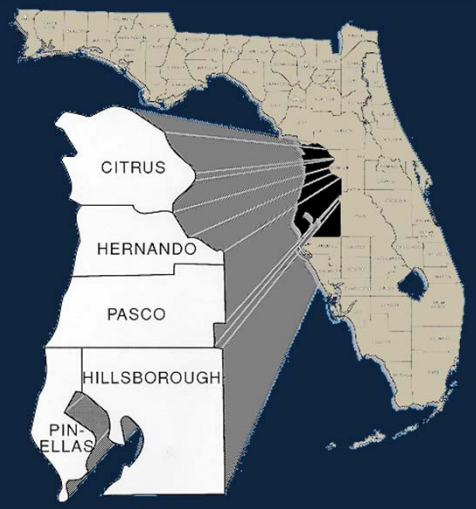
# Florida Department of Transportation – District 7

Benefit Cost Calculation

Off-System Safety Projects



# General Steps

Estimate Benefit from Crashes

Estimate Improvement Cost

Calculate Benefit/Cost Ratio

# Benefit Methodology

- Analyze the Crashes
- Identify the problem(s)
- Identify the Countermeasure
- Estimate the Crash Reduction
  - Crash Type
  - Crash Severity
- Identify the Crash Cost
  - Facility Specific

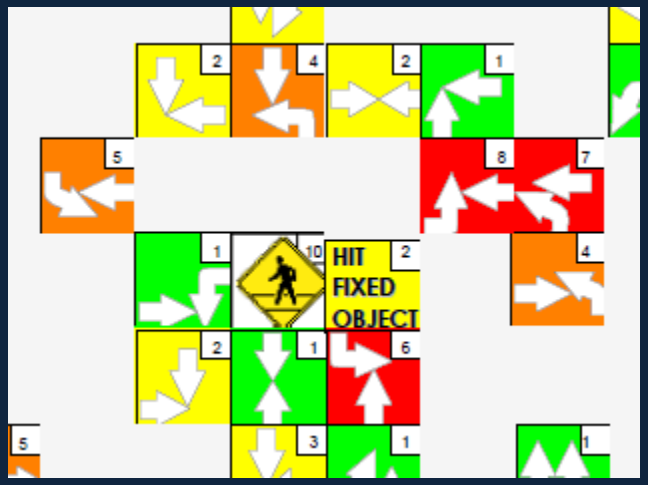
# Estimating Benefit
## *Number of Crashes*

- Historical Crash Data Source

– Historical Crash Data
- Your Countywide Crash Data Management System (CDMS)

# Estimating Benefit
# *Crash Pattern(s) to Correct*

- Identify the pattern(s) to correct



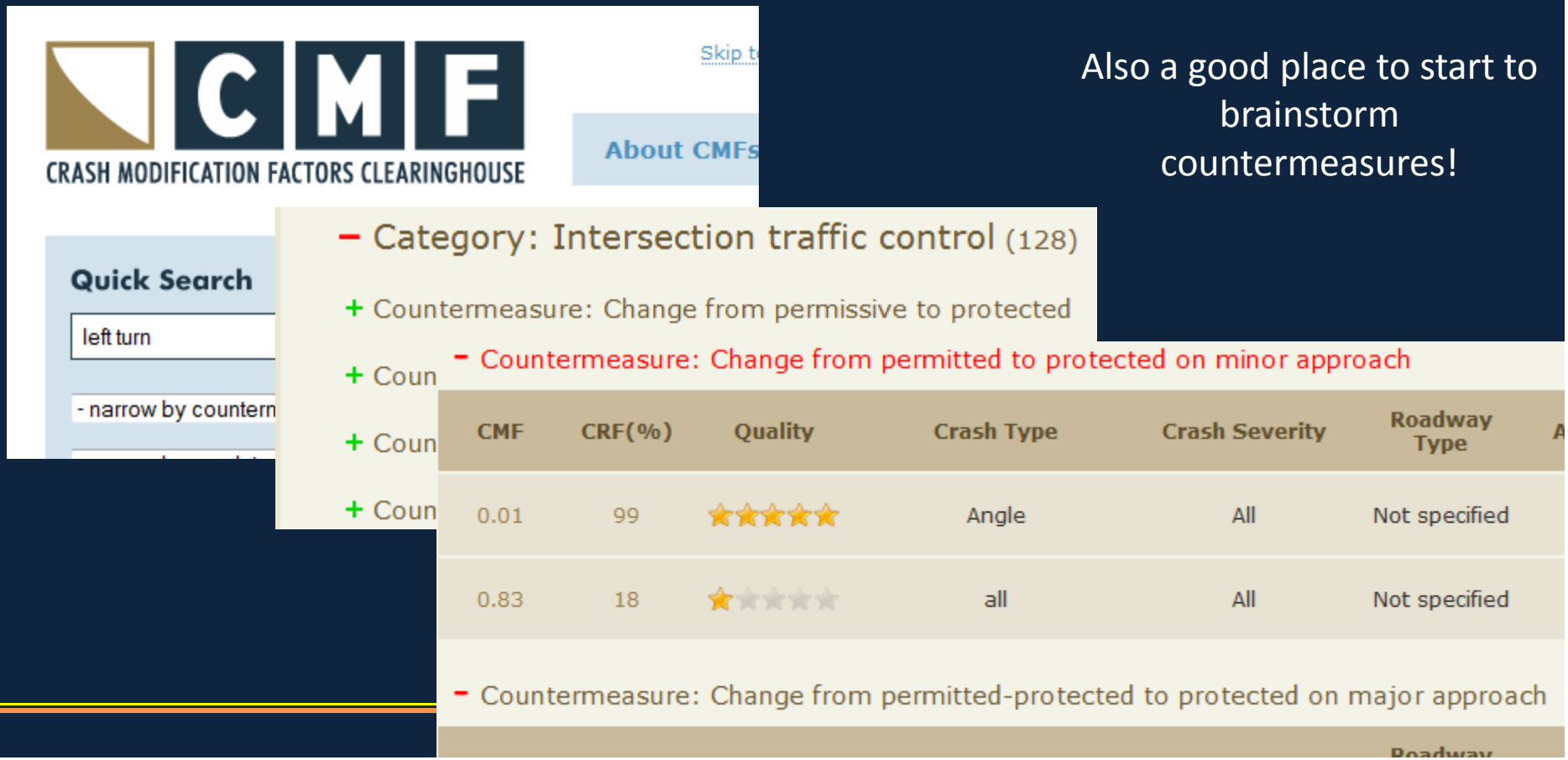

**Left-turn and angle problems!**

# Estimating Benefit
## *Identify the Countermeasure*

- Review proposed improvement
- Identify the applicable safety countermeasure
- Example – Rebuild a traffic signal
  - Project: Rebuild Traffic Signal
  - **Countermeasure: Provide Exclusive Left Turn Phasing**

# Estimating Benefit
# *Estimate Crash Reduction*

- Estimate crashes reduced by countermeasure




Also a good place to start to brainstorm countermeasures!

# Estimating Benefit
## *Estimate Crash Reduction*

- Apply to proper Type and Severity

- Countermeasure: Change from permitted to protected on minor approach

| CMF | CRF(%) | Quality | Crash Type | Crash Severity | Roadway Type | Area Type | Reference |
|---|---|---|---|---|---|---|---|
| 0.01 | 99 | ★★★★★ | Angle | All | Not specified | Urban | Davis and Aul, 2007 |
| 0.83 | 18 | ★☆☆☆☆ | all | All | Not specified | Urban | Davis and Aul, 2007 |

- Countermeasure: Change from permitted-protected to protected on major approach

| CMF | CRF(%) | Quality | Crash Type | Crash Severity | Roadway Type | Area Type | Reference |
|---|---|---|---|---|---|---|---|
| 0.01 | 99 | ★★★★★ | Angle | All | Not specified | Urban | Davis and Aul, 2007 |
| 0.58 | 42 | ★★★☆☆ | All | All | Not specified | Urban | Davis and Aul, 2007 |

# Estimating Benefit
## *Estimate Crash Reduction*

- Apply to proper Type and Severity

rmitted to protected on minor appr

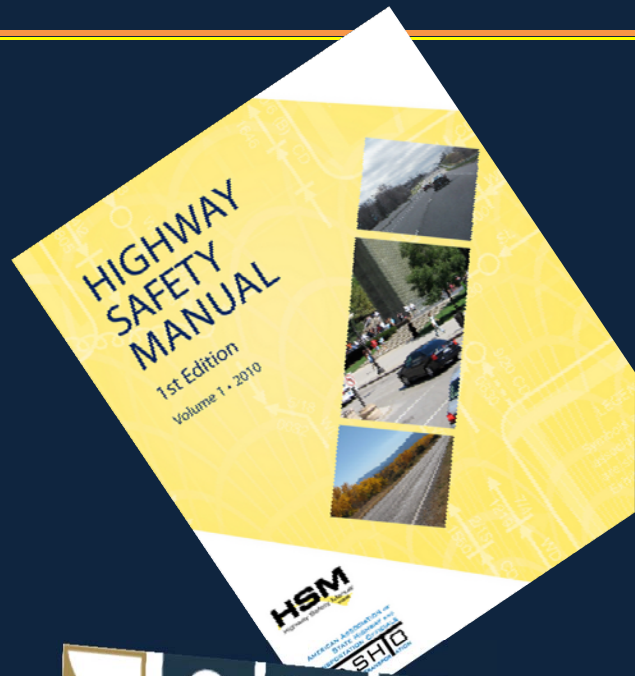
| Crash Type | Crash Severity |
|---|---|
| Angle | All |
| all | All |

Apply to All Angle Crashes

Apply to All Crashes

# Estimating Benefit
# *Crash Reduction Factor*

- FHWA Crash Modification Factors (CMF) Clearinghouse.
  - http://www.cmfclearinghouse.org/
- Highway Safety Manual
- Other sources with documented engineering assumptions and justification.




CMF
CRASH MODIFICATION FACTORS CLEARINGHOUSE
U.S. Department of Transportation
Federal Highway Administration

*Accident Reduction Factors for use in Calculating Benefit / Cost (State Project #99700-7434-119)* no longer can be used.

# Estimating Benefit
## *Crash Cost*

- Crash Benefit =
  (Correctable Crashes)(Cost per Crash*)

* See attached FDOT crash cost per roadway types. For local highways, the crash cost will be 50% of the state highway crash cost for similar type of roadways.

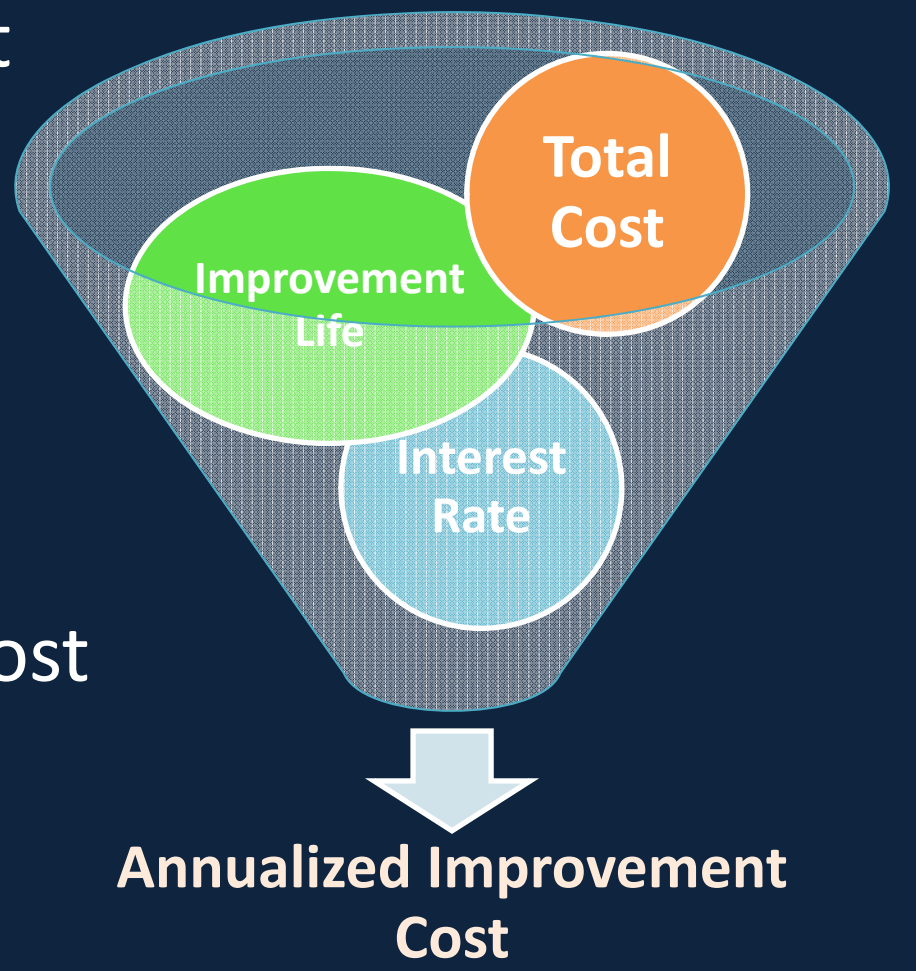
| Local Agency Cost per Crash by Facility Type (2009-2011) | | | | | | |
|---|---|---|---|---|---|---|
| | Divided | | | Undivided | | |
| Facility Type | Urban | Suburban | Rural | Urban | Suburban | Rural |
| 2-3 Lanes | $48,862 | $71,195 | $133,076 | $59,784 | $101,317 | $208,205 |
| 4-5 Lanes | $46,434 | $71,889 | $136,106 | $44,362 | $95,536 | $31,366 |
| 6+ Lanes | $50,957 | $62,138 | $161,441 | N/A | N/A | N/A |
| Interstate | $66,733 | N/A | $126,026 | N/A | N/A | N/A |
| Turnpike | $58,213 | N/A | $92,073 | N/A | N/A | N/A |

**These values are to be aplied to crashes on off-system roadways. Revised 04/01/13.**

# Estimating Project Cost

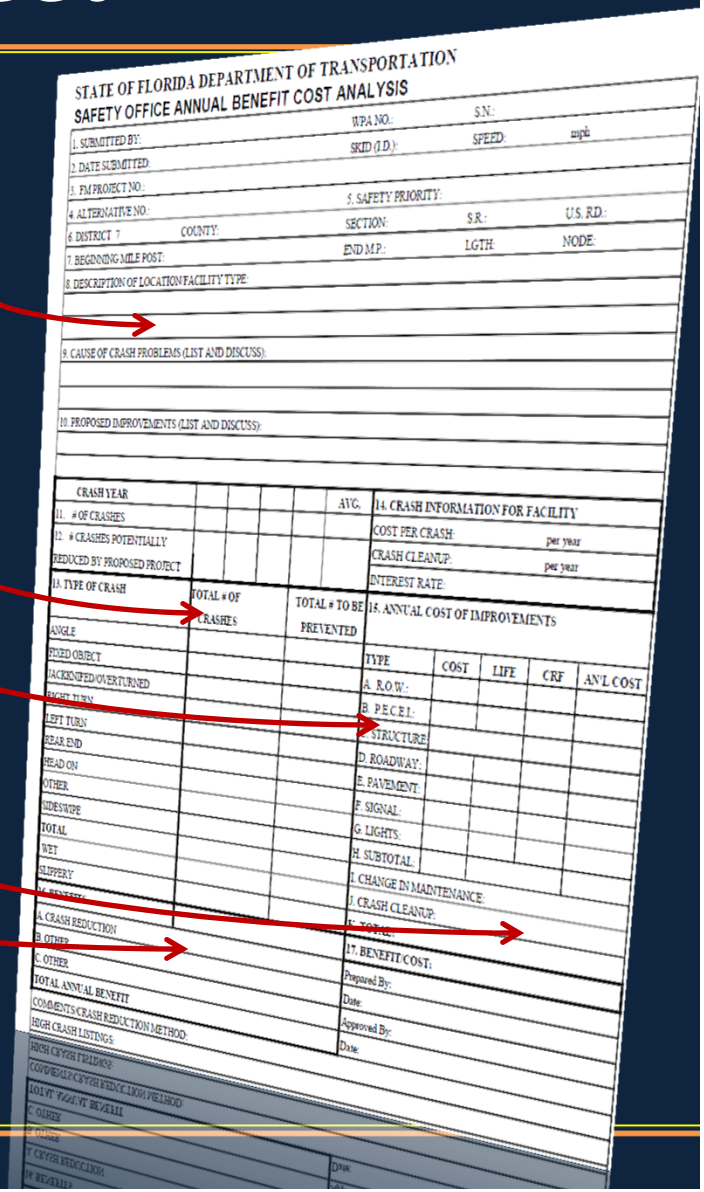
- Total Improvement Cost
- Improvement Life
- Interest Rate (4%)
- Capital Recovery Factor

- Annual Improvement Cost



# Benefit Cost *Calculation Sheet*

- FDOT B/C Sheet
  - List & Discuss Project / Improvements
  - Crash History
  - Improvement Cost
  - Final Benefit / Cost Ratio
  - Comments



STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
SAFETY OFFICE ANNUAL BENEFIT COST ANALYSIS

1. SUBMITTED BY: WPA NO.: S.N.:
2. DATE SUBMITTED: SKID (I.D.): SPEED: mph
3. FM PROJECT NO.:
4. ALTERNATIVE NO.: 5. SAFETY PRIORITY:
6. DISTRICT 7 COUNTY: SECTION: S.R.: U.S. RD.:
7. BEGINNING MILE POST: END M.P.: LGTH: NODE:
8. DESCRIPTION OF LOCATION/FACILITY TYPE:

9. CAUSE OF CRASH PROBLEMS (LIST AND DISCUSS):

10. PROPOSED IMPROVEMENTS (LIST AND DISCUSS):

| CRASH YEAR | | | | | AVG. |
|---|---|---|---|---|---|
| 11. # OF CRASHES | | | | | |
| 12. # CRASHES POTENTIALLY REDUCED BY PROPOSED PROJECT | | | | | |

| 13. TYPE OF CRASH | TOTAL # OF CRASHES | TOTAL # TO BE PREVENTED |
|---|---|---|
| ANGLE | | |
| FIXED OBJECT | | |
| JACKKNIFED/OVERTURNED | | |
| RIGHT TURN | | |
| LEFT TURN | | |
| REAR END | | |
| HEAD ON | | |
| OTHER | | |
| SIDESWIPE | | |
| TOTAL | | |
| WET | | |
| SLIPPERY | | |
| 14. BENEFIT: | | |
| A. CRASH REDUCTION | | |
| B. OTHER | | |
| C. OTHER | | |
| TOTAL ANNUAL BENEFIT | | |

COMMENTS/CRASH REDUCTION METHOD:
HIGH CRASH LISTINGS:

14. CRASH INFORMATION FOR FACILITY
COST PER CRASH: per year
CRASH CLEANUP: per year
INTEREST RATE:

15. ANNUAL COST OF IMPROVEMENTS

| TYPE | COST | LIFE | CRF | AN'L COST |
|---|---|---|---|---|
| A. R.O.W.: | | | | |
| B. P.E.C.E.I.: | | | | |
| C. STRUCTURE: | | | | |
| D. ROADWAY: | | | | |
| E. PAVEMENT: | | | | |
| F. SIGNAL: | | | | |
| G. LIGHTS: | | | | |
| H. SUBTOTAL: | | | | |
| I. CHANGE IN MAINTENANCE: | | | | |
| J. CRASH CLEANUP: | | | | |
| K. TOTAL: | | | | |

17. BENEFIT/COST:
Prepared By:
Date:
Approved By:
Date:

# Navigating the B:C Form

**STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION**
**SAFETY OFFICE ANNUAL BENEFIT COST ANALYSIS**

Yellow cells require information from you.
Gray cells are automatically tabulated.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. SUBMITTED BY: | | | | WPA NO.: | | S.N.: | | |
| 2. DATE SUBMITTED: | | | | SKID (I.D.): | | SPEED: | | mph |
| 3. FM PROJECT NO.: | | | | | | | | |
| 4. ALTERNATIVE NO.: | | | | 5. SAFETY PRIORITY: | | | | |
| 6. DISTRICT 7 | COUNTY: | | | SECTION: | | S.R.: | | U.S. RD.: |
| 7. BEGINNING MILE POST: | | | | END M.P.: | | LGTH: | 0.000 | NODE: |
| 8. DESCRIPTION OF LOCATION/FACILITY TYPE: | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| 9. CAUSE OF CRASH PROBLEMS (LIST AND DISCUSS): | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| 10. PROPOSED IMPROVEMENTS (LIST AND DISCUSS): | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

| CRASH YEAR | 2009 | 2010 | 2011 | AVG. PER YEAR |
|---|---|---|---|---|
| 11. # OF TOTAL CRASHES | 0.00 | 0.00 | 0.00 | 0.00 |
| 12. # CRASHES POTENTIALLY REDUCED BY PROPOSED PROJECT | 0.00 | 0.00 | 0.00 | 0.00 |

| 14. CRASH INFORMATION FOR FACILITY | |
|---|---|
| COST PER CRASH: | |
| CRASH CLEANUP: | $100 |
| INTEREST RATE: | 4.0% |

| 13. CRASH TYPE / SEVERITY (FROM CLEARINGHOUSE) | TOTAL # OF CRASHES 2009 | 2010 | 2011 | CRF % | TOTAL # TO BE PREVENTED |
|---|---|---|---|---|---|
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| **TOTAL** | 0 | 0 | 0 | | 0.00 |
| **16. BENEFITS** | | | | | |
| A. CRASH REDUCTION | | | | | $0 |
| B. OTHER | | | | | |
| C. OTHER | | | | | |
| **TOTAL ANNUAL BENEFIT** | | | | | **$0** |

| 15. ANNUAL COST OF IMPROVEMENTS TYPE | COST | LIFE | CAPITAL RECOVERY | ANNUAL COST |
|---|---|---|---|---|
| A. R.O.W.: | | | | |
| B. P.E.C.E.I.: | | | | |
| C. STRUCTURE: | | | | |
| D. ROADWAY: | | | | |
| E. PAVEMENT: | | | | |
| F. SIGNAL: | | | | |
| G. LIGHTING: | | | | |
| H. SUBTOTAL: | $0 | | | $0 |
| I. CHANGE IN MAINTENANCE: | | | | $0 |
| J. CRASH CLEANUP: | | | | $0 |
| **K. TOTAL ANNUAL COST:** | | | | **$0** |
| **17. BENEFIT/COST:** | | | | **#DIV/0!** |
| Prepared By: | | | | |
| Date: | | | | |
| Approved By: | | | | |
| Date: | | | | |

COMMENTS/CRASH REDUCTION METHOD (COUNTERMEASURE CATEGORY AND NAME FROM CLEARINHOUSE):

HIGH CRASH LISTINGS:

- Yellow to be entered by preparer
- Grey calculates

# Navigating the B:C Form

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION** | | | | | | | **Yellow cells require information from you.** | | |
| **SAFETY OFFICE ANNUAL BENEFIT COST ANALYSIS** | | | | | | | **Gray cells are automatically tabulated.** | | |
| 1. SUBMITTED BY: | | | | WPA NO.: | | S.N.: | | | |
| 2. DATE SUBMITTED: | | | | SKID (I.D.): | | SPEED: | | mph | |
| 3. FM PROJECT NO.: | | | | | | | | | |
| 4. ALTERNATIVE NO.: | | | | 5. SAFETY PRIORITY: | | | | | |
| 6. DISTRICT 7 | COUNTY: | | | SECTION: | | S.R.: | | U.S. RD.: | |
| 7. BEGINNING MILE POST: | | | | END M.P.: | | LGTH: | 0.000 | NODE: | |
| 8. DESCRIPTION OF LOCATION/FACILITY TYPE: | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 9. CAUSE OF CRASH PROBLEMS (LIST AND DISCUSS): | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 10. PROPOSED IMPROVEMENTS (LIST AND DISCUSS): | | | | | | | | | |
| | | | | | | | | | |

# Navigating the B:C Form

| SH YEAR | 2009 | 2010 | 2011 | AVG. PER YEAR |
|---|---|---|---|---|
| OTAL CRASHES | 0.00 | 0.00 | 0.00 | 0.00 |
| SHES POTENTIALLY ED BY PROPOSED PROJECT | 0.00 | 0.00 | 0.00 | **0.00** |

| TYPE / SEVERITY | TOTAL # OF CRASHES | | | CRF % | TOTAL # TO BE PREVENTED |
|---|---|---|---|---|---|
| EARINGHOUSE) | 2009 | 2010 | 2011 | | |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | | | | | 0.00 |
| | 0 | 0 | 0 | | 0.00 |
| TS | | | | | |
| EDUCTION | | | | | $0 |

| ype | Crash Severity |
|---|---|
| | All |
| | All |

| CRF(%) |
|---|
| 99 |
| 18 |

- Section 13:
  - Enter the number of crashes that meet the criteria of the CMF (Type and Severity)
  - Enter the CRF% from the Clearinghouse
  - Don't "double count" crashes

# Navigating the B:C Form

| INFORMATION FOR FACILITY | | | |
|---|---|---|---|
| CRASH: | | | |
| ANUP: | $100 | | |
| RATE: | 4.0% | | |
| | | | |
| ST OF IMPROVEMENTS | | | |
| COST | LIFE | CAPITAL RECOVERY | ANNUAL COST |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| $0 | | | $0 |
| AINTENANCE: | | | $0 |
| UP: | | | $0 |
| AL COST: | | | $0 |
| ST: | | | #DIV/0! |
| | | | |
| | | | |
| | | | |

| Local Agency Cost per Crash by Facility Type (2009-2011) | | | | | | |
|---|---|---|---|---|---|---|
| | Divided | | | Undivided | | |
| Facility Type | Urban | Suburban | Rural | Urban | Suburban | Rural |
| 2-3 Lanes | $48,862 | $71,195 | $133,076 | $59,784 | $101,317 | $208,205 |
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| 6+ Lanes | $50,957 | $62,138 | $161,441 | N/A | N/A | N/A |
| Interstate | $66,733 | N/A | $126,026 | N/A | N/A | N/A |
| Turnpike | $58,213 | N/A | $92,073 | N/A | N/A | N/A |

- Engineers Cost Estimate
- All Project Costs
- Estimate Project Life

- Preparer (Agency)
- Approved (FDOT)

# Navigating the B:C Form

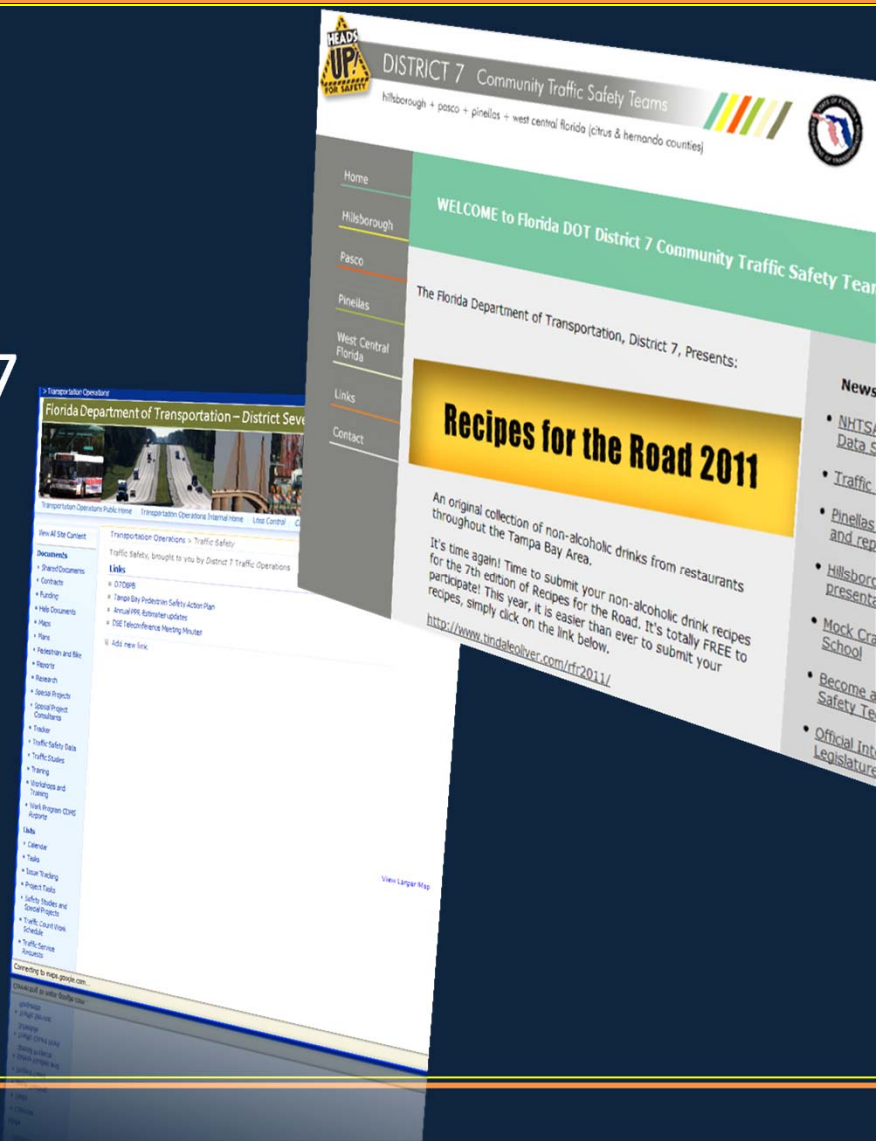
| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **TOTAL ANNUAL BENEFIT** | | | | **$0** | Date: | | | | | |
| COMMENTS/CRASH REDUCTION METHOD (COUNTERMEASURE CATEGORY AND NAME FROM CLEARINHOUSE): | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| HIGH CRASH LISTINGS: | | | | | | | | | | |
| | | | | | | | | | | |

- Use this section for assumptions, descriptions, or any information to assist the reviewer.

# Additional Resources

- D7 Community Traffic Safety Team (CTST) Website
  - http://www.d7ctst.org/d7SafetySummit/

- Summit Website
  - http://www.d7safetysummit.org



# Final Comments

- B:C Estimation is Art and Science!
- Not all calculations are “cookie cutter”,
- Complex scenarios may require manual calculations,
- Not all countermeasures are on the CMF, research other sources if needed,
- Application of multiple countermeasures requires creativity,
- Contact FDOT for technical questions or tips

# Questions?