Request for HSIP Funds by Tippecanoe County

Project: Safety Improvements along Old US 231 and CR 500S in the McCutcheon High School and Mayflower Mill Elementary School area

Submitted by the Area Plan Commission of Tippecanoe County
March 2017

Tippecanoe County is seeking Highway Safety Improvement Program funds to improve Old US 231 and CR 500S in the vicinity of McCutcheon High School and Mayflower Mill Elementary School. The Tippecanoe County Commissioners have reviewed the safety audit and concur with its findings (attached letter). They have requested HSIP and Prior Year Balance (PYB) funds for the improvements. The cost estimates, project time line, and agreement to fund all future maintenance can be found below.

The MPO is programming PYB funds for construction at this time and requests the committee approve HSIP funds for preliminary engineering *and* construction. This will give us flexibility to fund construction with HSIP funds if needed without having to submit an additional approval request. The cost to benefit calculation was based on both phase being funded with safety funds.

1) *Addresses SHSP Emphasis Area*

Strategic Highway Safety Plan Emphasis Area Targeted:
Emphasis Area 5.8, Pedestrian Involved Crashes, and
Emphasis Area 5.11, Human Behavior Factors

2) Needs Analysis

A Road Safety Audit was conducted on November 22, 2016 and a copy of the report is attached. The report includes the following background information: crash history (January 2011-December 2015), traffic characteristics, school information, Census demographics, aerial photography, parcel boundaries, elevation contours and zoning. It also includes the RSA team observations, analysis and recommendations.

RSA Observations and Analysis section clearly defined the problems:

a) Lack of sidewalks and crosswalks,
b) Students walking to McCutcheon High School and their interaction with buses and motor vehicles,
c) Bus movements at both schools,
d) Parents dropping and picking up students at both schools,
e) Driveways and rural road designs,
f) The lack of street lighting, and
g) Crash data shows a significant number of crashes during dark, dawn and dusk hours and crashes involving those between 15 and 19 years of age.

The team recommended the following solutions:

a) Pedestrian crossing improvements at both schools which include constructing pedestrian crossings, install a warning system with supporting signage and pavement markings, construct sufficient sized waiting areas on either side of the road, construct a wide multi-use trail at various locations, and install street lighting.
b) Construct a sidewalk and/or trail along both roads,

c) Install street lighting along both corridors,
d) Urbanize both roads and includes a raised median in front of McCutcheon,
e) Redesign and reconstruct the existing driveways,
f) Construct a new driveway at McCutcheon to separate and remove student drivers from buses and parent drop offs,
g) Construct safe accommodations for cars pulling into the Mayflower Mill parking lot, and
h) Install larger signage.

3) Financial Analysis

The following parameters were used in calculating the benefit to cost ratio.

Total Project Cost: $600,000

This amount includes preliminary engineering and construction. At this time no additional right-of-way is needed. The following table summarizes the cost per phase and amount of federal funds requested.

	Federal	Local	Total
PE	90,000	10,000	100,000
RW	0	0	0
CN	450,000	50,000	500,000
Total	540,000	60,000	600,000

The following table summarizes the additional parameters used with the HAT software:

	CRF PD	CRF IF	Service Life	Capital Cost	Annual Maintenance	Salvage Cost
Install Pedestrian Crossing	37.0	37.0	20	$220,000	$1,000	$0
Rapid Flashing Beacons	10.0	10.0	20	$75,000	$500	$0
Add Sidewalk	74.0	74.0	20	$140,000	$500	$0
Install Street Lighting	20.0	29.0	20	$50,000	$300	$0
Install Raised Median	25.0	25.0	20	$25,000	$100	$0
Install Right, Left Turn Lanes	25.0	25.0	20	$90,000	$300	$0

Source of CRF is located at the end of the request.

A benefit to cost ratio was calculated through the HAT software. When factoring in the cost of both phases as described in the RSA, the B/C ratio is 2.72. The crash reduction factors and copies of the HAT work sheets can be found below.

4) Project Development Timeline

Preliminary Engineering is scheduled to begin in FY 2018
Construction is scheduled to begin in FY 2020

5) Maintenance of HSIP Installation

Tippecanoe County will maintain the improvements when the project has been completed. Please see the attached letter.

6) Post Construction Safety Evaluation

The Area Plan Commission will perform a post construction evaluation.

Crash Reduction Factor Sources

Install Pedestrian Crossing:
Federal Highway Administration
Desktop Reference for Crash Reduction Factors
Table 3, Signs, Markings & Operational Countermeasures
Countermeasure: Install Pedestrian Crossing (signed and marked with curb ramps & extensions)
Crash Reduction Factor: 37

Rapid Flashing Beacons:
Oregon Department of Transportation
ODOT's HSIP Countermeasures and Crash Reduction Factors
Install Rectangular Rapid Flashing Beacon
ODOT Countermeasure: BP8
CRF Value: 10

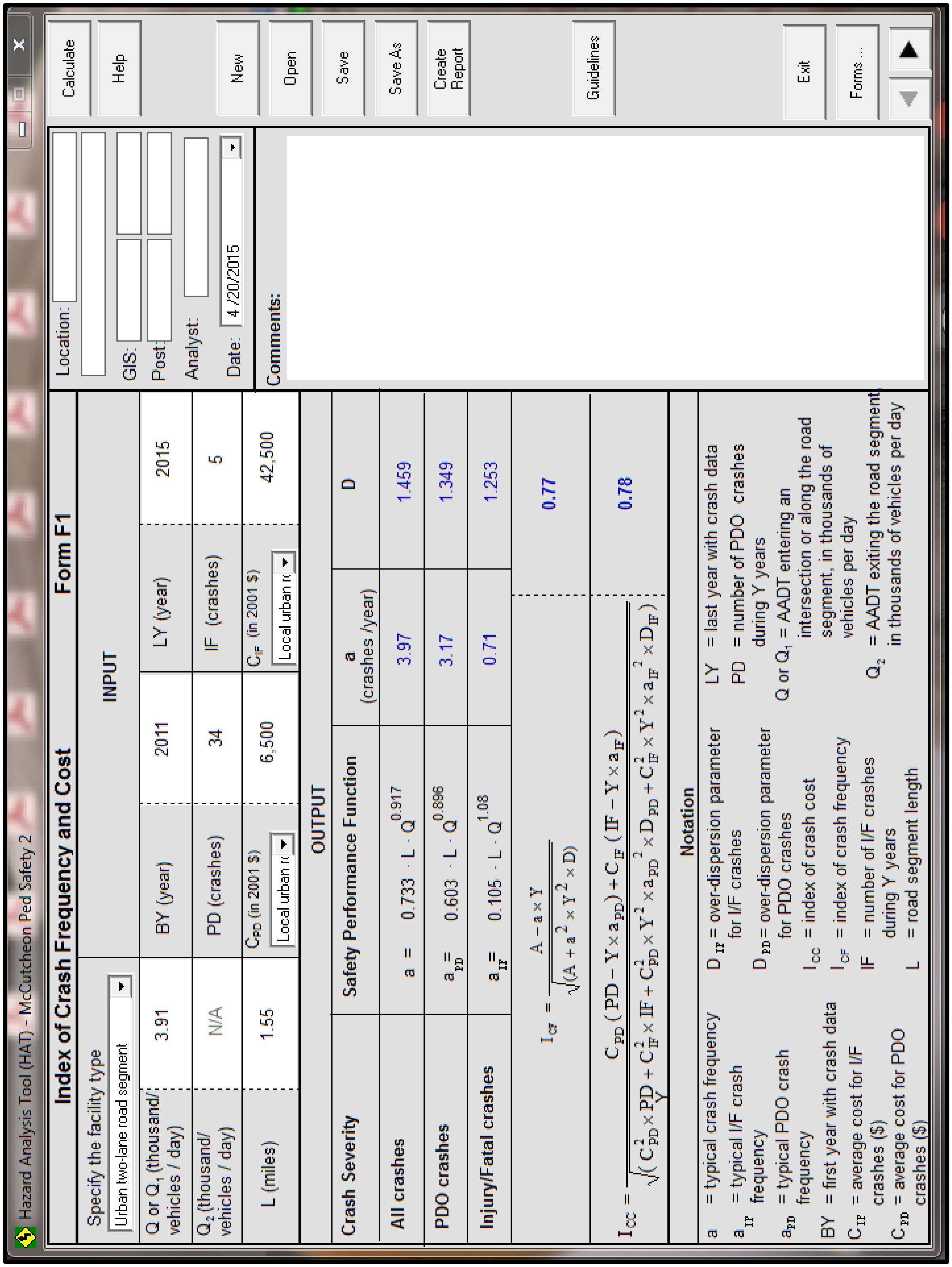
Add Sidewalks
Federal Highway Administration
Desktop Reference for Crash Reduction Factors
Table 11, Geometric Countermeasures
Countermeasure: Install Sidewalk (to avoid walking along roadway)
Crash Reduction Factor: 74

Install Street Lighting:
FHWA Desk Top Administration
Desktop Reference for Crash Reduction Factors
Table 12, Signs/Marking/Operational Countermeasures
Countermeasure: Add Segment Lighting
Crash Reduction Factor: 20 (at night for all crashes)
Crash Reduction Factor: 29 (at night for injuries)

Install Raised Median:
FHWA Desk Top Administration
Desktop Reference for Crash Reduction Factors
Table 11, Geometric Countermeasures
Countermeasure: Install Raised Median
Crash Reduction Factor: 25

Install Right and Left Turn Lanes:
Texas Department of Transportation
Highway Safety Improvement Progtrm Work Codes Table
Work Code 519, Add Left Turn Lane
CRF: 25
Work Code 521, Add Right Turn Lane
CRF: 25

Hazard Analysis Tool Calculations



Hazard Analysis Tool (HAT) - McCutcheon Ped Safety 2

Benefit Cost Analysis — Form F5.1

Improvement	CRF_{PD} (%)	CRF_{IF} (%)	SL (years)	CC ($)	M ($)	S ($)
Install Pedestrian Crossing	37.0	37.0	20.00	220,000	1,000	0
Rapid Flashing Beaxons	10.0	10.0	20.00	75,000	500	0
Add Sidewalks	74.0	74.0	20.00	140,000	500	0
Install Street Lighting	20.0	29.0	20.00	50,000	300	0
Install Raised Median	25.0	25.0	20.00	25,000	100	0
Install Right & Left Turn Lanes	25.0	25.0	20.00	90,000	300	0

PD (crashes)	34	IF (crashes)	5	CY (year)	2001
a_{PD} (crashes/year)	3.17	a_{IF} (crashes/year)	0.71	BY (year)	2011
Z_{PD}	0.896	Z_{IF}	1.080	LY (year)	2015
C_{PD} ($)	6,500	C_{IF} ($)	42,500	PY (year)	2015
CRF_{PD} (%)	93.4	CRF_{IF} (%)	94.1	IY (year)	2016
F (%)	2.0	I (%)	4.0	R (%)	2.0
		GF	1.25	GY (year)	2035

Location:

GIS:

Post:

Analyst:

Date: 2 /27/2017

Notation:

a_{IF} = typical I/F crash frequency
a_{PD} = typical PDO crash frequency
BY = first year with crash data
LY = last year with crash data
C_{IF} = cost of an I/F crash ($)
C_{PD} = cost of a PDO crash ($)
CC = capital cost ($)
CRF_{IF} = crash reduction factor for I/F crashes
CRF_{PD} = crash reduction factor for PDO crashes
CY = year for which crash cost is provided
F = inflation rate
GF = total growth factor
GY = input traffic growth period
I = interest rate
IF = number of I/F crashes
IY = year of project implementation (construction)
M = change in annual maintenance cost ($)
PD = number of PDO crashes
PY = present year
R = traffic volume change rate
S = salvage value ($)
SL = service life of the safety improvement
Z_{IF} = exponent for volume in I/F equation in Form F1 (sum if two volumes)
Z_{PD} = exponent for volume in PDO equation in Form F1 (sum if two volumes)

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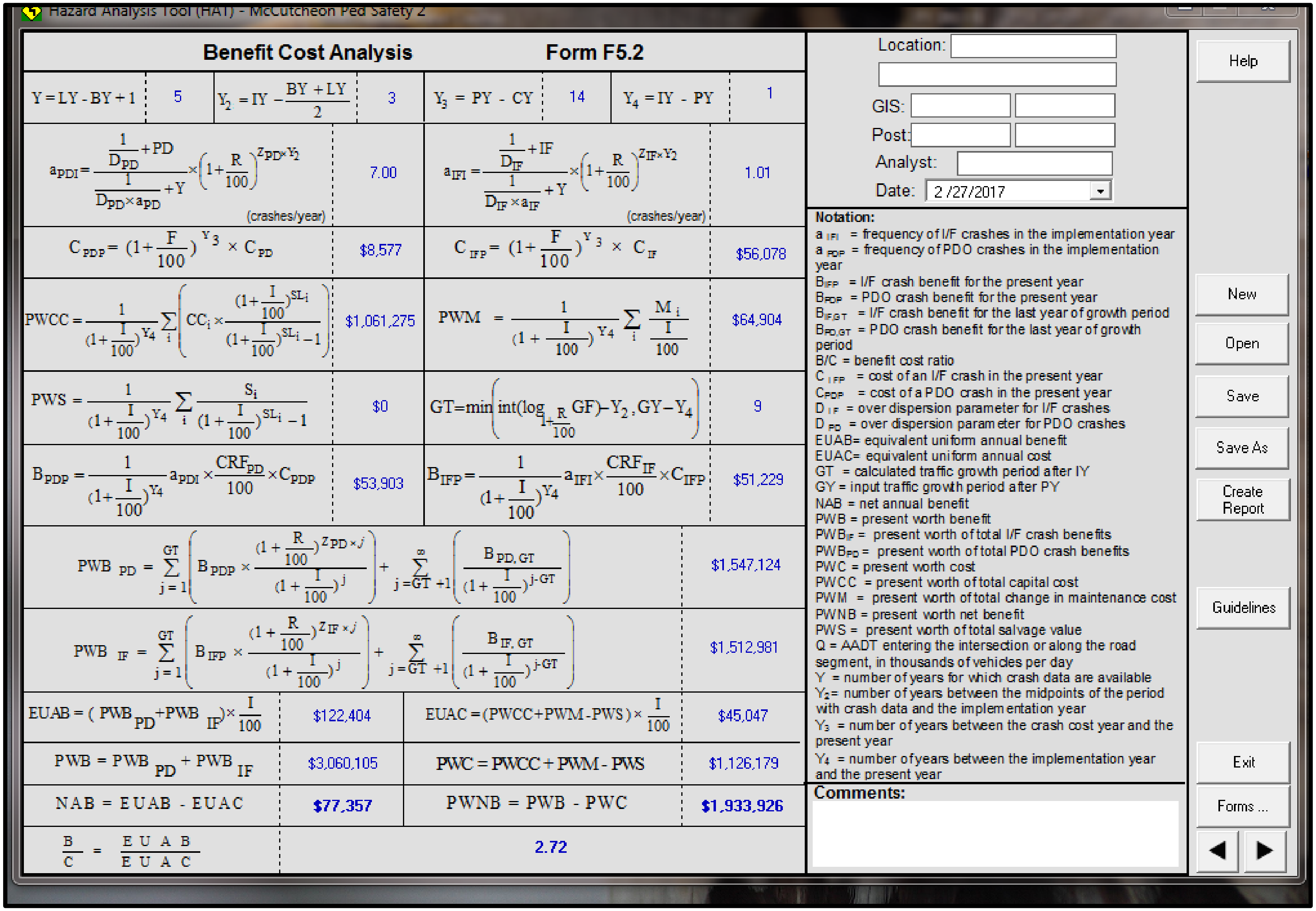

Hazard Analysis Tool (HAT) - McCutcheon Ped Safety 2

Benefit Cost Analysis — Form F5.2

$Y = LY - BY + 1$	5	$Y_2 = IY - \frac{BY + LY}{2}$	3	$Y_3 = PY - CY$	14	$Y_4 = IY - PY$	1

$a_{PDI} = \frac{\frac{1}{D_{PD}} + PD}{\frac{1}{D_{PD} \times a_{PD}} + Y} \times \left(1 + \frac{R}{100}\right)^{Z_{PD} \times Y_2}$ (crashes/year)	7.00	$a_{IFI} = \frac{\frac{1}{D_{IF}} + IF}{\frac{1}{D_{IF} \times a_{IF}} + Y} \times \left(1 + \frac{R}{100}\right)^{Z_{IF} \times Y_2}$ (crashes/year)	1.01
$C_{PDP} = (1 + \frac{F}{100})^{Y_3} \times C_{PD}$	\$8,577	$C_{IFP} = (1 + \frac{F}{100})^{Y_3} \times C_{IF}$	\$56,078
$PWCC = \frac{1}{(1+\frac{I}{100})^{Y_4}} \sum_i \left(CC_i \times \frac{(1+\frac{I}{100})^{SL_i}}{(1+\frac{I}{100})^{SL_i} - 1} \right)$	\$1,061,275	$PWM = \frac{1}{(1 + \frac{I}{100})^{Y_4}} \sum_i \frac{M_i}{\frac{I}{100}}$	\$64,904
$PWS = \frac{1}{(1+\frac{I}{100})^{Y_4}} \sum_i \frac{S_i}{(1+\frac{I}{100})^{SL_i} - 1}$	\$0	$GT = \min\left(\mathrm{int}(\log_{1+\frac{R}{100}} GF) - Y_2, GY - Y_4 \right)$	9
$B_{PDP} = \frac{1}{(1+\frac{I}{100})^{Y_4}} a_{PDI} \times \frac{CRF_{PD}}{100} \times C_{PDP}$	\$53,903	$B_{IFP} = \frac{1}{(1+\frac{I}{100})^{Y_4}} a_{IFI} \times \frac{CRF_{IF}}{100} \times C_{IFP}$	\$51,229

$PWB_{PD} = \sum_{j=1}^{GT} \left(B_{PDP} \times \frac{(1 + \frac{R}{100})^{Z_{PD} \times j}}{(1 + \frac{I}{100})^j} \right) + \sum_{j=GT+1}^{\infty} \left(\frac{B_{PD,GT}}{(1 + \frac{I}{100})^{j-GT}} \right)$	\$1,547,124
$PWB_{IF} = \sum_{j=1}^{GT} \left(B_{IFP} \times \frac{(1 + \frac{R}{100})^{Z_{IF} \times j}}{(1 + \frac{I}{100})^j} \right) + \sum_{j=GT+1}^{\infty} \left(\frac{B_{IF,GT}}{(1 + \frac{I}{100})^{j-GT}} \right)$	\$1,512,981

$EUAB = (PWB_{PD} + PWB_{IF}) \times \frac{I}{100}$	\$122,404	$EUAC = (PWCC + PWM - PWS) \times \frac{I}{100}$	\$45,047
$PWB = PWB_{PD} + PWB_{IF}$	\$3,060,105	$PWC = PWCC + PWM - PWS$	\$1,126,179
$NAB = EUAB - EUAC$	**\$77,357**	$PWNB = PWB - PWC$	**\$1,933,926**
$\frac{B}{C} = \frac{EUAB}{EUAC}$	2.72		

Location:

GIS:

Post:

Analyst:

Date: 2 /27/2017

Notation:

a_{IFI} = frequency of I/F crashes in the implementation year
a_{PDP} = frequency of PDO crashes in the implementation year
B_{IFP} = I/F crash benefit for the present year
B_{PDP} = PDO crash benefit for the present year
$B_{IF,GT}$ = I/F crash benefit for the last year of growth period
$B_{PD,GT}$ = PDO crash benefit for the last year of growth period
B/C = benefit cost ratio
C_{IFP} = cost of an I/F crash in the present year
C_{PDP} = cost of a PDO crash in the present year
D_{IF} = over dispersion parameter for I/F crashes
D_{PD} = over dispersion parameter for PDO crashes
EUAB= equivalent uniform annual benefit
EUAC= equivalent uniform annual cost
GT = calculated traffic growth period after IY
GY = input traffic growth period after PY
NAB = net annual benefit
PWB = present worth benefit
PWB_{IF} = present worth of total I/F crash benefits
PWB_{PD} = present worth of total PDO crash benefits
PWC = present worth cost
PWCC = present worth of total capital cost
PWM = present worth of total change in maintenance cost
PWNB = present worth net benefit
PWS = present worth of total salvage value
Q = AADT entering the intersection or along the road segment, in thousands of vehicles per day
Y = number of years for which crash data are available
Y_2= number of years between the midpoints of the period with crash data and the implementation year
Y_3 = number of years between the crash cost year and the present year
Y_4 = number of years between the implementation year and the present year

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