENT SUMMARY					Rate of Return				
Segment	Crashes	Crash Costs	Maintenance Cost	Repair Costs	Alternative	Annualized Construction Cost	Annual Maintenance Cost	Annual Repair Cost	Annual Crash Cost
<u>Alternative1</u>					1	\$ 0	\$ 0	\$ 0	\$ 453,393
1	3.60	\$ 453,393		\$ 0	2	\$ 18,044	\$ 500	\$ 4,524	\$ 181,294
<u>Alternative2</u>					3	\$ 30,369	\$ 0	\$ 377	\$ 100,035
1	4.14	\$ 181,294		\$ 4,524	4	\$ 46,583	\$ 0	\$ 377	\$ 69,057
<u>Alternative3</u>									
1	3.97	\$ 100,035		\$ 377					
<u>Alternative4</u>									
1	3.84	\$ 69,057		\$ 377					

<http://www.rsap.roadsafellc.com/>

RSAP v 3.0.0 Download Page

RSAP v 3.0.0 (Release 121024)

[INSTALL FROM WEB](#) [DOWNLOAD ZIP FILES](#) [EMAIL COMMENT](#)

**RoadSafe LLC**  
P.O. Box 312  
12 Main Street  
Canton, Maine 04221  
[rsap@roadsafellc.com](mailto:rsap@roadsafellc.com)

**Requirements**  
RSAPv3 is written as a series of Microsoft Excel macros. RSAPv3 will run on any Windows computer running Excel 14 or better and will run on both 32 and 64 bit computers. RSAPv3 has been successfully tested with Windows7, Windows XP and Vista.

**RSAP Information**

- [User Manual](#)
- [Engineer's Manual](#)
- [Programmer's Manual](#)
- [TR News Article about RSAPv3](#)  
(posted with permission of NAS/TRB)

**Resources**

- Go to the RSAP Support [Facebook](#) page for questions and answers.
- See the [Release Notes](#).
- [Installation Tips](#)
- [Tip #1](#) — Dire warnings when downloading using the "Install from Web" button.
- [Tip #2](#) — Security message when opening the workbook for the first time.
- [Tip #3](#) — I don't have administrative privileges on my computer. Can I still install RSAP?

**Example Case Workbooks**  
These are the Excel macro-enabled workbooks for the cases described in the [User's Manual](#). It may take some time to open up Excel over the internet so you should save these locally and open them on your computer.

- [NJTA Concrete Median Barrier](#)
- [WSDOT Cable Median Barrier](#)
- [RDG Culvert Example](#)

**User Submitted Examples**  
If you have an example that you would like to share, please email it to the project team using the button at the top of the page. We will post it here.

# Finding the RSAP Facebook Page

- ▶ Go to <http://www.facebook.com/RSAPv3>
- ▶ Or ... search for the RSAPv3 Facebook Page by name within Facebook
- ▶ Or ... search for RSAPv3 in Google.
- ▶ Or ... If you see the RSAPv3 Page on a friend's profile, you can click on the RSAP logo.
- ▶ When on the RSAPv3 Page, click on the "Like" button in the upper right hand corner.





Wall

Hidden Posts

Info

Friend Activity (1+)

Insights

Photos

EDIT

About

Edit

Use this page to provide feedback, discuss tips with other users and share...

More

49

like this

37

talking about this

Remove from My Page's Favorites

Get Updates via SMS

Get Updates via RSS

Unlike

# RSAPv3

Software · Edit Info



rsap@roadsafello.co

Wall

RSAPv3 · Everyone (Most Recent)

Share: Status Photo Link Video Question

Write something...



RSAPv3

RSAPv3 Release 120116 has been posted on at <http://rsap.roadsafello.com/>.

Unlike · Comment · Share · January 16 at 5:02pm

You like this.

1 share

Write a comment...



RSAPv3

After downloading and using the Alpha version of RSAPv3, please take this survey to provide your feedback. Thank you!

Can you spare a few moments to take my survey?

[www.surveymonkey.com](http://www.surveymonkey.com)

Please take the survey titled "RSAPv3 Software Evaluation". Your feedback is important!

Like · Comment · Share · January 15 at 11:30am

Admins (2)



Use Facebook as

Notifications

Promote with an

View old Insights

Invite Friends

You and RSAPv3



16 friends like this

Sponsored

Free Electricity Ho  
[homemadeenergy.org](http://homemadeenergy.org)



No Young Guys Wa  
[lps.seniorpeoplemeet](http://lps.seniorpeoplemeet)

Chat (3)

# I'm not a Facebook user. Can I participate?

- ▶ The page is publicly *viewable*.
- ▶ Posting on the Page (i.e., full participation) does require joining Facebook.
- ▶ You can also go to the RSAPv3 download page ([rsap.roadsafellc.com](http://rsap.roadsafellc.com)) and send a comment by email to [rsap@roadsafellc.com](mailto:rsap@roadsafellc.com).
- ▶ The development team will post responses on Facebook and also answer any emails.



# Acknowledgments

- ▶ The work is funded by the National Cooperative Highway Research Program (NCHRP) Project 22–27, “Roadside Safety Analysis Program (RSAP) Update.”

# Thank you!

- ▶ Visit [rsap.roadsafellc.com](http://rsap.roadsafellc.com)
  - Download the newest release of RSAPv3
  - Link to Facebook page.
  - Manuals which accompany the software.
  - List of improvements.
  - Register your copy.
- ▶ Questions? Email: [rsap@roadsafellc.com](mailto:rsap@roadsafellc.com)

