# TNS

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Dear Jerry,

True North Safety has completed the network screening for the road segments and the intersections of Essex County using traffic volume and collision data from 2017,2018,2019,2022, and 2023. This brief memorandum summarizes the methodology and the network screening results.

## **1.0 NETWORK SCREENING**

## 1.1 Methodology

Then Empirical Bayes (EB) method was utilized for the network screening of the road segments and intersections. The EB method is used to estimate the long-term safety performance of each location. The long-term safety performance of each location is compared with its peers (i.e. other locations with similar geometric, traffic, and environment characteristics). If the safety performance of the subject location is worse than average safety of its peers (i.e. average predicted number of collisions obtained from SPFs) then the subject location has a potential for safety improvement.

The EB method provides an indication of the level of safety at a location, by taking into account both the observed number of collisions at the location, and the expected number of collisions, based on the developed SPFs. It also accounts for the regression to the mean phenomenon, therefore providing a better estimate than the number of collisions or the collision rate.

The EB method uses the following equation to calculate the Expected number of collisions:

 $Exp = w \times Pr + (1 - w) \times Obs$ 

Eq. 1

Where:

Exp is the total expected number of collisions for the study period (2017,2018,2019,2022, and 2023) which is calculated by combining the observed number of collisions and the predicted number of collisions. This measure represents the long terms average number of collisions at the road segments and intersections.

Pr is the total predicted number of collisions obtained from Safety Performance Function (SPF) models and represents the likely number of collisions at a road segment or intersection with similar characteristics compared to the investigated one;

Obs is the total observed number of collisions for the study period;

w is a weight factor calculated by:

$$w = \frac{1}{1 + k \times Pr}$$
 Eq. 2

Where:

 $\boldsymbol{k}$  is the over-dispersion parameter associated with the SPF used.

The PSI is then calculated as the difference between the expected number of collisions and the predicted number of collisions. This is shown in Figure 1.



Figure 1- Empirical Bayes Method

In this assignment, SPF models were calibrated based on the County of Essex data.

The PSI index is then calculated separately for severe (i.e. Fatal and Major, Minor and Minimal injuries) and for property damage only (PDO) collisions. The PSI for the severe collisions is also adjusted as the function of the societal cost of collisions for fatal and injury collisions. Midblocks are then ranked from the highest to the lowest PSI<sub>All</sub> index where:

$PSI_{All} = PSI_{PDO} + PSI_{Severe}$	Eq. 3
$PSI_{PDO} = Exp_{PDO} - Pr_{PDO}$	Eq. 4
$PSI_{Severe} = RSI \times (Exp_{Severe} - Pr_{Severe})$	Eq. 5

Because the PSIsevere is used in this study, the weighted factor, or relative safety index (RSI), must be derived for severe collisions. The RSI for a given group is estimated by,

$$RSI = \frac{EPDO_{Fatal} \times \sum Fatal Collisions + EPDO_{Injury} \times \sum Injury Collisions}{\sum Fatal Collisions + \sum Injury Collisions} Eq. 6$$

EPDO<sub>fatal</sub> and EPDO<sub>injury</sub> denote the equivalent PDO collisions for the fatal and injury collision types respectively. The equivalent PDO factors are calculated based on the societal costs of collisions for fatal and injury collisions. Since only the equivalent PDO factors are required for this assignment, no average annual growth was applied to the Societal Costs of Collisions. **Table 1** shows the societal cost of collisions and equivalent PDO factor for fatal, injury, and PDO collisions. It should



be noted that the equivalent PDO factors for fatal and injury collision are simply the ratio of societal cost of fatal and injury over the societal cost of PDO collisions.

	Fatal	Injury	PDO
Societal Costs of Collisions	\$1,143,166	\$27,614	\$8,437
EPDO	135.5	3.3	1.0

#### Table 1: Societal Costs of Collisions and Equivalent PDO Factors<sup>1</sup>

### **1.2 Network Screening Results**

The TES application was used to conduct network screening using the EB method. The results of the network screening and ranking for the top 10 road segments and intersections with the highest PSI index are provided in **Table 2** and **Table 3**.

**Appendix A**, which accompany this memorandum, includes the complete results of network screening for the road segments and intersections.

<sup>&</sup>lt;sup>1</sup> The Social cost of motor vehicle crashes in Ontario, Safety Research Office, Safety Policy Branch in cooperation with Research and Development Branch, 1994



#### Table 2: Road Segments Network Screening Results

PSI Rank	Geo ID	Description	SPF Group	PSI Value	PDO Obs	PDO Pred	PDO Exp	Fl Obs	Fl Pred	FI Exp
1	10057	County Rd 2 / Tecumseh Rd Btwn County Rd 19 / Manning Rd & Green Valley Dr	Urban multilane Road Segments	34.22	32	7.50	30.08	4	1.24	3.11
2	10447	County Rd 20 Btwn Fraser Rd & Pinecrest Dr	Rural Two-Lane Road Segments	25.93	13	5.06	10.96	5	1.25	3.03
3	10421	County Rd 19 Btwn Baseline Rd & Walls Rd	Rural Two-Lane Road Segments	24.40	11	5.96	9.86	5	1.53	3.36
4	10936	County Rd 34 Btwn County Rd 37 / Mersea Rd 19 & Mersea Rd 21	Rural Two-Lane Road Segments	22.42	10	7.14	9.44	5	1.93	3.72
5	10055	County Rd 2 / Tecumseh Rd Btwn Shawnee Rd & Southfield Dr	Urban multilane Road Segments	20.69	12	6.65	11.53	5	1.11	3.65
6	10907	County Rd 34 Btwn Crest View Dr & Fraser Rd	Rural Two-Lane Road Segments	17.66	9	4.90	7.92	4	1.20	2.50
7	11014	County Rd 42 Btwn County Rd 22 / Myers Rd & County Rd 27	Rural Two-Lane Road Segments	16.23	7	4.50	6.30	4	1.09	2.37
8	10425	County Rd 19 Btwn County Rd 42 & Little Baseline Rd	Rural Two-Lane Road Segments	16.14	23	5.84	19.05	2	1.50	1.76
9	10053	County Rd 2 / Tecumseh Rd Btwn Poisson St & Shawnee Rd	Urban multilane Road Segments	15.87	18	4.90	16.49	2	0.81	1.50
10	10811	County Rd 29 Btwn Road 2 E / Road 2 W & Road 3 E / Road 3 W	Rural Two-Lane Road Segments	14.57	4	4.76	4.20	4	1.16	2.46

#### Table 3: Intersections Network Screening Results

PSI Rank	Geo ID	Description	SPF Group	PSI Value	PDO Obs	PDO Pred	PDO Exp	Fl Obs	Fl Pred	FI Exp
1	INT10422	COUNTY RD 19 @ COUNTY RD 22	4-legged Signalized	56.25	68	41.36	68.59	15	7.13	13.46
2	INT10676	COUNTY RD 22 / MYERS RD @ COUNTY RD 42	4-legged Stop Rural	51.61	5	3.49	4.56	9	1.72	8.15
3	INT10411	COUNTY RD 18 @ COUNTY RD 34	4-legged Stop Rural	45.88	12	2.22	9.66	7	1.06	5.95
4	INT10971	BASELINE RD @ COUNTY RD 43	4-legged Stop Rural	43.52	9	2.05	7.17	7	0.98	5.87
5	INT10887	COUNTY RD 34 @ MERSEA RD 12	4-legged Stop Rural	37.03	7	4.24	6.53	7	2.10	6.52
6	INT10628	COUNTY RD 22 @ LESPERANCE RD	4-legged Signalized	32.62	66	31.25	64.59	5	5.93	5.21
7	INT10412	COUNTY RD 18 @ COUNTY RD 31	4-legged Stop Rural	30.28	13	3.65	11.58	5	1.80	4.64
8	INT10889	COUNTY RD 34 @ COUNTY RD 37 / MERSEA RD 19	4-legged Stop Rural	27.45	12	4.19	10.94	5	2.08	4.71
9	INT10736	COUNTY RD 27 @ COUNTY RD 46	4-legged Stop Rural	27.40	7	2.96	6.19	5	1.44	4.51
10	INT10430	BASELINE RD @ COUNTY RD 19	3-legged Stop	26.86	12	3.99	10.99	5	0.96	3.68

Should you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

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