

Technical Memorandum

Project: Vehicle Crimes in the City of Hamilton				
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Subject: Spatial Statistics				
Date: February 8, 2015	Deliverable 4A			

1. Introduction

The city of Hamilton has an estimated population of 504,560. As a result of its large population, crime is quite rampant. What makes Hamilton unique in comparison to other metropolitan areas in Canada, is that the Hamilton Police Service posts all of the reported crimes in the city online. Every posted crime has the following information. The type of crime and specific name/charge, the incident number, the date and time at which the crime occurred, and the address of the crime. The information on crimes can be accessed online via the Hamilton Police Service website. The statistical information can be viewed via a map of the city of Hamilton or a list/data grid.

The following technical memorandum provides an initial statistical analysis of all of the motor vehicle theft crimes which occurred in the city of Hamilton between the dates of January 1 and February 7 for the year 2015. There are three separate and distinct motor vehicle theft crimes and they are theft of a truck, theft of an automobile, or theft under or equal to \$5,000 from a motor vehicle. Between the dates of January 1 and February 7, 204 motor vehicle theft crimes were reported. Of the 204 reported crimes, 39 were theft of an automobile, 38 were for theft of a truck, and 127 were theft under or equal to \$5,000 from a motor vehicle.

Activities completed as a part of this initial statistical analysis of motor vehicle theft crimes in Hamilton include:

- A formal study area layout
- A formal map showing the crime point locations
- A table of locations (northing/easting) versus 'z' values
- Histograms for the x, y, and z value data
- A statement of the mean, median, and standard deviation for all of the data
- A description of the data collection methodology
- Plus additional commentary about the distribution of the data values and their validity

2. Study Area

For the statistical analysis of motor vehicle theft crimes in the city of Hamilton the study area was chosen to be a rectangular area with a length of 30.62 kilometers and a width of 15.93 kilometers. The



study area has a total area of 487.78 kilometers squared. The study area encloses Dundas in the west, Stoney Creek in the east, and Mount Hope in the south. The Burlington Skyway of the Queen Elizabeth Way highway is not a part of the study area, as the northern border of the study area runs along the southern end of the Skyway. The center of the study area is downtown Hamilton/Hess Village. As a result of the use of the rectangular study area, 4 vehicle theft crimes from the initial list of data were omitted, as they did not fall within the area of study.

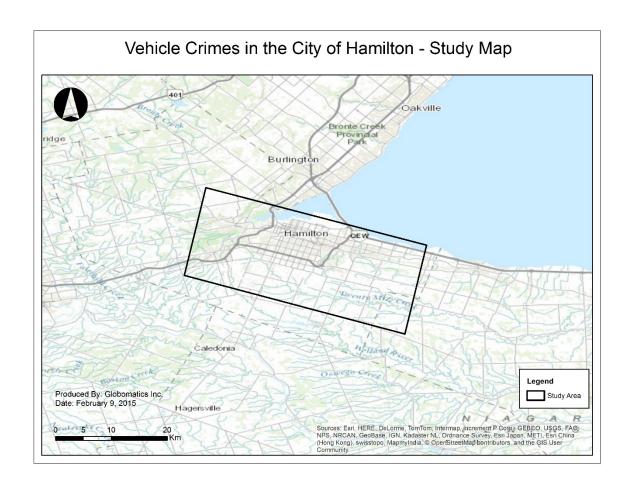
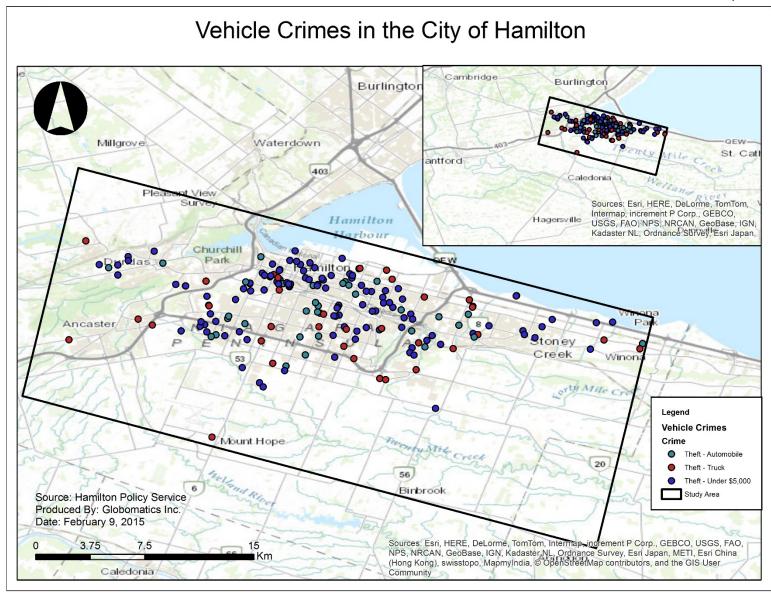


Figure 1 - Study Area Map





_Figure 2 - Plotted raw data



3. Methodology

Vehicle crime data was derived from the Hamilton Police Service online Crime Mapping. Within the collected data was location in the form of an address, along with the date and time that each vehicle crime took place. The location data however, is classified material, so the location belonging to the respective criminal act lies within a block radius of the calculated location.

Supplied by the Hamilton Police was the Street name along with the number of digits for the street number (example: XX Bay St. S was the given address). This address was then imported into google maps, where the XX was replaced with "50" and this generated the recorded latitude and longitude. These latitude and longitude were then imported into ArcMap using the Nad83 coordinate system, spatially displaying the events with the time of event as the Z values.

The Hamilton Police provided the event-time in a 24 hour format. When trying to do statistical analysis on time data through excel, it was noticed that excel does not account for hours at the end of the day are similar to the hours at the start of the day. For example 23:59 in reality is only 2 minutes away from 00:01, however excel calculates it as a difference of 23:58. To calculate statistics on the time values, the time was then calculated into decimals with 0.0 as midnight, 0.5 being 12:00pm (noon) and 0.999 as 23:59pm. The next step was to represent the likeness between midnight (0.00) and 01:00. If the event-time was past 0.5 (12:00) the value was then subtracted by one giving a negative value with 23:00 now, -0.04167, much similar to 0:00 as in reality (See Table 1 for calculated time values).

Table 1 - Time vs. Calculated time used for statistical analysis

Time	13:00	18:00	21:00	0:00	3:00	6:00	9:00	12:00
Calculated Time	-0.45833	-0.25	-0.125	0	0.125	0.25	0.375	0.5

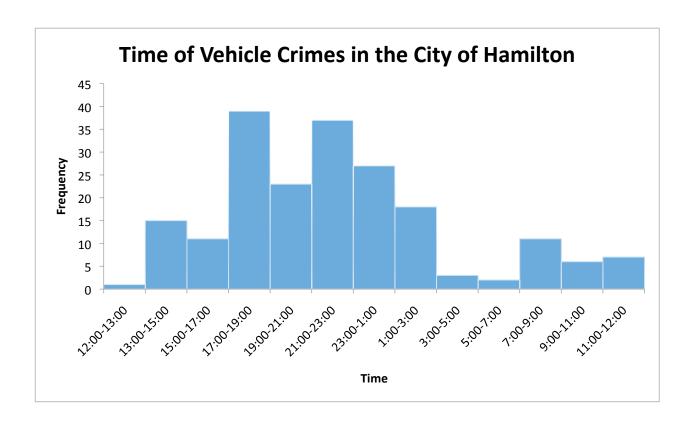
4. Preliminary Statistical Analysis

Preliminary analysis show that most of vehicle-based crimes happen occur between 17:00 and 03:00 with a negative skew to the otherwise fairly normal distribution. The mean event time was calculated to be 22:16 with a standard deviation of 5 hours and 35 minutes with a corresponding mode to be 22:00 (Table 2). The mean latitude and longitude laid southeast of Hamilton's downtown core, located at -79.8475, 43.23736 with standard deviations of 0.0653 and 0.0216, respectively.



Table 2 - Summary of raw data

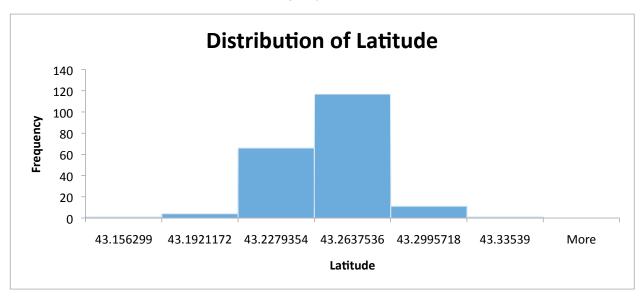
	Calculated Time	Longitude	Latitude
SD	5:35	0.0653	0.0216
Mean	14:50	-79.8475	43.23736
Median	17:05	-79.8527	43.23789
Mode	22:00	-79.876	43.2599

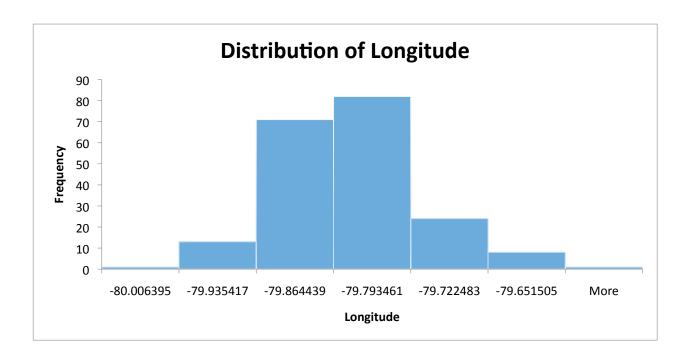


The above histogram lists frequency of the time at which each vehicle theft crime occurred in the city of Hamilton. As most of the crimes occurred in the evening and early morning, the graph's middle was chosen to be midnight, with either end representing noon of separate days. The information is positively skewed.



The following two histograms display the distribution and frequency of the latitude and longitude coordinates used to pinpoint the location of where each of the vehicle theft crimes occurred in Hamilton. In both histograms, the data is uniformly distributed. The middle three bins on both histograms have the highest frequencies. This makes sense, as these coordinates correlate to the location of downtown Hamilton, where the majority of the crimes occurred.







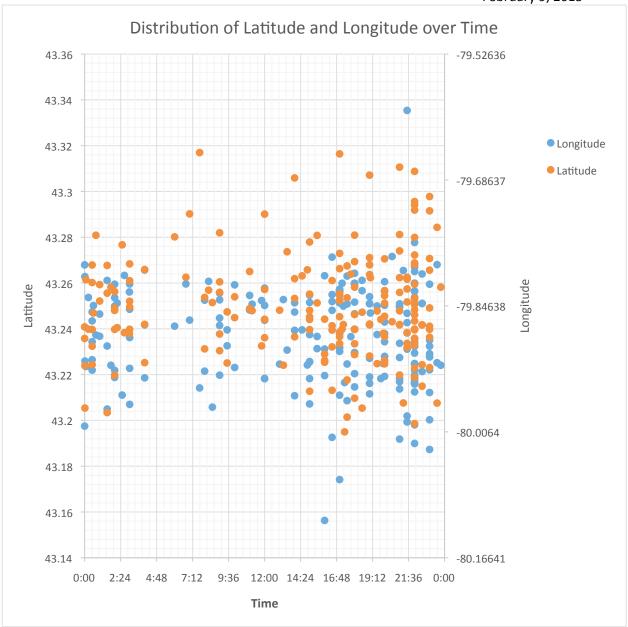
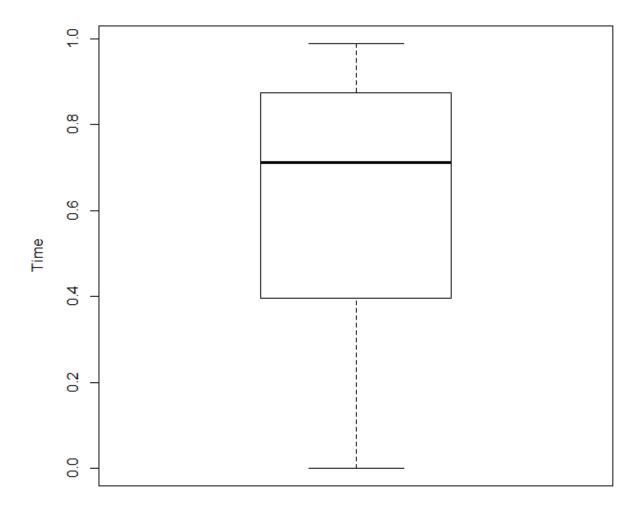


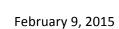
Figure 6 - Scatterplot of Latitude/Longitude vs. Time

The above scatterplot lists all of the longitude and latitude points used to pinpoint the location of where each vehicle theft crime occurred, along with the time at which each crime occurred. The scatterplot shows the distribution of the latitude coordinates over time and the distribution of the longitude coordinates over time.



The following boxplot shows the distribution of time at which the vehicle theft crimes occurred in the city of Hamilton. If there were any outliers with the data, they would be visible here. However, there were no outliers with the data collected. The points 0.0 and 1.0 both on the boxplot both represent midnights of separate days. The median of the boxplot was found to be roughly 0.7 or 2:50 PM.







Bibliography

Hamilton Police Services. (2015). RAIDS Online: Regional Analysis and Information Sharing. Retrieved February 4, 2015, from

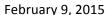
 $http://www.raidsonline.com/?address=Hamilton, ON\&crimeTypes=[1,6,7,10,11,16,17]\&startDate=14\&z\\oom=12$



Appendix

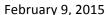
Table 3 - Raw Data

ID	Northings	Eastings	Time	Crime
1	43.33539	-79.809922	21:30	Theft - under \$5000
2	43.24271	-79.812286	21:30	Theft - under \$5000
3	43.253709	-79.875873	0:15	Theft - under \$5000
4	43.252521	-79.835566	8:00	Theft - Auto
5	43.192599	-79.81413	16:30	Theft - Truck
6	43.260597	-79.826944	20:00	Theft - Auto
7	43.249444	-79.870018	21:00	Theft - under \$5000
8	43.224838	-79.92534	22:00	Theft - under \$5000
9	43.221346	-79.921104	22:30	Theft - under \$5000
10	43.227703	-79.924714	23:00	Theft - under \$5000
11	43.225923	-79.922514	0:01	Theft - under \$5000
12	43.246446	-79.819266	1:00	Theft - under \$5000
13	43.21957	-79.915476	16:00	Theft - Auto
14	43.229651	-79.90824	18:00	Theft - Auto
15	43.234343	-79.816661	0:30	Theft - under \$5000
16	43.204954	-79.830166	1:30	Theft - Truck
17	43.260738	-79.826324	8:16	Theft - Truck
18	43.232597	-79.918906	9:30	Theft - under \$5000
19	43.239348	-79.811731	14:00	Theft - under \$5000
20	43.23748	-79.852182	15:00	Theft - Auto
21	43.263193	-79.863203	16:00	Theft - under \$5000
22	43.191832	-79.810515	21:00	Theft - Truck
23	43.233083	-79.851196	22:00	Theft - Truck
24	43.253605	-79.849084	2:00	Theft - under \$5000
25	43.214642	-79.790104	18:00	Theft - Truck
26	43.22041	-79.756452	18:00	Theft - under \$5000



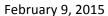


				February 9, 20
27	43.216189	-79.785034	19:00	Theft - under \$5000
28	43.213726	-79.776431	21:00	Theft - under \$5000
29	43.238189	-79.824753	21:30	Theft - under \$5000
30	43.234199	-79.818707	22:00	Theft - under \$5000
31	43.263962	-79.948341	22:30	Theft - Auto
32	43.232415	-79.848894	23:00	Theft - Truck
33	43.232483	-79.794899	1:30	Theft - under \$5000
34	43.219746	-79.75343	9:00	Theft - Truck
35	43.25077	-79.852377	11:10	Theft - under \$5000
36	43.230723	-79.777533	13:30	Theft - Auto
37	43.25129	-79.894433	17:00	Theft - Auto
38	43.236583	-79.80599	17:45	Theft - under \$5000
39	43.265034	-79.865559	22:00	Theft - under \$5000
40	43.2221	-79.725555	23:00	Theft - under \$5000
41	43.259613	-79.809906	6:45	Theft - Truck
42	43.24381	-79.729419	7:00	Theft - under \$5000
43	43.205799	-79.842087	8:31	Theft - under \$5000
44	43.24472	-79.829075	9:00	Theft - Auto
45	43.230149	-79.799064	17:00	Theft - under \$5000
46	43.22464	-79.83604	17:30	Theft - under \$5000
47	43.229368	-79.963604	18:00	Theft - Truck
48	43.22747	-79.670017	21:00	Theft - under \$5000
49	43.246796	-79.893973	21:30	Theft - under \$5000
50	43.229117	-79.707363	23:00	Theft - under \$5000
51	43.212183	-79.786157	23:00	Theft - Auto
52	43.225202	-79.746508	23:30	Theft - under \$5000
53	43.261137	-79.981945	1:30	Theft - Auto
54	43.24374	-79.72973	12:00	Theft - under \$5000
55	43.25152	-79.876479	15:00	Theft - under \$5000
56	43.246543	-79.822524	18:00	Theft - under \$5000
57	43.229388	-79.793725	22:00	Theft - under \$5000



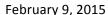


				February 9, 20
58	43.249866	-79.934355	2:00	Theft - under \$5000
59	43.211055	-79.768735	2:30	Theft - Truck
60	43.241164	-79.758627	6:00	Theft - Truck
61	43.259211	-79.86122	10:00	Theft - under \$5000
62	43.231806	-79.839303	17:00	Theft - under \$5000
63	43.237851	-79.839583	17:00	Theft - under \$5000
64	43.23113	-79.841361	21:30	Theft - under \$5000
65	43.226489	-79.89755	0:30	Theft - Auto
66	43.250155	-79.855335	0:35	Theft - Auto
67	43.263342	-79.880473	2:39	Theft - under \$5000
68	43.221516	-79.900947	8:00	Theft - under \$5000
69	43.225496	-79.765146	15:00	Theft - Auto
70	43.224659	-79.713742	22:00	Theft - under \$5000
71	43.216449	-79.675402	22:00	Theft - Truck
72	43.23676	-79.840177	1:00	Theft - under \$5000
73	43.25126	-79.873973	2:10	Theft - Auto
74	43.236188	-79.840443	3:00	Theft - under \$5000
75	43.218263	-79.863527	12:00	Theft - under \$5000
76	43.218263	-79.863527	15:00	Theft - Truck
77	43.254736	-79.831376	15:00	Theft - under \$5000
78	43.254798	-79.860077	17:00	Theft - under \$5000
79	43.257788	-79.886771	12:00	Theft - under \$5000
80	43.249943	-79.870015	17:15	Theft - under \$5000
81	43.250923	-79.870457	19:00	Theft - Automobile
82	43.211596	-79.794132	19:00	Theft - Under \$5,000
83	43.250923	-79.870457	21:00	Theft - Automobile
84	43.22274	-79.814299	3:00	Theft - under \$5000
85	43.248207	-79.802641	11:00	Theft - under \$5000
86	43.208611	-79.795525	17:30	Theft - Under \$5,000
87	43.201904	-79.880372	21:30	Theft - Truck
88	43.200257	-79.872169	23:00	Theft - Automobile



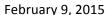


				February 9, 20
89	43.21876	-79.852047	2:00	Theft - Automobile
90	43.256917	-79.879774	17:00	Theft - Truck
91	43.251023	-79.869366	19:00	Theft - Under \$5,000
92	43.265683	-79.869789	4:00	Theft - Under \$5,000
93	43.255605	-79.88206	9:00	Theft - Under \$5,000
94	43.224591	-79.851811	13:00	Theft - Truck
95	43.227977	-79.915598	20:00	Theft - Under \$5,000
96	43.189938	-79.888495	22:00	Theft - Under \$5,000
97	43.224087	-79.822514	23:45	Theft - Under \$5,000
98	43.267938	-79.887702	0:00	Theft - Automobile
99	43.206996	-79.792981	3:00	Theft - Under \$5,000
100	43.239543	-79.853951	9:30	Theft - Automobile
101	43.251675	-79.894486	18:00	Theft - Under \$5,000
102	43.219234	-79.84301	20:00	Theft - Under \$5,000
103	43.198058	-79.79167	22:00	Theft - Truck
104	43.224087	-79.822514	1:45	Theft - Under \$5,000
105	43.24808	-79.898415	16:30	Theft - Under \$5,000
106	43.256445	-79.885393	17:00	Theft - Under \$5,000
107	43.218977	-79.910062	19:00	Theft - Under \$5,000
108	43.246915	-79.810566	19:03	Theft - Under \$5,000
109	43.271603	-79.866432	20:30	Theft - Under \$5,000
110	43.233701	-79.852577	21:00	Theft - Automobile
111	43.212457	-79.836295	22:00	Theft - Truck
112	43.251071	-79.870414	22:30	Theft - Automobile
113	43.231348	-79.842532	15:30	Theft - Under \$5,000
114	43.257306	-79.832722	17:00	Theft - Under \$5,000
115	43.237929	-79.91999	20:00	Theft - Truck
116	43.265471	-79.969694	21:15	Theft - Under \$5,000
117	43.222004	-79.937059	22:00	Theft - Under \$5,000
118	43.268046	-79.969841	23:30	Theft - Under \$5,000
119	43.243462	-79.921073	0:30	Theft - Under \$5,000





				February 9, 20
120	43.237307	-79.75657	0:45	Theft - Under \$5,000
121	43.256105	-79.881515	2:59	Theft - Under \$5,000
122	43.250207	-79.82544	12:00	Theft - Under \$5,000
123	43.251085	-79.876785	22:00	Theft - Under \$5,000
124	43.247337	-79.876339	0:30	Theft - Truck
125	43.251918	-79.871571	16:30	Theft - Under \$5,000
126	43.263047	-79.987677	17:30	Theft - Under \$5,000
127	43.256477	-79.885425	20:00	Theft - Under \$5,000
128	43.216633	-79.8963	22:00	Theft - Under \$5,000
129	43.225727	-79.954816	15:00	Theft - Truck
130	43.231157	-79.907593	16:00	Theft - Automobile
131	43.251375	-79.836902	14:00	Theft - Automobile
132	43.249846	-79.934237	21:00	Theft - Under \$5,000
133	43.219136	-79.781644	22:00	Theft - Under \$5,000
134	43.187311	-79.886225	23:00	Theft - Under \$5,000
135	43.247325	-79.885634	14:00	Theft - Under \$5,000
136	43.224194	-79.80047	14:51	Theft - Under \$5,000
137	43.264255	-79.85736	18:00	Theft - Under \$5,000
138	43.242988	-79.786549	20:00	Theft - Truck
139	43.216901	-79.82921	21:00	Theft - Under \$5,000
140	43.199302	-79.899256	21:30	Theft - Under \$5,000
141	43.252658	-79.815794	9:00	Theft - Automobile
142	43.223113	-79.834822	10:00	Theft - Truck
143	43.17413	-79.779589	17:00	Theft - Under \$5,000
144	43.277712	-79.995986	22:00	Theft - Truck
145	43.218584	-79.91847	4:00	Theft - Automobile
146	43.256338	-79.830996	17:00	Theft - Under \$5,000
147	43.251103	-79.870457	22:30	Theft - Under \$5,000
148	43.197499	-79.873034	0:00	Theft - Under \$5,000
149	43.254585	-79.849864	11:00	Theft - Under \$5,000
150	43.207194	-79.860181	15:00	Theft - Automobile





				February 9, 20
151	43.259901	-79.875957	17:10	Theft - Under \$5,000
152	43.259901	-79.875957	18:00	Theft - Under \$5,000
153	43.259901	-79.875957	18:00	Theft - Automobile
154	43.259901	-79.875957	22:00	Theft - Under \$5,000
155	43.259901	-79.875957	22:00	Theft - Under \$5,000
156	43.266972	-79.837451	22:00	Theft - Under \$5,000
157	43.223523	-79.812967	0:05	Theft - Truck
158	43.21654	-80.006395	17:20	Theft - Truck
159	43.237511	-79.919743	19:30	Theft - Truck
160	43.253805	-79.857762	22:00	Theft - Under \$5,000
161	43.221885	-79.828242	2:00	Theft - Under \$5,000
162	43.210779	-79.68375	14:00	Theft - Under \$5,000
163	43.227123	-79.680123	19:00	Theft - Under \$5,000
164	43.24998	-79.852837	19:30	Theft - Under \$5,000
165	43.256443	-79.844169	22:00	Theft - Automobile
166	43.256443	-79.844169	22:00	Theft - Under \$5,000
167	43.219768	-79.724556	22:00	Theft - Under \$5,000
168	43.217863	-79.71813	22:00	Theft - Under \$5,000
169	43.214179	-79.651505	7:40	Theft - Automobile
170	43.241485	-79.903303	9:00	Theft - Under \$5,000
171	43.236657	-79.756732	15:30	Theft - Truck
172	43.271327	-79.953608	16:30	Theft - Under \$5,000
173	43.261192	-79.85435	18:30	Theft - Under \$5,000
174	43.259491	-79.876161	18:00	Theft - Under \$5,000
175	43.259491	-79.876161	18:00	Theft - Under \$5,000
176	43.259491	-79.876161	23:00	Theft - Under \$5,000
177	43.254028	-79.806485	19:00	Theft - Truck
178	43.218247	-79.755664	21:00	Theft - Automobile
179	43.259491	-79.876161	2:00	Theft - Under \$5,000
180	43.259569	-79.876043	3:00	Theft - Under \$5,000
181	43.248549	-79.847631	3:00	Theft - Under \$5,000



182	43.156299	-79.917953	16:00	Theft - Truck
183	43.239543	-79.808168	14:30	Theft - Under \$5,000
184	43.250829	-79.94043	17:30	Theft - Under \$5,000
185	43.256656	-79.976222	18:30	Theft - Under \$5,000
186	43.224779	-79.881301	19:55	Theft - Truck
187	43.250292	-79.833231	20:00	Theft - Automobile
188	43.232312	-79.759317	22:00	Theft - Automobile
189	43.211012	-79.65314	17:00	Theft - Truck
190	43.262825	-79.976158	0:01	Theft - Under \$5,000
191	43.252776	-79.921686	13:15	Theft - Truck
192	43.218263	-79.863527	19:45	Theft - Truck
193	43.234355	-79.859557	20:00	Theft - Automobile
194	43.221954	-79.794345	0:30	Theft - Automobile
195	43.241726	-79.800088	4:00	Theft - Under \$5,000
196	43.254975	-79.87702	16:30	Theft - Truck
197	43.215887	-79.887431	22:00	Theft - Truck
198	43.235042	-79.800858	23:00	Theft - Automobile
199	43.218263	-79.863527	12:00	Theft - Automobile
200	43.252376	-79.897134	11:48	Theft - Automobile