APPENDIX 2I – Road Safety Program Benefit Assessment and Benefit/Cost Analysis

EFFECTIVENESS AND BENEFIT OF THE ROAD SAFETY INITIATIVES TO 2000

Executive Summary

Several major road safety programs were introduced in B.C. during the period 1996-1998. As part of the implementation, each was subjected to a comprehensive evaluation of short-term driver behaviour change as well as 2-3 year crash reduction. The effectiveness of each program in reducing applicable crash types has been estimated from the individual evaluation results and these estimates are factored-up to an overall proportional impact on all crashes in B.C. But has this projected province-wide impact been realized in terms of fewer ICBC claims?

In order to determine what the likely number of ICBC claims would have been in each year from 1996-on without the safety programs, we construct models of fatal, injury and material-damage-only crash-claim counts going back to 1979. This allows us to build-in the long-term effect of important external influences such as vehicle population growth, travel changes, weather, vehicle design etc., and to ensure that these factors have a likely cause-and-effect relationship with claims – not just generally coincident long-term trends. The relative magnitude of safety program "effort" in each year is entered and the "shape" of this function is then adjusted until the best fit, in conjunction with all other external variables, is found for the actual recorded claim counts. The expected count, were no safety programs in place, is then found by removing the program function from the final model. The program effect is the difference between actual and expected counts.

Both claim reduction estimates (sum of programs and claim modeling) are converted to dollar benefits using appropriate severities and loss development factors. The total benefit obtained from the model is then distributed by program according to the same proportions as the first method produced. This results in a benefit range for each individual program covering both the model- and evaluation-based results. Using this methodology, we have arrived at the following total ultimate benefit ranges by program for the years 1996 – 2000.

Photo Radar	$112.7 million	-	$139.6 million
Targeted Traffic Enforcement	$32.6 million	-	$39.1 million
Enhanced CounterAttack	$94.5 million	-	$116.8 million
Road Improvement	$48.6 million	-	$56.4 million
Graduated Licensing	$41.9 million	-	$48.2 million
Intersection Safety Cameras	$1.7 million	-	$1.7 million

Because our modeling processes employ economic variables which are not available until the third quarter of the year following their applicability, we have not been in a position to extend the results to 2001. But in any event we have reached the limit beyond which the results of the individual program evaluations conducted in 1997-98 cannot reliably be stretched in time. Hereafter, it will only make sense to continue the economic modeling work which relates to the collective effectiveness of the entire program package.

In general, the results for 1996-2000 demonstrate a substantial loss reduction benefit of the road safety programs for ICBC. That this benefit is not just a reflection of a larger geographic or jurisdictional trend is confirmed by a comparison of fatality rates over the period 1991-2000 between B.C. and other provinces. B.C. rates have declined twice as much since 1995 as have the rates for the rest of Canada. Over the five years from 1996 to 2000 the B.C. road safety programs are estimated to have saved between about 220 and 330 fatal crashes together with between about 12,000 and 21,000 injury crashes for a total (gross) benefit of between $332 million and $402 million to ICBC. The cost of implementing and maintaining these programs has not been addressed in this document.

EFFECTIVENESS AND BENEFIT OF THE ROAD SAFETY INITIATIVES

There are six major programs which will be considered in this report:

(i) the photo radar program (PRP)
(ii) the enhanced CounterAttack program (ECAP)
(iii) the targeted traffic enforcement program (TTEP)
(iv) the intersection camera program (ISCP)
(v) the graduated licensing program (GLP)
(vi) the road improvement program (RIP)

All of the above programs with the exception of GLP and ISCP commenced operation at a significant level in 1996. The GLP was instituted in late1998; the ISCP commenced during 1999 and should be fully operational by the middle-to-end of 2001.

Each program has an official evaluation methodology (approved by the Corporation's Measurement & Monitoring Committee - "M&M", and subjected to outside scientific review by Human Factors North in Toronto) which is designed to determine whether or not the program is effective in changing road user behaviour and crashes or claims <u>where it is applied.</u> But since the programs are not applied everywhere and they generally all primarily address the incidence of injury-producing crashes, there is no absolute way to establish definitively the sole impact of each on claims experience at the overall provincial level. Moving from specific program effectiveness assessments to annual province-wide benefits thus requires a number of assumptions.

This report will first address the four programs in place during 1996 which have all produced some measurable results which, in turn, have been reviewed by Human Factors North. The estimates of effectiveness for individual programs are really only valid through 1998 since some of them largely depend on time series models which are not reliably extendable very far beyond the 1996 interventions. Also, as the programs (which all primarily addressed fatal and serious-injury crashes) became implemented on a wider scope they became more and more integrated so that attribution of individual effects becomes problematic. Beyond 1998 it will only be possible to make qualitative projections concerning continuation of individual program impacts. For the remaining two programs which commenced in 1999 and are still not fully operational, the effectiveness estimates will of necessity be very speculative.

1. 1996 to 1998 Effectiveness

1.1 Speed Reduction Programs (PRP and TTEP)

The PRP commenced in mid-to-late 1996 at a point when the TTEP was in its infancy which permitted a more-or-less independent evaluation of the former in terms of speed and collision change during 1996-97. This evaluation of PRP was continued through to the middle of 1998 but a major increase in scope of the TTEP beginning in the late spring of '98 made any further attempts to distinguish the two programs at the provincial level impractical. But an assessment of the overall changes in speed-related crashes was made using a discriminant function model to derive a claim-based surrogate. The model was based on a comparison of matched claims and police-reported collisions where causal factors were listed. The 1999 report entitled "The Development of Claim-Based Surrogate Models for Drinking Driving and Speed-Related Crashes and Their Application in Assessing the Impact of Road Safety Program Interventions" was reviewed by both M&M and Human Factors North.

The results arrived at by modeling probable speed-related claims up to 1996 and comparing actual values to those "expected" thereafter were:

1997 - 9.2% reduction in injury claims and 0% reduction in material-damage-only (m.d.o.)claims
1998 - 12.7% reduction in injury claims and 8% reduction in m.d.o. claims

These reductions applied to a sample of claims over half of which were most likely caused by speed, but the sample its self represented only a portion of all probable speed-related claims. In other words, the surrogate measure was appropriate for assessing a proportional change in speed-related claim occurrence but not for determining the actual counts or the numerical size of any effect. In order to convert the above percentages into a proportion of all crash-claims we need to know what proportion of crashes are likely to be speed-related. This can be estimated from the police collision data (TAS) by taking all police-attended crashes in which there was either an assigned contributor of "unsafe speed" or else a pre-collision action noted which implied loss of vehicle control (e.g. skidding). According to this "definition" about 20% of crashes could be "speed-related". Applying this 20% factor to the above proportional reductions gives:

1997 - 1.9% reduction in injury claims and 0% reduction in m.d.o. claims
1998 - 2.6% reduction in injury claims and 1.6% reduction in m.d.o. claims

photo radar
The above results should apply to the total effect of both PRP and TTEP. The former program (PRP) was subjected to extensive separate evaluation with the following results (confirmed by M&M):

1996-97 - 17% reduction in daytime fatalities and 11% reduction in daytime ambulance trips
1996-98 - 20% reduction in daytime fatalities and 13% reduction in daytime ambulance trips\

These crash reduction effects were supported by concomitant reductions in mean traffic speeds of 1.3% and just under 1% for 1996-97 and 1996-98 respectively found from covert speed loop data.

The above results applied to the first 12 and 24 months respectively following implementation of the program in mid-1996 when ticketing commenced. The calendar year breakdown would probably have been something like:

1996 - 8% reduction in daytime fatalities and 5% reduction in daytime ambulance trips
1997 - 18% reduction in daytime fatalities and 12% reduction in daytime ambulance trips
1998 - 22% reduction in daytime fatalities and 15% reduction in daytime ambulance trips

Using daytime fatalities and ambulance trips was intended to separate the PRP from the ECAP effect since the latter program operated only during the late evening and nighttime. Since the daytime fatal and serious injury crash totals represent about 60% of the daily total, the above percentages should be multiplied by 0.6 to get the effect on all fatalities and ambulance trips. But ambulance trips are characteristic of moderate-serious crashes which represent at most 20% of all injury crashes (and the annual number of ambulance trips divided by the total ultimated annual injury crash count confirms this). Thus the percentage injury reduction related to ambulance trips needs to be multiplied by a further 0.2 in order to arrive at a reduction proportion for all injuries (or injury crashes). These corrections give the following likely maximum PRP effect:

1996 - 4.8% reduction in fatalities and 0.6% reduction in injuries
1997 - 10.8% reduction in fatalities and 1.4% reduction in injuries
1998 - 13.2% reduction in fatalities and 1.8% reduction in injuries

However, while the operation of the PRP was specifically designed to address high-end speeders and, therefore, more severe crashes such as those represented by ambulance attendance, it is not unreasonable to suppose some lesser effect on minor injury events. Since a large proportion of minor injury crashes are associated with whiplash occurrences (which tend to be rear-enders) it is likely that the effect of PRP on these collisions would be very substantially less than the effect on serious-injury crashes. A very conservative estimate might be 10%. Using this factor, the total injury (or injury crash) reduction proportions could be greater than those given above by an additional 0.80 x 0.10 = 0.08; i.e. multiplied by 1.08.

We do not have estimates from the specific evaluation studies of the impact on non-injury (mdo) crashes, but we might assume that the 1.6% found in 1998 claim surrogate analysis was, based on visibility hours of PRP compared to TTEP, about 1/3 due to PRP - i.e. 0.5% although other evidence points to PRP being more effective than TTEP. Nevertheless, it can be argued that speed enforcement impacts mostly on crash severity rather than crash incidence, in which case some fatal crashes would reduce to non-fatal injury events and the latter would become mdo collisions. Thus we might expect the additional mdo incidents that this would produce to cancel out any independent impact on mdo occurrence so that the net effect would be zero. Combined with the fatal and injury crash effect estimates, this produces:

1996 - 4.8% fatal, 0.6% injury and 0.0% mdo crash reduction
1997 - 10.8% fatal, 1.5% injury and 0.0% mdo crash reduction
1998 - 13.2% fatal, 1.9% injury and 0.0% mdo crash reduction

corridor speed enforcement
Now, in considering the TTEP impact it turns out that this program was much more difficult than PRP to evaluate owing to its later start and the fact that TTEP corridors were likely also to have photo radar activity. The difficulty in identifying the precise location of crashes and thus being able to relate them reliably to the program also militated against a reliable assessment of effect. However, a detailed study in 2000 of four of the corridors was conducted using the services of a database (GIS) consulting firm which cleaned five years of data (1995-99) and used various logic rules to assign crash claims to the routes. The results of this study (reviewed by M&M) suggested the following effect of TTEP:

1998-99 - 3% reduction in injury claims

An earlier study (1998) using police-reported crashes on 10 of the 1997 program corridors concluded that the TTEP was associated with a mean speed reduction of close to 3% and a crash-reduction impact of 2 fatal crashes, 256 injury crashes and 682 m.d.o. crashes saved. This would have been equivalent to a 0.4% across-the-board crash reduction. M&M, however, did not endorse these results owing to methodological issues concerning the use of police data which spanned the 1996 period when police crash reporting dropped. A separate earlier (1999) study on a larger number of the highway corridors had found a mean speed reduction of just under 1%. That both earlier studies found a speed reduction effect supports the level of claim effect given above.

Since the total number of injury claims on the four highways in the 2000 study represented about 4% of all the injury claims in B.C. for that period, and assuming that both the effect and the initial claim count level was roughly the same for the 16 other corridors in the program (i.e. 3% effect on a 20% potential), we can arrive at the following estimate:

1998-99 - 0.6% reduction in injury claims

Since the program was operating at a lower level in 1997 than in 1998-99, we should account for this by reducing the likely impact. Based on enforcement hours committed, the 1997 impact should have been slightly more than half of that for 1998 and thus we could have:

1997 - 0.4% reduction in injuries
1998 - 0.6% reduction in injuries
(we can assume no substantial impact in 1996)

The effect for 1997 derived in this manner exactly coincides with the 1997 estimate from the 1998 study. The 1998-99 analysis was unable to address fatal crash-claim reduction, but it is not unreasonable to assume that the ratio of fatal to injury crash reduction with TTEP should be similar to that for PRP since both programs act to reduce speed which has an increasing impact with crash severity. For PRP the ratio of fatal to injury crash reduction was between 7 and 8 : 1. If we use the 7:1 ratio for TTEP the possible effect becomes:

1997 - 2.8% reduction in fatal crashes and 0.4% reduction in injury crashes
1998 - 4.2% reduction in fatal crashes and 0.6% reduction in injury crashes

As discussed earlier for PRP we will assume no net effect in reducing mdo crash-claims. We now have:

1997 - 2.8% fatal, 0.4% injury and 0.0% mdo crash reduction
1998 - 4.2% fatal, 0.6% injury and 0.0% mdo crash reduction

1.2 Drinking Driving Programs (ECAP)

The ECAP was specifically evaluated in 1996 and again in 1998. Both evaluations were reviewed by M&M and by Human Factors North. The claim surrogate process (described earlier for speed-related claims) was applied to 1997 and 1998 data to obtain an estimate of the level of drinking-driving crash reduction in both years. The 1996 and 1998 evaluation results were expressed in terms of numbers of crashes reduced:

1996 - 10 fatal and 900 injury crashes reduced
1998 - 20 fatal and 1623 injury crashes and 4,637 mdo crashes reduced

That there was likely an effect on crashes was supported by the results of roadside alcohol surveys in conjunction with the campaigns. The number of nighttime impaired drivers in major municipalities was reduced by 27-45%.

But the M&M Committee decided that the 1998 results as derived using the particular analysis methodology should be halved to 10 fatal, 812 injury and 2,318 mdo crashes respectively. Using these figures, the proportional reductions based on the average annual ultimated number of injury crash-claim events for 1996 and 1998 (see Table 3 later in this document) would have been:

1996 - 2.3% reduction in fatal crashes and 1.5% reduction in injury crashes
1998 - 2.4% reduction in fatal crashes, 1.4% reduction in injury crashes and 1.5% reduction in m.d.o.

The assumption of a low ratio of fatal to injury proportional effect (about 1.5 as compared to 7 for PRP) arose from the belief that anti-drinking-driving programs would have most effect on occasional or situational drinkers and little effect on hard-core drinkers who might be expected to be greatly over-involved in fatal incidents.

The claim surrogate analysis gave the following results for drinking-driving crash-claims:

1997 - 23% reduction in injury crash-claims and 18% reduction in mdo crash-claims
1998 - 28% reduction in injury crash-claims and 19% reduction in mdo crash-claims

Since, based on TAS data, drinking-driving-related crashes represent about 11% of all reported crashes, the above proportions can be revised to reflect all injury and mdo events as follows:

1997 - 2.5% reduction in injury crashes and 2% reduction in mdo crashes
1998 - 3% reduction in injury crashes and 2% reduction in mdo crashes

While the above results for injury crashes are somewhat similar to the proportions based on the 1996 and 1998 evaluation conclusions, they are greater than M&M was prepared to accept. The M&M decision to accept the effect that it did for 1998 limits the potential for both 1997 and 1996 effectiveness. Since the ECAP entailed 6,463 hours of visible enforcement in 1996, 8,690 in 1997 and 14,744 in 1998, we could assume that the 1997 effect should have been 59% of that in 1998 and that the 1996 effect should have been 44% of 1998's. This leaves the following:

1996 - 1.1% reduction in fatal crashes, 0.6% reduction in injury crashes, 0.5% reduction in mdo
1997 - 1.4% reduction in fatal crashes, 0.8% reduction in injury crashes, 0.7% reduction in mdo
1998 - 2.4 %reduction in fatal crashes, 1.4% reduction in injury crashes, 1.2% reduction in mdo

It should be noted here that one other drinking-driving-related program existed during the 1996-98 period. This was the Administrative Driver Prohibition and Vehicle Impoundment Program (ADP/VI) which is administered through the Office of the Superintendent of Motor Vehicles. But since this program applies only to those drivers charged with Criminal Code drinking-driving offenses and especially to those subsequently driving with a suspended license, it has a relatively small scope when compared to the ECAP and thus has not been considered in this report.

1.3 Road Infrastructure Programs (RIP)

The major difficulty in evaluating the RIP concerns the general lack of reliable data concerning crash location. Location information from TAS, while by no means 100% accurate, has historically been considerably more accessible than that from claims. But the number of police-reported crashes in TAS reduced markedly from 1995 through 1998 as a result of a reduction in police resources. And while claim location data are now vastly improved over the situation in 1998, the 1996-98 period represents a low point in the utility of both TAS and claim data - especially insofar as location identification is concerned.

But for 31 intersections treated during 1998-99 a proper scientific evaluation was conducted using Bayesian techniques as per the M&M-approved evaluation plan. In January of 2002, the M&M Committee approved a 4.7:1 benefit/cost ratio based on these results. In other words, M&M accepted benefits accruing to RIP that *could* represent up to 4.7 times the cost of ICBC's contribution to the infrastructure improvements. But this ratio cannot reasonably be multiplied by each year's expenditure to get an annual benefit for purposes of this document. That would represent a self-fulfilling prophecy that would not be consistent with the manner in which the other programs have been assessed. Accordingly, we must go back to the evaluation details to obtain a better estimate of actual crash-reduction effect.

For the 31 locations in the evaluation, the effects of the program were judged to be: 20.6% reduction in casualty crashes ± 1.5% (95% confidence range) and 18.5% reduction in mdo crashes ± 1.1%. There are no program records which summarize the actual total number of crashes applying to <u>all</u> of the pre-treated locations in each program year but a detailed review of 2 ½ pre-treatment years of crash-claim record was conducted by the Loss Prevention Business Intelligence Unit for the 1999 treatment year. In this year, 148 locations were identified that underwent improvements as part of the RIP – 52 for which ICBC contributed less than $3,000 and 96 for which the contribution ranged from $3,000 to $175,000. The high-contribution locations averaged about 38 geocodeable crashes per year while the average for all locations was about 35. This difference was not felt to be sufficient to warrant disregarding the low-contribution sites and thus all the 148 sites were included in the analysis. Geocodeability varies by region and by year and thus the average annual crash rates had to be adjusted to reflect the differential impact of unassigned claims. Since the main geocodeability difference by region is between the LM/FV and the rest of BC, the 148 locations were divided into these two geographic groupings and the average annual crash rate per site for each of the two groups was divided by the pertinant geocode rate for 1999 (0.665 for LM/FV and 0.326 for the remainder). The estimate of total crashes per location per year thus obtained was:

Fatal	0.07
Injury	14.39
Mdo	41.08

Knowing the number of intersections treated per year and assuming the that above average pre-fix crash levels and treatment effects apply to all years, we can arrive at an estimate of the likely impact. In doing this, we will assume the lower 95% interval effect (20.6%-1.5% = 19.1% for casualty crashes and 18.5%-1.1% = 17.4% for mdo crashes). So now we have the following annual number of crashes saved due to treatments in a given year:

1996- 61 sites(0.07fat x 0.191), 61(14.4inj x 0.191), 61(41.1mdo x 0.174) = 1 fat, 168 inj and 436 mdo
1997- 56 sites(0.07fat x 0.191), 56(14.4inj x 0.191), 56(41.1mdo x 0.174) = 1 fat, 154 inj and 400 mdo
1998- 78 sites(0.07fat x 0.191), 78(14.4inj x 0.191), 78(41.1mdo x 0.174) = 1 fat, 215 inj and 558 mdo

But the effects of the treatments (which are usually not completed until late in the program year) are not experienced until the following year and M&M has also adopted a convention of considering only two years of benefit per location. Thus the above numbers translate into the following effects by year:

1996 - 0 fatal, 0 injury and 0 mdo crashes saved (1994 + 1995)
1997 - 1 fatal, 168 injury and 436 mdo crashes saved (1995 + 1996)
1998 - 2 fatal, 322 injury and 836 mdo crashes saved (1996 + 1997)

To get the proportion of all crashes in the province that the above reductions represent, we can divide by the number of relevant crashes in each year for all B.C. as obtained from the Business Information Warehouse.

1996 - 0.0% fatal, 0.0% injury and 0.0% mdo crash reduction
1997 - 0.2% fatal, 0.3% injury and 0.2% mdo crash reduction
1998 - 0.5% fatal, 0.6% injury and 0.4% mdo crash reduction

2. 1999 to 2000 Effectiveness

2.1 Speed Reduction Programs (PRP and TTEP)

As already mentioned, our ability to assess directly the impacts of specific programs after 1998 is very limited. The method which must be adopted is an inferential one, meaning that the 1998 benefits will be considered to continue on an annual basis unless there is compelling evidence from on-going behavioural measures to suggest that the programs are losing impact.

photo radar

Monitoring of the speeds at photo radar (PRP) sites from 1996 to 2000 shows that mean speed is still down from pre-program levels and has shown no sign of increasing. Similarly, the 85th percentile speed and the proportion of vehicles exceeding the speed limit have continued to decrease, although this effect is leveling off. However, an examination of the monitoring results from the covert speed loops which are not connected with PRP enforcement locations indicates that both mean speeds and the proportion of vehicles speeding (especially those at 16+ km/h over the limit) have been rising since 1998. This rise was not very noticeable through 1999 but by 2000 it had become significant. The trends are shown in the table below.

Results of Speed Loop Data Review (April, 2002)

	Mean Speed				Proportion > SL				Proportion > (SL+15)			
Speed Limit (km/h)	1995 Avg. (km/h)	1999 avg. (km/h)	2000 avg. (km/h)	Min. (in yr.) (km/h)	1995 Avg. (km/h)	1999 avg. (km/h)	2000 Avg. (km/h)	min. (in yr.) (km/h)	1995 Avg. (km/h)	1999 avg. (km/h)	2000 Avg. (km/h)	Min. (in yr.) (km/h)
50	64.9	67.1	67.7	64.9 (95)	97.0	97.0	97.0	97.0(95)	52.4	52.4	52.4	52.4(95)
60	61.8	62.3	63.2	61.8 (95)	60.0	60.1	64.0	57.0(97)	7.3	6.1	6.8	5.8 (98)
80	89.0	85.4	85.2	85.2 (00)	90.6	73.6	73.0	72.8(00)	21.0	11.5	11.5	11.5(99)
100	105.2	103.3	103.9	103.1(98)	72.5	65.7	67.6	65.1(98)	15.2	8.1	9.7	7.7 (98)
110	109.6	108.8	110.0	108.0(97)	54.0	45.2	49.6	43.3(98)	7.9	6.2	7.9	4.8 (98)
Average # of speeders per 100 vehs:					74.8	68.3	70.2		20.8	16.8	17.7	

The 1999 average number of speeders is 1.039 times the minimum value. Thus we can assume that the program impact during 1999 was still close to maximum. Looking at the individual driver behaviour measure of exceeding the speed limit (>SL), we find that the number of speeders per 100 vehicles decreased by an average of 6.5 between 1995 and 1999 but by 2000 the decrease from 1995 was only 4.6. Thus it could be said that the 2000 effect was about 71% of the 1999 effect. Similarly, using the high-level speeders (SL+15), the average number decreased by 4.0 from 1995 to 1999 but by 2000 the decrease from 1995 was only 3.1. This would suggest that the 2000 effect was only about 77% of the 1999 effect. Combining both speeder categories indicates that the 2000 effect should be about 74% of 1999.

The question arising from the above analysis is: "what does this mean for safety?". Unfortunately the literature offers no categorical answer. But since, in general, both mean speeds and proportion of vehicles speeding (meaning an increase in speed variance) have increased from 1999 to 2000 it is not unreasonable to assume that the safety benefit of the PRP should have also decreased by a similar proportion. It should also be mentioned that the number of visible hours of police enforcement in 2000 reduced somewhat (about 8%) over the high point achieved in 1998-99. So for 1999 we will assume an effectiveness level equal to that for 1998 but for 2000 the effectiveness should be 74% of the 1998 level.

1999 - 13.2% fatal, 1.9% injury and 0.4% m.d.o. crash reduction
2000 - 9.8% fatal, 1.4% injury and 0.3% m.d.o. crash reduction
(these reductions are still related to pre-program or "expected" crash levels)

corridor speed enforcement
The speed loop evidence presented above applies equally to TTEP as to PRP. And as with PRP the visible enforcement hours associated with TTEP decreased a little from 1999 to 2000 (although 1999 was a small amount higher than 1998). So it makes sense to assume a similar effectiveness for 1999 as for 1998 and to apply a 74% factor to the 1998 impact in order to estimate what should apply for 2000.

1999 - 4.2% fatal, 0.6% injury and 0.4% mdo crash reduction
2000 - 3.1% fatal, 0.4% injury and 0.3% mdo crash reduction

2.2 Drinking Driving Programs (ECAP)

For the same reason as with the speed enforcement programs (i.e. confounded effects) there has been no attempt to assess the independent impact of the ECAP since 1998. There is some evidence from TAS data that the proportion of injured drivers assigned alcohol by police as a crash-contributing factor has reduced from 1998 to 2000-2001 (11.9% down to 11.7%) but this change is not substantial. There was also not much of a change in the level of enforcement effort between 1998 and 2000. 1999 and 2000 visible enforcement hours were both only 3% above the 1998 level.

Therefore, it would seem reasonable to continue to assume the 1998 effectiveness of ECAP through 2000.

1999 - 2.4% reduction in fatal, 1.4% reduction in injury and 1.2% reduction in mdo crashes
2000 - 2.4% reduction in fatal, 1.4% reduction in injury and 1.2% reduction in mdo crashes

2.3 Road Infrastructure Programs (RIP)

The same methodology used for the 1996-97 effectiveness estimation can be applied to the 1999 and 2000 program. With 129 and 314 intersections treated in 1999 and 2000 respectively, the effects are:

1999- 129 sites(0.07fat x 0.191), 129(14.4inj x 0.191), 129(41.1mdo x 0.174) = 2 fat, 355 inj and 922 mdo
2000- 314 sites(0.07fat x 0.191), 314(14.4inj x 0.191), 314(41.1mdo x 0.174) = 4 fat, 864 inj and 2246 mdo

As for 1996-1998, the above costs can be converted to the assumed effectiveness below:

1999 - 3 fatal, 490 injury and 1272 mdo crashes saved (1997 + 1998)
2000 - 4 fatal, 677 injury and 1758 mdo crashes saved (1998 + 1999)

This translates to the following proportion of total crashes by year

1999 - 0.7% of fatal, 0.8% of injury and 0.6% of mdo crashes saved
2000 - 1.0% of fatal, 1.2% of injury and 0.9% of mdo crashes saved

2.4 Driver Licensing Programs (GLP)

The GLP was implemented in August of 1998. There was a comprehensive evaluation plan developed at the time of program design and this plan was reviewed and approved by M&M. The first phase of the evaluation (examining safety effects up to 14 months after implementation) has recently been completed. The principal finding so far is that the effects are mainly limited to the learner period. Based on this, an estimate of the impact of GLP for 1999 and 2000 has been made, taking into account the changing proportions of age and gender of the novice driver population and also the changing size of this population. For example, the advent of GLP in the summer of 1998 was preceded by a large "surge" in learner license applications from new drivers (especially young males) trying to avoid the program. Thus the remaining GLP population that year was substantially lower than pre-GLP levels. Thereafter the GLP population has increased somewhat and may make it back close to where it was previously (including the age/sex breakdown) by 2003.

The most recent estimates of GLP effects and benefits were approved by M&M on March 7, 2002. These estimates gave a reduction of 4.8 fatal crashes, 577 injury crashes and 1,191 mdo crashes for 1999, and 3.5 fatal crashes, 923 injury crashes and 1,376 mdo crashes for 2000. The effects given below reflect these numbers as a proportion of a base level which is taken as the average for the overall B.C. driving population during the years 1996-1998 (about 420 fatal, 58,000 injury and 200,000 mdo from the BIW).

1999 - 1.2% reduction in fatal, 1.0% reduction in injury and 0.6% reduction in mdo crashes
2000 - 0.9% reduction in fatal, 1.6% reduction in injury and 0.7% reduction in mdo crashes

There are no impacts assumed for Aug.-Dec.'98 due to the pre-August "surge effect mentioned above.

One issue with the GLP evaluation which must be addressed here has to do with specific crash severities of participants. Since, for GLP, the precise crashes occurring to the beginning drivers both before and after program implementation can be retrieved from the BIW, it is possible to obtain a crash cost savings directly. When this is done it turns out that the average severity of year-2000 crashes involving the 1999 beginner group was markedly higher than the pre-GLP severity and this negated a substantial part of the benefit which *should* have accrued from the crash-claim count reduction given above. But to use the reduced benefit directly in this document would not be consistent with the manner in which we have necessarily had to treat the other programs (i.e. estimating a crash reduction and then applying an average severity value from the BIW for the year in question). So the decision has been made to proceed with GLP as though the precise severities were unknown and use the overall average severities by year from the BIW as is documented later in this report. This seems justifiable for GLP since the number of claims involved in giving the high actual severities for the 1999 learner group in 2000 is only a couple of hundred. One or two low-probability extreme events could account for all the effect.

2.5 Dangerous Driving Enforcement (ISCP)

The ISCP commenced operation at a partial level in 1999 with full implementation of all 30 cameras slated at 120 instrumented locations by the end of 2001. A comprehensive evaluation plan was developed which was vetted by Human Factors North and approved by the M&M Committee. The original estimate of individual camera effect for program planning purposes was a 17% reduction in traffic collisions per location as a result of general violation deterrence. The 30 cameras will be rotated among the 120 locations in a covert manner so as to produce (as far as possible) maximum impact at all locations.

However, the extent to which the hoped-for effect materializes is a direct function of driver reaction to the cameras. Experience in other jurisdictions and with similar types of enforcement technology suggests that after an initial "novelty effect" the impact may be expected to reduce somewhat. Publicity regarding charge levels and the capability of drivers easily to avoid the instrumented sites will both be influential.

A small study undertaken in late 2000 at ISCP locations in Kamloops and Kelowna found that immediately after implementation the incidence of red-light running at the intersections decreased by 60% - a highly statistically significant result. But by 6 months following activation, red-light running had rebounded to 82% of its pre-program level. The remaining apparent 18% effect was not statistically significant. The Interim

Post-Implementation Evaluation report was approved by M&M on March 27, 2002. This report compared the results at seven treatment sites with those at seven matched comparison sites without ISCs. When the proportional effects at the comparison sites are subtracted from those at the treatment locations there is an implied 36% reduction in red-light violations, a 26% reduction in all violations and a 16% reduction in severe and turning/crossing conflicts associated with the ISCs. Based on the relationship found between such conflicts and ICBC injury-producing crash-claims, this apparent conflict reduction (if real) could imply an 8% reduction in casualty crashes.

This reduction would relate to the "expected" number of crashes per location. Of the locations now operating , only a few have readily available prior crash-claim counts. These data indicate a pre-program collision level of 53 per location per year but the high-volume Lower Mainland sites are not included in the eight. Based on two years of crash-claim data for 54 potential program sites identified during 2000 (including the eight just mentioned plus several major Lower Mainland intersections), an average count of 88 per year can be calculated. The fourteen Lower Mainland intersections in the Interim Evaluation averaged 0.1 fatal crash-claims, 36 injury crash-claims and 95 mdo crash-claims per year each. This amounted to 131 total crashes per year per location but it would probably be more representative of the full, province-wide program to use the 88 figure. This would mean 0.1 fatal, 24 injury and 64 mdo crashes per year per location.

Now, based on the implementation dates for each of the 120 intersections in the program, the following number of "camera-year" (one installation operating for one whole year) equivalents can be calculated:

1999 - 2; this means 0.2 fatal, 48 injury and 128 mdo crashes, times 8%.
2000 - 28; this means 2.8 fatal, 672 injury and 1,792 mdo crashes times 8%.

In terms of the number of crash-claims incurred in 1998-99, we can arrive at the following approximate proportional effect on provincial totals:

1999 - 0.004% of fatal, 0.006% of injury and 0.005% of mdo crashes saved
2000 - 0.013% of fatal, 0.089% of injury and 0.069% of mdo crashes saved

3. Total Effect on Crashes by Year

Taking all of the above estimated program effects, the following year-by-year summary is obtained:

Table 1

Percent of all Crash-Claims Reduced per Year

Safety	1996			1997			1998			1999			2000		
Pgm.	Fat.	inj.	Mdo	fat.	Inj.	Mdo	fat.	inj.	Mdo	fat.	inj.	mdo	Fat.	inj.	Mdo
PRP	4.8	0.6	0.0	10.8	1.5	0.0	13.2	1.9	0.0	13.2	1.9	0.0	9.8	1.4	0.0
TTEP	0.0	0.0	0.0	2.8	0.4	0.0	4.2	0.6	0.0	4.2	0.6	0.0	3.1	0.4	0.0
ECAP	1.1	0.6	0.5	1.4	0.8	0.7	2.4	1.4	1.2	2.4	1.4	1.2	2.4	1.4	1.2
RIP	0.0	0.0	0.0	0.2	0.3	0.2	0.5	0.6	0.4	0.7	0.8	0.6	1.0	1.2	0.9
GLP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.0	0.6	0.9	1.6	0.7
ISCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
ALL	5.9	1.2	0.5	15.2	3.0	0.9	20.3	4.5	1.6	21.7	5.7	2.4	17.2	6.1	2.9

(note that in 1997 and 1998 the injury claim proportion totals for PRP and TTEP together are compatible with the numbers derived separately from the speed-related claim surrogate process)

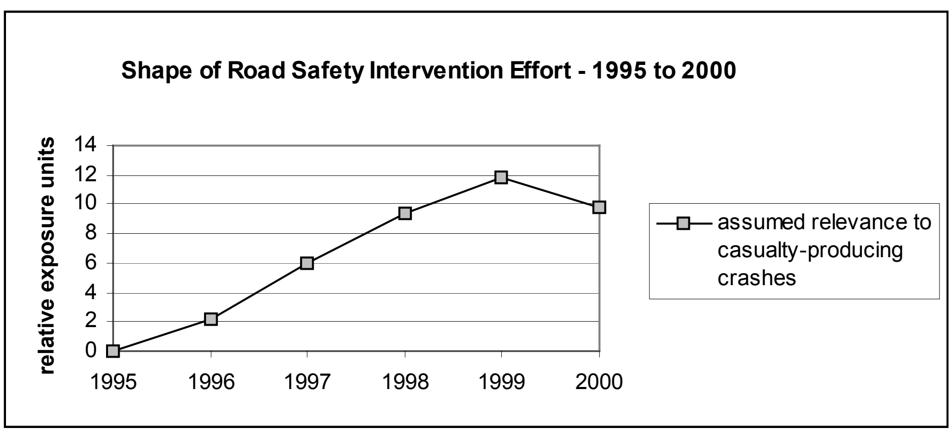
4. Benefit Associated with the Road Safety Programs

The estimated program effects listed above conceptually refer to changes measured against an otherwise "expected" level of crash occurrence. In some cases we have had to assume in calculating these estimated effects that the pre-program period of 1993-95 constituted this "base-line" level of expectation, but in arriving at a program cost saving we must allow for the possibility that post-1996 trends would not likely have been flat even in the absence of road safety and claims operations initiatives. The only way to investigate this possibility, and also to identify how much total claim reduction can actually be identified from examining documented claim experience, is to model claim counts over an extended historical period and either superimpose the program interventions beginning in 1996 or project the pre-program trends beyond 1996.

Inputting a program intervention effect into the model is the most direct and statistically-accepted way to estimate the impact of the road safety initiatives because the coefficient assigned to the intervention by the modeling process defines the size of the program effect. The nature or "shape' of the intervention must first be assumed and this assumption can then be modified based on the results of the model in "predicting" the last year of actual data. Since the three major programs early on were enforcement-related, and driver awareness depended on the number of hours of visible enforcement, we can use this information to define how the interventions were implemented – at least during 1996-98. All three began at a relatively low level of visible hours in 1996 (about 20,000) with hours increasing through 1997 (about 60,000) to 1998 (about 90,000).

In 1999, however, GLP commenced in earnest with over 50,000 new licensees in the program. This would imply an increased overall road safety program presence, although the notion of "visibility hours" cannot be applied to GLP in the same manner as with the direct enforcement interventions. In 2000, GLP remained steady but now we had RIP investments increasing substantially together with about 25% of the ISC locations active. On the other hand, 2000 also saw a decrease in speed enforcement which, based on the speed loop evidence, could have had important consequences. So 1999 should probably be represented by a higher program exposure than1998, but it is unclear what to assume for 2000.

The best way to decide what the final shape of the net intervention should look like is to adjust it so as to produce the optimum model fit to the data. This was the procedure adopted using a number of iterations of the process described in the following paragraphs. The final shape that best fit the casualty claim data is shown below. A description of the entire modeling process follows.



In order to account for both short and longer-term cyclical effects and possibly recurring outside influences, a long time series was required. Since crash-claim event counts are only available from 1993-on, it was necessary to employ crash-related claim file counts as a unit of analysis. While not an exact match, such counts approximate the number of vehicles involved in crashes and a documented relationship exists from 1993 to 1999 between these counts and the number of crash-claim events for each of the fatal, injury and mdo event categories. The modeling process employed monthly crash-related claims (those involving KOLs indicative of collision occurrence) from loss-years 1979 to 1999. Since only counts were used, the 15-month development time prior to data extraction would have been adequate for stabilization purposes. It was decided to employ all claims including those closed without payment (CWP) so as to minimize any prior impact of the 1992 Minimum-No-Damage program.

A number of exogenous variables were investigated in addition to the auto-regressive time series effect. The external factors which were found to be statistically or practically significant in the injury claim model were: estimated monthly vehicle-km of travel (based on gasoline sales for roadway use and federal government estimates of the B.C. fleet fuel economy in each year); weather (based on the amount and type of precipitation in the Lower Mainland area where over half of all crashes in the province occur); the frequency of week-end and holiday days by month (representative of exposure quality – e.g. more high-speed highway travel and drinking-driving); and the number of vehicle licenses issued (representative of the growth in mobility opportunity, even though economic and social changes will impact how this translates to driving exposure quantity and quality represented by two of the other factors). The model developed in this way and including the 1996 intervention previously described accounted for over 97% of the pre-2000 claim count variance and "predicted" the 2000 actual claim counts very accurately (the differences between actual and predicted monthly counts were not individually or collectively significant).

External factors found to be statistically significant in the fatal claim model were: estimated vehicle-km of travel; the frequency week-end and holiday days; the average minimum daily temperature; the proportion of the driving population less than 26 years of age; and the use/availability of occupant restraints (this factor combines the utilization of available seat belts reported in provincial surveys and the increase in the number of vehicles in the population since 1990 which were equipped with airbags). The fatal claim counts were aggregated on a quarterly rather than a monthly basis in order to add more stability to the time series since the monthly fatal claim counts were very small. The general shape of the 1996 safety program intervention was assumed to be the same as that used for the injury claim model but this was found to produce forecasts of quarterly claims which were clearly too high (resulting in apparent program effects which were excessive). Owing to the inherently greater instability of the fatal as compared to injury claim data, this model only explained about 76% of the fatal claim variance and this may have accounted for part of the difficulty . But the assumption that the shape of the intervention should be the same for fatal as for injury claim outcomes may also be problematic. Since there was not time to investigate this fully before the deadline for production of this report, the assessment of safety program impact on fatal claims was calculated using the model containing the intervention assumption but using the lower 95% confidence values for the difference between actual and expected claims. This results in lower (more conservative) effectiveness estimates.

Using the above methodologies produced the following estimates of overall crash-claim count reduction due to all programs (including presumably additional claim procedure initiatives such as fraud detection etc.) since 1996:

Table 2
Overall Crash-Claim File Reduction Estimates from Time Series & Econometric Modeling

fatal claims:
- 1996 - 2.6% reduction from expected, resulting in a saving of 12 claims
- 1997 - 8.4% reduction from expected, resulting in a saving of 33 claims
- 1998 - 12.4% reduction from expected, resulting in a saving of 49 claims
- 1999 - 16.4% reduction from expected, resulting in a saving of 63 claims
- 2000 - 13.3% reduction from expected, resulting in a saving of 52 claims

injury claims:
- 1996 - 1.1% reduction from expected, resulting in a saving of 1,123 claims
- 1997 - 5.9% reduction from expected, resulting in a saving of 5,684 claims
- 1998 - 8.6% reduction from expected, resulting in a saving of 8,435 claims
- 1999 - 11.2% reduction from expected, resulting in a saving of 11,002 claims
- 2000 - 9.8% reduction from expected, resulting in a saving of 8,985 claims

A provisional model for material-damage-only (mdo) claims was also developed using essentially the same external variables as for the injury model described above (the only change being that precipitation was replaced by snow). However, we inserted a somewhat different program function in order to be consistent with the assumptions made in interpreting the individual program evaluation results. The first two years of road safety program activity (1997 and 1998) consisted largely of the speed enforcement initiatives which were not expected to have much impact on mdo crash occurrence. Thus the program intervention shape for the mdo model was assumed to be simple step function commencing at January, 1998.

The expectations for mdo crash savings are certainly less than for injury crash savings but, based on the earlier estimates of individual program effects for ECAP, RIP, ISC and GLP, it would seem logical that there should be some for these programs at least. But it is possible that these mdo impacts might not show up on the ICBC "bottom line". In fact, the mdo modeling results suggested an overall effect for the road safety programs which was in the direction of *increasing* claims but which was not statistically significant when considered in conjunction with all the other variables. Therefore, the only justifiable interpretation is that no effect of the road safety programs on mdo claims could be found. The overall model explained a reasonably substantial proportion of the mdo claim variance (92%) but the inclusion of the safety programs did not improve the fit significantly.

A logical reason why mdo crash counts might not decrease much even though injury crash counts do, relates to the nature of the major speed-related road safety programs which should have a disproportional impact by crash severity. That is, they are designed to have a greater impact on serious injury crashes than on minor injury crashes and probably relatively little impact on mdo crashes. But when we "save" a fatal or serious injury crash through such programs, rather than disappearing entirely as an event it most probably would become a moderate injury crash instead. The amount saved for such an event would therefore only be the difference between the value of a fatal/serious injury crash and a moderate one. Such a "cascade" effect should continue with moderate injury crashes becoming minor injury ones and minor injury crashes becoming mdo events. In the final analysis the increase in mdo crashes due to cascading minor injury collisions would more or less cancel any reduction in mdo incidence at the "bottom end" due to the programs. The number and severity of fatal, severe injury, minor injury and mdo crash-claim events including CWPs were calculated in April, 2002 by the Corporate Controller's office with LDFs supplied from Corporate Actuarial. The intermediate category of "moderate injury" was estimated subsequently based on work done in 2001 and such that the overall weighted claim counts and severities were consistent with the totals provided by year. The "cascaded" value of a fatal crash is simply the difference between a fatal and a moderate injury crash severity. To arrive at the cascaded value of an injury crash we take the proportion of events at each of the three levels and multiply each by the severity difference between this level and the one immediately below. Adding these products produces a weighted average dollar figure for all injury crashes. The crash-claim incident counts and severities are set-out below.

Table 3

Crash-Claim Counts and Severities by Type of Crash

	1996		1997		1998		1999		2000	
Type	Count	Severity	Count	Severity	Count	severity	Count	Severity	Count	Severity
Fatal	437	$204,907	419	$197,569	417	$237,121	406	$182,251	398	$288,079
ser.inj.	1,530	$305,094	1,517	$319,166	1,453	$336,354	1,222	$387,761	967	$442,986
mod.inj.	9,202	$51,167	8,308	$53,679	8,521	$54,258	7,850	$59,537	6,176	$70,255
min.inj.	49,313	$8,195	47,972	$8,527	48,383	$8,245	48,890	$8,898	48,616	$10,649
Mdo	197,680	$1,482	199,404	$1,533	197,923	$1,514	200,393	$1,515	201,601	$1,631

So we assume that both fatal and serious injury crashes will devolve into moderate injury crashes, moderate injury crashes devolve into minor injury crashes and minor injury crashes devolve into m.d.o. events as described above for the PRP and TTEP. The other programs are assigned full fatal and injury crash costs on the assumption that these events would have been totally eliminated. The fact that we have assumed a low but existing level of mdo claim reduction for the individual program effects (and sum thereof) while not including any mdo model effects may be viewed as inconsistent. However, we are dealing with a range of estimates produced by two different methodologies and ultimately the "truth" will lie somewhere in-between.

Table 4 gives the values associated with crash reduction under the two conditions: elimination and cascade.

Table 4
Crash-Claim Values Based on Crash Elimination and Cascade Assumptions

	Fatal Crashes (eliminated)	Fatal Crashes (cascaded)	Injury Crashes (eliminated)	Injury Crashes (cascaded)
1996	$204,907	$153,740	$22,346	$18,569
1997	$197,569	$143,890	$23,171	$19,264
1998	$237,121	$182,863	$23,133	$19,323
1999	$182,251	$122,714	$23,744	$20,006
2000	$288,079	$217,824	$24,749	$20,929

Now, returning to Table 1 in Section 3, and using the crash counts by year (Table 3) together with the cascaded crash reduction values (Table 4) for PRP and TTEP but using the eliminated crash values for all other programs, we can arrive at the following benefits by program by year (Table 5):

Table 5

Estimated Benefits Associated with Individual Program Effects

Pgm.	1996	1997	1998	1999	2000
PRP	$9.9 million	$23.2 million	$31.5 million	$28.6 million	$24.8 million
TTEP	$0.00	$6.1 million	$10.0 million	$9.1 million	$7.4 million
	(81%fat, 50%inj)	(89%fat, 63%inj)	(86%fat, 56%inj)	(80%fat, 44%inj)	(75%fat, 30%inj)
ECAP	$10.5 million	$14.0 million	$24.9 million	$24.7 million	$26.0 million
RIP	$0.0 million	$4.8 million	$9.8 million	$13.3 million	$20.7 million
GLP	$0.00	$0.00	$0.00	$16.5 million	$25.4 million
ISCP	$0.00	$0.00	$0.00	$0.00	$1.7 million
All	$20.4 million	$48.1 million	$76.2 million	$92.2 million	$106.0 million

Using the proportions of total yearly crash-claim saving (calculated from Table 1 and shown in Table 5 above) for which the cascaded fatal and injury crash values apply, we can calculate net fatal and injury crash costs using weighted averages of PRP/TTEP vs. all other programs by year. These net values can be applied to the modeling results (i.e. the overall claim reduction below expected levels).

Table 6
Net Crash-Claim Values to be Applied to Reductions from Model Expected Levels

	Fatal Crashes (eliminated)		Fatal Crashes (cascaded)		Fatal Crashes (net)	Inj.Crashes (eliminated)		Inj.Crashes (cascaded)		Inj.Crashes (net)
	prop.	value	prop.	value		prop.	value	prop.	value	
1996	0.19	$204,907	0.81	$153,740	$163,462	0.50	$22,346	0.50	$18,569	$20,458
1997	0.11	$197,569	0.89	$143,890	$149,795	0.37	$23,171	0.63	$19,264	$20,710
1998	0.14	$237,121	0.86	$182,863	$190,459	0.44	$23,133	0.56	$19,323	$20,999
1999	0.20	$182,251	0.80	$122,714	$134,621	0.56	$23,744	0.44	$20,006	$22,099
2000	0.25	$288,079	0.75	$217,824	$235,388	0.70	$24,749	0.30	$20,929	$23,603

Now, converting the claim count reductions from Table 2 into crash-claim event reductions (using the ratio of claim incidents to claim file counts from the Business Information Warehouse) and then multiplying by the applicable claim incident reduction net values shown above (Table 6) gives:

Table 7
Crash-Claim Reduction Benefits from the Modeling Exercise

	Fatal	Injury	Mdo	Total
1996	$2.0 million	$13.7 million	$0.0 million	$15.7 million
1997	$5.1 million	$69.8 million	$0.0 million	$74.9 million
1998	$9.7 million	$103.7 million	$0.0 million	$113.4 million
1999	$8.8 million	$141.7 million	$0.0 million	$150.5 million
2000	$12.4 million	$122.4 million	$0.0 million	$134.8 million

It is important to realize that these estimated cost savings have fairly large confidence limits surrounding them. They are still the most likely estimates from the models but their probability distribution is such that we are 95% certain only that the estimates lie somewhere between just over zero and under about twice the above levels. The principal reason for such wide confidence levels is that the claim count model employed a logarithmic transformation in order to improve the fit. Translating the confidence interval for log of claim count back into one for the claim count itself produces a large range. This range can, however, be reduced somewhat by lowering our standard for "confidence" to 90% although the range will still be from about 16% to 190% of the above estimates.

But a portion of these annual estimated cost savings must be set aside for claim and auto crime programs independent of the six road safety initiatives specifically addressed in this report. These savings have been assessed by the individual claim project managers and reviewed by M&M Committee. The best estimates of such program benefits are as follows, where only programs which could produce a crash-claim count deterrence (incl. CWPs) have been included:

Table 8
Estimates of Annual Claim Program Crash Reduction Benefits

	1996	1997	1998	1999	2000
Fraud (deterrence)	$6.2 million	$12.6 million	$15.0 million	$15.0 million	$15.0 million
Hit-and-run	0.0	0.0	$11.5 million	$11.5 million	$11.5 million
TOTAL	$6.2 million	$12.6 million	$26.5 million	$26.5 million	$26.5 million

If all such "actual" savings documented by Fraud Programs (year-end 2001) and approved by M&M are subtracted from the above total savings by year we have:

Table 9
Net Safety Program Benefits Based on Crash-Claim Modeling

	Total Savings	Claim Program Savings	Net Savings for Safety Pgms.
1996	$15.7 million	$6.2 million	$9.5 million
1997	$74.9 million	$12.6 million	$62.3 million
1998	$113.4 million	$26.5 million	$86.9 million
1999	$150.5 million	$26.5 million	$124.0 million
2000	$134.8 million	$26.5 million	$108.3 million

Comparing the net total savings by year given above (Table 9) which were derived from the modeling process with those previously calculated based on the sum of the individual program benefits (Table 5), we have:

	Model-Based	**Sum of Programs**
1996	$9.5 million	$20.4 million
1997	$62.3 million	$48.1 million
1998	$86.9 million	$76.2 million
1999	$124.0 million	$92.2 million
2000	$108.3 million	$106.0 million

We can use the above figures to define a range of road safety program annual benefits. If the model-based benefits are allotted to the individual programs in the same proportion within each year as the other benefit estimates, the following ranges result:

Table 10
Range of Estimated Annual Benefits for the Road Safety Programs

	1996 ($million)	1997 ($million)	1998 ($million)	1999 ($million)	2000 ($million)
PRP	4.6 - 9.9	23.2 - 30.0	31.5 - 35.9	28.6 - 38.5	24.8 - 25.3
TTEP	-	6.1 - 7.9	10.0 - 11.4	9.1 - 12.2	7.4 - 7.6
ECAP	4.9 - 10.5	14.0 - 18.1	24.9 - 28.4	24.7 - 33.2	26.0 - 26.6
RIP	-	4.8 - 6.2	9.8 - 11.2	13.3 - 17.9	20.7 - 21.1
GLP	-	-	-	16.5 - 22.2	25.4 - 26.0
ISCP	-	-	-	-	1.7 - 1.7

The above estimated benefits indicate that all programs have likely achieved substantial benefits. Both TTEP and ECAP show increasing benefits from 1996 to 1998/9 consistent with the increase in scope for these two programs. The slight decrease from 1999 to 2000 for ECAP is probably not of much practical significance. The relatively substantial drop in both PRP and TTEP benefit after 1998/9, however, may be rationalized in terms of the increasing familiarization of drivers to deployment practices and a reduction in deployment itself.

The above estimated benefits are *relatively* consistent with those which have been estimated previously, although PRP is somewhat lower. The "best estimate" for PRP based on earlier models was judged to be about $34 million per year for all years from 1996 to 2000. Table 11 above would suggest for PRP an average of $23 - $28 million per annum over this same period.

Finally, the 2000 benefit for GLP as calculated in a manner consistent with that for the other programs comes out to about $25 million. When the actual crash costs are accumulated directly from the specifically relevant claims on the BIW, a net saving of only about $13 million for that year can be found. As mentioned earlier, this is a result of a high average severity associated with a small group of year-2000 claims involving 1999 beginning drivers which substantially reduces the overall value of the crash reduction effect. It is too early to say whether or not this increased average claim severity between first and second year of driving is real or whether it is just an artifact of small sample sizes. But for now it must be recognized that the actual GLP benefit might be less than the $25 million shown above. Of course this same possibility might apply to any or all of the other programs (either a greater or a lesser benefit) but for most we cannot identify specifically relevant claims as we can for GLP.

5. Number of Casualties Saved by the Programs

In order to put the estimated dollar savings into perspective, it is important to go back and look at the more personal side of the equation – the lives saved and injuries prevented. Table 1 showed the proportional reductions in crashes by type based on the individual evaluation results. To get the number of crashes saved we simply need to multiply each percentage by the appropriate crash counts in Table 3. For the model estimates, the number of claims saved in Table 2 must be multiplied by the appropriate proportion of incidents to claim files. For fatal events, the annual proportions increase from 1.0000 in 1996 to 1.0102 in 2000 while for injury events the proportions go down from 0.5974 to 0.5772.

Comparing the two estimates, we find that consistently the modeling process gives lower fatal crash estimates but higher injury crash estimates than does the sum of individual program evaluations. Of course, had we chosen to use the mean fatal claim reductions instead of the lower 95% confidence limit values, the model results would have been substantially higher here as well. The range of total road safety program casualty savings by year (as calculated using the above methodology) is given below.

Year	Fatal Crashes Saved	Injury Crashes Saved
1996	12 to 26	671 to 721
1997	34 to 64	1,734 to 3,372
1998	51 to 85	2,626 to 4,940
1999	66 to 88	3,304 to 6,410
2000	53 to 68	3,401 to 5,186

6. Comparison with Other Jurisdictions

Because of differences in the definition of injuries and in the availability of complete injury crash data from other provinces, the only reliable comparison measure between B.C. and the rest of Canada is represented by fatalities. Similarly, due to differences between definitions of active DLs and licensed/registered vehicles by province the most reliable denominator for a rate calculation is the total population.

Comparisons of B.C. crash fatalities per population with those of other provinces indicate that the change in the road safety picture reflected in the forgoing analysis, and which commenced in 1996, did indeed suggest some experience unique to B.C. Prior to 1996, fatality rates for youths (aged 13-21 as defined by ICBC's secondary school and university programs) and adults (22+) in B.C. were substantially above those for the rest of Canada (see Figures 1 and 2 below). Comparing the five years prior to road safety program implementation (1991-1995) with the five years following (1996-2000) shows that the B.C. youth fatality rate decreased by 35% (2.69 avg. down to 1.74 avg.) and the adult fatality rate decreased by 27% (1.50 to 1.10). For the rest of Canada the decreases were only 15% (1.86 to 1.59) and 13% (1.28 to 1.12) respectively.

While the fatality rate for children (ages 12 and under) fluctuates widely for B.C. by year owing to the small numbers involved, it is evident from Figure 3 that, beginning in 1996, the B.C. rate is consistently below that for the rest of the country.

A number of other provinces had road safety efforts in place over the 1991-2000 data period and the principle external influences of population demographics and macro economic climate were relatively similar for all. So the fatality rate comparisons would seem to confirm that the specific suite of road safety programs enacted between 1996 and 1998 in B.C. were effective in reducing crash risk and consequences.

Peter Cooper
Performance Analysis Services
June, 2002

FIGURE 1: Fatally Injured Youths Aged 13-21: Rate per 10,000 Population in Age Group

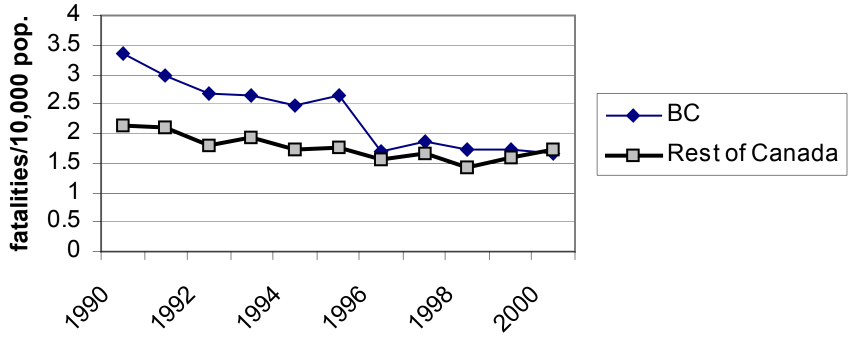


FIGURE 2: Fatally Injured Adults Aged > 21: Rate per 10,000 Population in Age Group

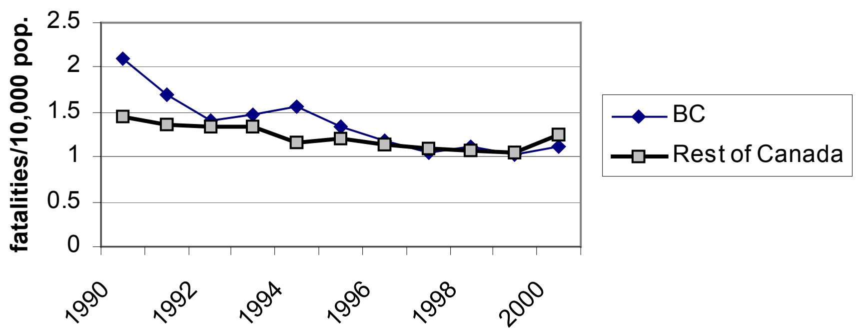
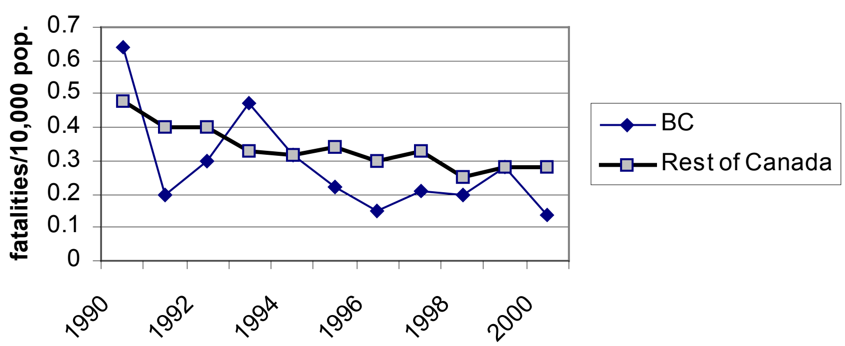


FIGURE 3: Fatally Injured Children Aged <= 12: Rate per 10,000 Population in Age Group



Traffic Safety Management and Educational Programs
Summary of Expenditures

Program Name	1997	1998	1999	2000
Enforcement Support	28,315	25,386	40,600	35,678
Engineering	4,246	8,211	8,156	12,036
Road Safety Education	8,926	19,651	18,668	19,771
Research & Administration	326	2,941	4,053	2,840
Other Education		7,008	9,898	6,759
Auto Crime Prevention	2,067	2,180	3,366	2,690
Total Traffic Safety Management and Educational Programs	43,880	65,377	84,741	79,774