

Section 4

Intersection Evaluation

The majority of this report is a summary of the numbers, types, and patterns of crashes. That information can be used to identify overall mitigation and safety efforts throughout the City. Another important element is to use the crash data to identify specific locations for potential improvements.

Total crash numbers at any location (either in a chart or through crash density maps) identify the locations where the most crashes occur. While helpful information, because volumes and other elements at specific locations vary widely, it's difficult to draw relevant conclusions from this data. Therefore, Traffic Operations staff conducts detailed analysis to identify intersections where there are more crashes than expected taking into account traffic volumes, roadway geometry, type of traffic control etc.

Traffic crashes are at least partially deterministic (i.e. factors affecting crash potential can be controlled). At the same time crashes are, to some extent, random events. This random nature of crashes makes it difficult to determine if a location is truly a problem versus a location where normal variations lead to a high crash frequency during the observation period. In order to identify locations that truly warrant further investigation it is helpful to use a methodology that accounts for the somewhat random nature of crashes.

In 2010 the Transportation Research Board (TRB) and the American Association of State Highway and Transportation Officials (AASHTO) published the *Highway Safety Manual* (HSM). The HSM includes a statistical approach used to account for regression to the mean bias to identify locations that have a higher than expected crash frequency even after accounting for random variation. That approach is applied to intersections in Fort Collins.

The method utilizes a calibrated model to predict the number of crashes at a location given the traffic volumes, the roadway geometry, and the type of intersection control. This prediction is then compared to the actual number of crashes at the location (adjusted to account for regression to the mean). The more the actual adjusted number of crashes exceeds the number of crashes predicted by the model the more likely it is that a location has an unusually high number of crashes.

City staff does an annual statistical evaluation of intersections in Fort Collins using three years of data (in this report: 2016 – 2018). Over 250 intersections were evaluated with 47% having an excess crash cost and 53% with a negative crash cost (indicating less crashes than predicted). This means that when aggregated and averaged, intersections in Fort Collins have slightly less crashes and/or severity than what would be predicted.

The table on the following page shows the 50 intersections (ranked by excess crash costs) with the greatest excess crash costs. (The top 10 are shaded darker, and the next 15 are shaded lighter.) Since injury crashes have higher crash costs associated with them, the ranking method gives more weight to locations with more injury crashes compared to locations with primarily “fender benders”.

Each of these intersections is reviewed in more detail to look for specific types and trends of crashes. Staff works to identify potential countermeasures to address recurring patterns if present. Note that when considering possible safety projects the cost of specific improvements needs to be considered in order to determine if the benefit will outweigh the cost.

Intersection Excess Crash Costs (2016 – 2018)

Table 6

Intersection excess cost (2016-2018)

Intersection		Input Data (Includes 3 Years of Crash Data)					Excess Crash Cost				
North/South Street	East/West Street	Major Street Volume	Minor Street Volume	Total AADT	Model Predicted Crashes/Year	Model Predicted FI Crashes/Year	Adjusted Actual Crashes/Year	Adjusted Actual FI Crashes/Year	Excess PDO Crashes/Year	Excess FI Crashes/Year	Excess Expected Crash Value (\$)
College Av	Horsetooth Rd	42874	23531	66405	37.599	8.567	54.045	14.655	10.357	6.088	\$1,050,393
College Av	Tribby Rd	34218	13553	47771	23.187	5.554	30.245	8.687	3.925	3.133	\$525,663
Mason St	Harmony Rd	33717	7680	41397	17.289	4.253	33.068	6.656	13.377	2.402	\$512,943
Lemay	Harmony Rd	48940	15750	64690	32.263	7.365	41.215	9.940	6.376	2.576	\$465,537
Lemay	Drake Rd	28198	24983	53181	27.062	6.422	30.669	9.350	0.679	2.928	\$459,568
Timberline R	Carpenter	18285	11215	29500	11.825	2.901	18.582	5.443	4.214	2.543	\$437,511
Boardwalk D	Harmony Rd	47830	11350	59180	25.350	5.721	36.265	7.822	8.814	2.100	\$417,952
Shields St	Mulberry St	19374	17980	37354	15.940	3.842	20.895	5.982	2.815	2.140	\$360,534
Shields St	Prospect Rd	28850	21407	50257	25.544	6.095	32.036	8.098	4.488	2.003	\$357,060
College Av	Drake Rd	45364	28220	73584	43.719	9.696	46.649	11.745	0.881	2.049	\$325,976
Ziegler	Horsetooth	21185	6091	27276	4.934	0.938	16.180	1.180	11.004	0.242	\$309,428
College Av	Laurel	35556	8242	43798	17.351	4.478	26.045	5.888	7.284	1.411	\$295,132
College Av	Monroe	44097	4858	48955	14.597	3.742	25.199	4.841	9.503	1.099	\$270,500
Lemay	Vine	14372	7524	21896	7.328	1.794	16.296	2.796	7.966	1.002	\$239,241
Timberline R	Kechter	20332	4483	24815	8.398	2.155	14.008	3.244	4.522	1.089	\$216,164
Remington	Mulberry St	24667	4156	28823	9.813	2.531	12.889	3.697	1.910	1.166	\$200,344
College Av	Troutman	38392	6832	45224	16.322	4.202	21.631	5.188	4.323	0.986	\$198,175
College Av	Vine	30748	6443	37191	9.788	2.297	10.907	3.556	-0.140	1.259	\$193,035
Taft Hill Rd	Drake Rd	23530	17341	40871	19.118	4.635	29.045	5.207	9.354	0.572	\$187,592
College	Smokey	37262	500	37762	2.027	0.449	3.902	1.566	0.758	1.117	\$180,624
Mcmurry	Harmony Rd	52499	4452	56951	15.636	3.881	18.406	4.855	1.796	0.974	\$169,549
Shields St	Drake Rd	32008	24438	56446	29.637	6.971	34.893	7.749	4.477	0.778	\$167,737
Shields	Vine	8727	5281	14008	0.898	0.201	4.025	0.475	2.853	0.274	\$157,398
Snow Mesa	Harmony Rd	51074	6262	57336	18.900	4.595	17.934	5.687	-2.058	1.092	\$146,915
College Av	Harmony Rd	38799	36479	75278	41.157	9.261	49.497	9.590	8.011	0.329	\$135,774
Linden	Vine	6418	2872	9290	1.546	0.536	4.877	1.206	2.661	0.670	\$131,709
College Av	Swallow	43122	8854	51976	20.752	5.099	23.080	5.827	1.601	0.727	\$129,330
Taft Hill Rd	Mulberry St	17141	10305	27446	10.543	2.585	13.341	3.275	2.108	0.690	\$128,915
Lemay	Magnolia	19754	4215	23969	5.556	1.348	7.688	2.084	1.396	0.736	\$128,516
9th (Lemay)	Buckingham	15165	1786	16951	2.620	0.694	3.415	1.420	0.068	0.727	\$113,017
Raintree	Drake	22433	2006	24439	3.426	0.986	4.359	1.677	0.243	0.690	\$109,250
Taft Hill Rd	Prospect Rd	23157	12949	36106	16.272	3.995	18.061	4.579	1.205	0.583	\$102,885
College Av	Foothills	45886	2664	48550	10.390	2.768	15.451	3.055	4.773	0.287	\$95,008
Lemay	Carpenter	14995	7521	22516	7.198	1.536	7.892	2.454	-0.224	0.918	\$139,420
Mason	Mulberry	26295	3978	30273	10.185	2.628	14.056	2.986	3.514	0.358	\$92,577
Mcclelland	Horsetooth	28645	2369	31014	5.390	1.320	8.237	1.726	2.441	0.406	\$88,660
Overland	Elizabeth	11137	2275	13412	0.799	0.139	3.306	0.568	2.077	0.429	\$88,369
Stover (East	Prospect	25645	1720	27365	2.115	0.483	6.797	0.748	4.418	0.264	\$87,682
College	Mason/Palmer	40314	4466	44780	7.372	1.840	7.916	2.403	-0.018	0.563	\$86,788
Mcclelland	Drake	29357	3103	32460	6.357	1.538	9.291	1.920	2.553	0.381	\$85,950
Mathews	Mulberry	27088	1000	28088	2.935	0.812	5.388	1.227	2.039	0.415	\$85,662
Shields St	Harmony Rd	23093	18571	41664	19.423	4.694	21.412	5.132	1.551	0.438	\$84,092
Automation W	Horsetooth	26018	2421	28439	2.362	0.530	2.895	1.038	0.025	0.508	\$78,724
Overland	Drake	10983	5747	16730	2.542	0.758	9.065	0.786	6.495	0.028	\$73,244
College	Oak	21138	350	21488	1.093	0.247	3.831	0.539	2.446	0.292	\$71,027
Timberline R	Custer	30579	1225	31804	6.434	1.733	8.045	2.082	1.262	0.349	\$67,342
College Av	Bockman	42930	1979	44909	8.267	2.288	9.328	2.674	0.676	0.386	\$66,759
Shields	Bennett	29769	1140	30909	2.124	0.474	1.749	0.936	-0.837	0.462	\$62,508
Giddings	Richards Lake	3608	853	4461	0.392	0.123	1.014	0.508	0.237	0.385	\$62,050
Mason St	Horsetooth Rd	26632	5739	32371	12.367	3.139	14.560	3.394	1.937	0.256	\$60,029

AADT = Annualized Average Daily Traffic
 FI = Fatal / Injury Crashes
 PDO = Property Damage Only Crashes

XXX = top 10 intersections
 XXX = next 15 intersections

Intersection Location Map with Most Excess Crash Costs (2016 – 2018)

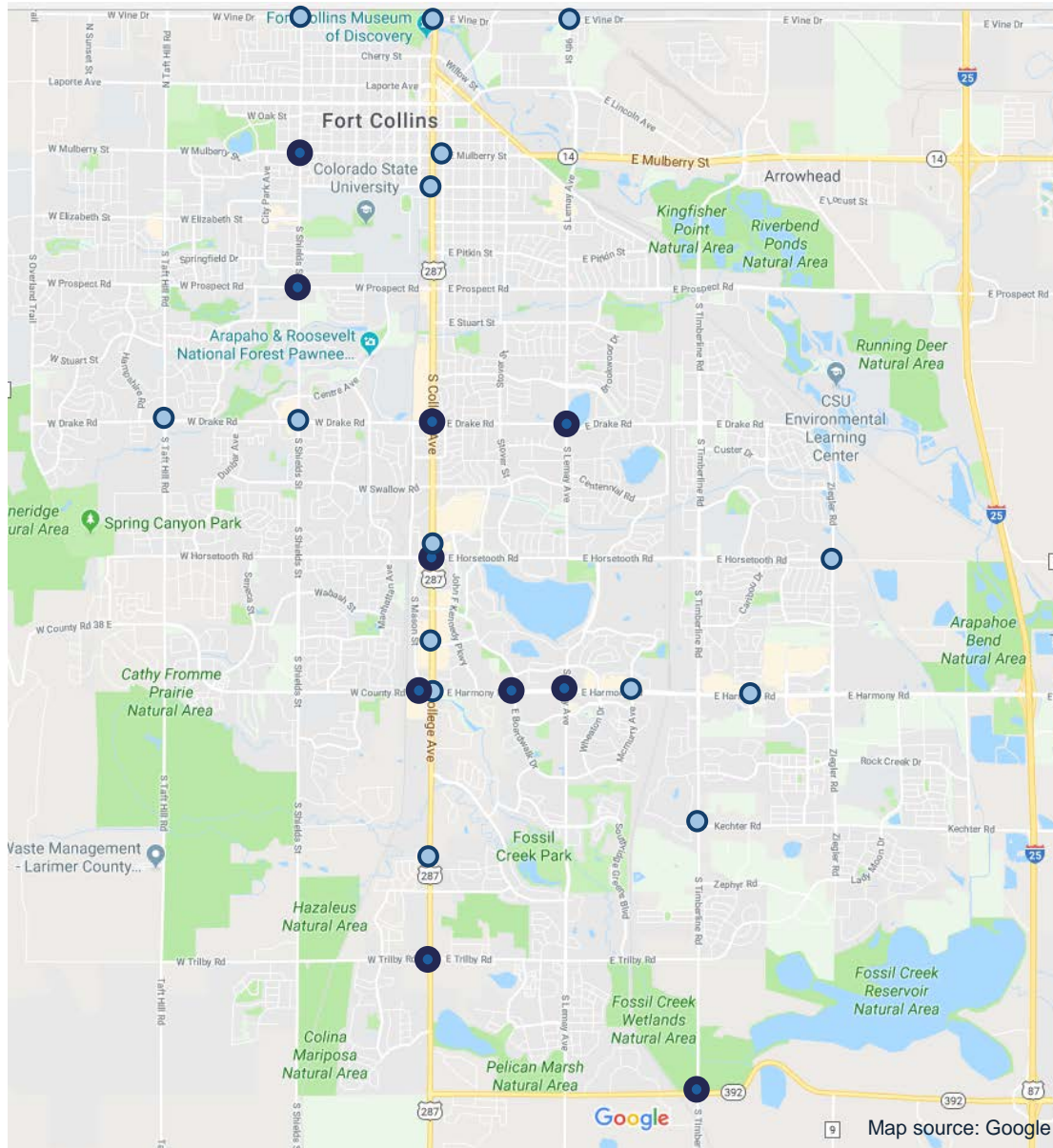


Figure 49
Map of intersections with most excess crash costs (2016-2018)

- Top 10 Intersections with most excess crash costs
- Next 15 Intersections with most excess crash costs

Maps, Trends and Patterns

In addition to identifying intersections with higher than expected crash numbers and severity, a review of maps, trends and patterns is helpful.

GIS Based Data

Crash information is geo-coded and can be evaluated through mapping efforts. This allows for a visual depiction of crash numbers at specific locations or along corridors. Maps can be created for specific crash types such as bicycle or pedestrian crashes.

Care should be taken to understand that 'hot spots' on the maps are simple number based, and neither correlated to volumes, nor necessarily indicative of statistically based higher than expected crash locations. The maps may be best used to target enforcement areas.



Example of Map.
Visit fcgov.com/traffic for maps

The heat maps of overall crashes as well as a few of the most prevalent severe crash types (bicycle, right angle, approach turn, and pedestrian) are posted to the City's Traffic Operations safety page at fcgov.com/traffic. Other maps can be created on request.

Changes in Excess Crash Costs

Intersection screening in the City has been done since 2009. Reviewing the trends of excess crash costs can identify changing conditions and safety at specific locations. The tables below indicate the intersections with significant changes in excess crash costs, both positively and negatively. The comparison was made using the last six years of data (2013-2018). Excess crash cost for three years of data (2013-2015) and again (2016-2018) were compared.

Table 7

Intersections with largest decreasing crash costs (i.e. less crashes) 2013/2015 and 2016/2018

Intersections with improving safety trends

Intersection		2013 - 2015 Excess Crashes & Cost			2016 - 2018 Excess Crashes & Cost			Changes in Excess Crashes & Cost		
North/South Street	East/West Street	PDO / year	FI / year	Excess Expected Crash Value (\$)	PDO / year	FI / year	Excess Expected Crash Value (\$)	PDO	FI	Excess Crash Cost
Lemay	Prospect Rd	2.15	0.52	\$79,030	-4.59	-3.10	-\$527,305	-6.74	-3.61	-\$606,334
Timberline Rd	Drake Rd	-6.42	1.79	\$135,098	-2.72	-1.18	-\$210,843	3.70	-2.96	-\$345,941
College Av	Prospect Rd	3.03	-0.13	\$15,454	-1.66	-1.73	-\$285,179	-4.69	-1.60	-\$300,633
Lemay	Riverside	2.50	1.28	\$167,750	-0.38	-0.83	-\$131,498	-2.88	-2.10	-\$299,248
College Av	Maple/Jefferson	2.44	-0.45	-\$26,330	-2.85	-1.89	-\$321,798	-5.29	-1.43	-\$295,469
Timberline Rd	Harmony Rd	-9.76	-0.66	-\$171,331	-8.81	-2.39	-\$462,505	0.95	-1.73	-\$291,174
JFK	Harmony Rd	3.40	0.45	\$84,014	-2.71	-1.11	-\$199,724	-6.11	-1.55	-\$283,738
Riverside Av	Prospect Rd	2.19	0.21	\$45,700	0.45	-1.22	-\$184,334	-1.74	-1.44	-\$230,034
Lemay	Horsetooth (West)	0.66	2.09	\$239,779	2.23	0.13	\$44,493	1.58	-1.95	-\$195,286
Timberline Rd	Horsetooth Rd	2.84	0.04	\$32,483	-3.76	-0.79	-\$161,157	-6.60	-0.82	-\$193,639
Timberline	Lincoln	4.03	0.46	\$91,534	-1.31	-0.51	-\$93,377	-5.33	-0.97	-\$184,911
Timberline Rd	Timberwood	-5.35	-0.34	-\$91,316	-4.52	-1.47	-\$275,638	0.82	-1.13	-\$184,322
Corbett	Harmony Rd	4.00	-0.40	-\$4,759	-1.45	-0.97	-\$164,536	-5.46	-0.56	-\$159,777
College	Triangle	0.26	0.93	\$105,916	-1.19	-0.26	-\$53,186	-1.45	-1.19	-\$159,102
College Av	Fossil Creek	1.91	0.22	\$44,133	-2.60	-0.54	-\$111,493	-4.52	-0.77	-\$155,626

FI = Fatal / Injury Crashes
PDO = Property Damage Only Crashes

Intersections with increasing crash trends

Intersection		2013 - 2015 Excess Crashes & Cost			2016 - 2018 Excess Crashes & Cost			Changes in Excess Crashes & Cost		
North/South Street	East/West Street	PDO/ year	FI/ year	Excess Expected Crash Value (\$)	PDO/ year	FI/ year	Excess Expected Crash Value (\$)	PDO	FI	Excess Crash Cost
College Av	Horsetooth Rd	3.770	3.490	\$427,169	10.357	6.088	\$1,050,393	6.587	2.598	\$623,224
Lemay	Drake Rd	-0.090	-1.401	-\$157,228	0.679	2.928	\$459,568	0.769	4.329	\$616,795
Shields St	Mulberry St	1.486	-0.224	-\$10,181	2.815	2.140	\$360,534	1.328	2.365	\$370,714
Taft Hill Rd	Drake Rd	6.171	-1.638	-\$121,068	9.354	0.572	\$187,592	3.183	2.210	\$308,659
Mason St	Harmony Rd	11.769	0.809	\$207,982	13.377	2.402	\$512,943	1.608	1.593	\$304,961
Shields St	Prospect Rd	-0.397	0.724	\$76,841	4.488	2.003	\$357,060	4.885	1.279	\$280,220
Lemay	Harmony Rd	6.332	1.235	\$201,193	6.376	2.576	\$465,537	0.044	1.340	\$264,343
College Av	Drake Rd	7.392	-0.025	\$71,136	0.881	2.049	\$325,976	-6.511	2.074	\$254,840
McMurry	Harmony Rd	-0.569	-0.588	-\$71,335	1.796	0.974	\$169,549	2.365	1.562	\$240,885
Boardwalk Dr	Harmony Rd	4.160	1.269	\$183,207	8.814	2.100	\$417,952	4.653	0.832	\$234,745
Ziegler	Horsetooth	2.863	0.119	\$77,309	11.004	0.242	\$309,428	8.141	0.123	\$232,119
Remington	Mulberry St	-0.988	-0.009	-\$10,906	1.910	1.166	\$200,344	2.897	1.175	\$211,250
College Av	Laurel	5.844	0.310	\$92,993	7.284	1.411	\$295,132	1.440	1.101	\$202,139
Taft Hill Rd	Prospect Rd	-2.254	-0.552	-\$84,166	1.205	0.583	\$102,885	3.459	1.135	\$187,051
College	Smokey	-0.175	-0.009	-\$2,733	0.758	1.117	\$180,624	0.933	1.126	\$183,357
College Av	Vine	0.134	0.165	\$19,720	-0.140	1.259	\$193,035	-0.274	1.094	\$173,314
Welch	Prospect	-2.227	-1.183	-\$154,316	0.000	0.120	\$18,504	2.227	1.303	\$172,820
Shields	Laurel	-4.307	-1.271	-\$184,932	0.505	-0.136	-\$15,624	4.813	1.135	\$169,308
College Av	Harmony Rd	7.346	-0.928	-\$30,095	8.011	0.329	\$135,774	0.665	1.257	\$165,869
Taft Hill Rd	Mulberry St	-1.748	-0.145	-\$33,623	2.108	0.690	\$128,915	3.857	0.834	\$162,538
College	Mason/Palmer	0.317	-0.682	-\$72,904	-0.018	0.563	\$86,788	-0.335	1.245	\$159,692

FI = Fatal / Injury Crashes

PDO = Property Damage Only Crashes

Note that in locations with few crashes, a single severe crash (especially a fatality) can create a pronounced swing in excess crash costs. Therefore, each location should be reviewed in more detail to determine contributing factors to either improved safety or concern and whether a specific mitigation or trend is present that could explain the change.

Interesting finds include that intersections rebuilt with capital projects tend to see a safety improvement (College / Prospect, and Timberline/Horsetooth). The next large capital project is slated for College / Trilby.

Table 8

Intersections with largest increasing crash costs (i.e. more crashes) 2013/2015 and 2016/2018

Recognizing Patterns in Crash Types

The table below identifies intersections where a pattern of crash types are identifiable and the total number of this type of crash in three years (2016-2018). Only intersections with at least three crashes in three years (average 1/yr) are included. The analysis is a statistical analysis developed by the Colorado Department of Transportation. Some intersections may be listed in more than one category. For instance, Remington and Prospect is listed under both Bicycle crashes and Red Light Running crashes, the causes of which may be related. This more detailed information about patterns of crashes can aid in pin-pointing mitigation measures.

Approach Turn			Rear End		
College	Troutman	28	College	Harmony	115
College	Trilby	27	Lemay	Harmony	100
Shields	Horsetooth	23	Timberline	Harmony	90
Snow Mesa	Harmony	18	Boardwalk	Harmony	84
College	Mason / Palmer	15	Timberline	Prospect	84
Ziegler	Council Tree	10	College	Monroe	69
Lemay	Carpenter	10	College	Laurel	67
Lemay	Magnolia	10	Riverside	Mulberry	56
College	Plum	6	McMurry	Harmony	45
Shields	Bennett	4	Timberline	Kechter	41
Riverside	Magnolia	4	Shields	Trilby	33
Cook	Mulberry	4	Lady Moon	Harmony	31
Right Angle			College	Fossil Creek	17
Meldrum	LaPorte	13	Tulane	Drake	14
Mathews	Mulberry	13	Taft Hill	Lake	13
College	Kensington	13	College	Oak	12
Mason	Magnolia	12	Sherwood	Laurel	9
Linden	Vine	12	Pedestrian		
Stanford	Horsetooth	12	Remington	Mulberry	4
Shields	Vine	9	Howes	Laurel	3
JFK	Horsetooth	9	Single Vehicle		
Overland	Elizabeth	8	Timberline	Harmony	13
Peterson	Mulberry	8	Timberline	Custer	7
Larkbunting	Harmony	7	Shields	Davidson	5
Giddings	Richards Lake	7	Remington	Laurel	4
JFK	Boardwalk	7	Shields	Vine	4
Taft Hill	Valley Forge	7	Snow and Ice		
Remington	Prospect	7	Taft Hill	Drake	14
Lochwood	Horsetooth	4	Tradition	Horsetooth	3
Remington	Elizabeth	6	Red Light Running		
Lady Moon	Kechter	4	College	Kensington	13
Bicycle			College	Cherry	12
City Park	Elizabeth	6	Remington	Prospect	9
Remington	Laurel	5	Stanford	Horsetooth	9
Remington	Prospect	5	Taft Hill	Valley Forge	7
Timberline	Custer	5	JFK	Boardwalk	7
Shields	Pitkin	4	Lemay	Oakridge	6
Raintree	Drake	4	Whedbee	Mulberry	5
Impala/Pond.	Mulberry	3	Lady Moon	Kechter	4
Shields	University	3			

Table 9

Intersections with higher than expected particular crash types (and total number of that type of crash in three years) (2016-2018)

Note that just because an intersection is listed above doesn't automatically indicate a concern. Some of these locations may have low crash volumes, and a few crashes could create a 'trend'. Each location should be evaluated further for determination of safety concerns.