

Review of Warrant Process for Crosswalks, Pedestrian Corridors and Traffic Signals

Traffic Engineering

Roads

The City of Calgary

November 2014

1.0 BACKGROUND

This report reviews The City of Calgary's existing processes for installing pedestrian traffic control devices. The main devices used in Calgary are: signed and marked crosswalks, pedestrian corridors and traffic signals (See Photo 1, 2 and 3 below). Unique warrant processes exist for each to guide decision making. The signed and marked crosswalk and traffic signal warrant systems follow the procedures and recommendations from the Transportation Association of Canada (TAC). The warrant system used to evaluate locations for pedestrian corridors was developed by staff at the City of Calgary and has been in use for many years. Pedestrian devices, when applied correctly, both protect pedestrians and encourage walking by creating safe opportunities to cross streets. The annual budget for traffic signals and pedestrian corridors is \$2.3 million dollars.

Photo 1 – Marked and Signed Crosswalk



Photo 2 – Pedestrian Corridor



Photo 3 – Traffic Signal



The City process for installing pedestrian traffic control devices is initiated by requests it receives from citizens. Calculating warrant scores uses some common data such as traffic volumes, as well as unique data to each treatment. An example of unique data is considering pedestrian age in the pedestrian crosswalk warrant system. The specific warrant considerations are shown in Section 2.

2.0 EXISTING WARRANT PROCEDURES FOR PEDESTRIAN CROSSWALKS, PEDESTRIAN CORRIDORS AND TRAFFIC SIGNALS

2.1 Traffic Signal Warrant

Calgary has 1001 traffic signals and installs between five and ten new signals each year. Decisions on where new signals should be located are made following the Transportation Association of Canada's (TAC) warrant for Traffic Signals. The TAC signal warrant is a cumulative factor methodology which requires a combined score of 100 points to warrant a traffic signal and considers the following factors:

- Number and type of vehicle lanes;
- Speed limits;
- Bus Routes;
- Presence of medians;
- Volume and types of vehicles;
- Presence of schools/Mobility challenged persons;
- Senior's Complexes; and
- Pathway to School Central Business District.

A review of the TAC signal warrant process found that one way to increase pedestrian accessibility at intersections would be to reduce the warrant score required for the installation of a traffic signal. This approach would mean that additional intersections would qualify for the installation of signals.

Based on the existing list of intersections that is currently being tracked for potential signal installations, Table 1 identifies the number of additional traffic signals that would be warranted by lowering warrant scores.

Table 1. Impact of Reducing Warrant Scores on Traffic Signals Installation

Revised Scores	All Roadways	Liveable Streets
100 (Existing)	0	0
95	1	0
90	4	0
85	7	0
80	10	2
75	26	8
70	46	9

A review of the existing locations from the current traffic signal warrant tracking list found that for the revised warrant score of 70 points with 46 additional warranted signals, 36 are on arterial roadways, 9 are on liveable roadways, and 1 is on a collector roadway.

For each additional traffic signal, the estimated capital cost is \$300,000 and the estimated operational and maintenance cost is \$3000 annually. Table 2 summarizes the capital costs (one time) as well as the annual operational/maintenance (ongoing) of installing additional signals to meet the revised score level.

Table 2. Additional Costs to Bring System to the Revised Warrant Score – Traffic Signals

Revised Scores	All Roadways	Capital	Annual Operational Maintenance	Liveable Streets	Capital	Annual Operational Maintenance
100 (Existing)	0	\$0	\$0	0	\$0	\$0
95	1	\$300 000	\$3 000	0	\$0	\$0
90	4	\$1 200 000	\$12 000	0	\$0	\$0
85	7	\$2 100 000	\$21 000	0	\$0	\$0
80	10	\$3 000 000	\$30 000	2	\$600 000	\$6 000
75	26	\$7 800 000	\$78 000	8	\$2 400 000	\$24 000
70	46	\$13 800 000	\$130 000	9	\$2 700 000	\$27 000

2.2 Pedestrian Corridor Warrant

There are 230 pedestrian corridors in Calgary and between five and ten new corridors are installed each year. The warrant system used to evaluate locations for pedestrian corridors was developed by staff at the City of Calgary. The pedestrian corridor warrant procedure is a cumulative factor methodology that considers:

- Pedestrian volumes;
- Vehicular traffic volumes;
- Pedestrian age;
- Speed limits;
- Lane configurations;
- Presence of medians;
- Collision data; and
- Available stopping sight distance.

The required score for the installation of a pedestrian corridor is 80 points. The score was reduced from 100 points following approval of TTP2000-03.

Table 3 identifies the number of traffic signals that are warranted as well as the additional intersections that would qualify if the threshold were lowered.

Table 1. Impact of Reducing Warrant Scores on Pedestrian Corridor Installation

Revised Warrant Scores	All Roadways	Liveable Streets
80 (Existing)	0	0
75	4	1
70	10	1
65	17	3
60	40	9

The typical capital costs of pedestrian corridors are \$85,000 and the estimated operational and maintenance cost is \$100 annually. Table 4 summarizes the capital costs of installing additional signals to meet the revised score level.

Table 4. Costs to Bring System to the Revised Warrant Score – Pedestrian Corridor

Revised Scores	All Roadways	Capital	Annual Operational Maintenance	Liveable Streets	Capital	Annual Operational Maintenance
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80 (Existing)	0	\$0	\$0	0	\$0	\$0
75	4	\$340 000	\$400	1	\$85 000	\$100
70	10	\$850 000	\$1000	1	\$85 000	\$100
65	17	\$1 445 000	\$1700	3	\$255 000	\$300
60	40	\$3 400 000	\$4000	9	\$765 000	\$900

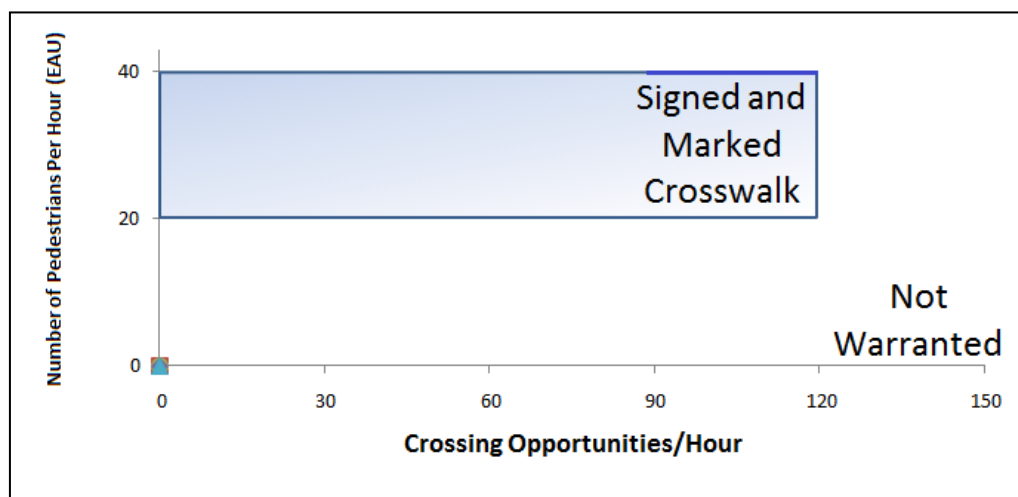
2.3 Signed and Marked Crosswalk Warrant

There are about 5000 marked crossings throughout Calgary. These are installed according to TAC's Pedestrian Crossing Control Manual (1998). The warrant model is a discrete factors methodology and specifically considers:

- Pedestrian volume;
- Pedestrian age;
- Roadway cross section; and
- Traffic volume

Traffic volumes and roadway cross sections are used to determine the number of crossing opportunities. The number (volume) and age of pedestrians is converted into equivalent adult units (EAU's). These results are then plotted (Figure 1) to determine if a signed and marked crosswalk is warranted. While pedestrian collisions are not included as a direct component of the warrant model, a review of the collision history at the proposed crossing location will also be considered in addition to the warrant model.

Figure 1: Pedestrian Crossing Warrant Model



A sensitivity analysis was conducted on the forty-seven requested signed and marked crosswalks received in 2014. This analysis was used to estimate on the number of additional signed and marked crosswalks that would need to be installed based on revised warrant threshold, see Table 5 for the result:

**Table 5. Extra Signed and Marked Crosswalk
Based on Revised Warrant Threshold**

Revised Pedestrians per hour (EAU*)	Crosswalk Warranted / Warrant Requests Received 2014	All Roadways	Capital Costs	Operational Maintenance
20 (Existing)	18 / 47 (38%)	0	\$0	\$0
18	20 / 47 (43%)	2	\$3,600	\$600
16	22 / 47 (47%)	4	\$7,200	\$1 200
14	22 / 47 (47%)	4	\$7,200	\$1 200
12	24 / 47 (51%)	6	\$10,800	\$1 800
10	24 / 47 (51%)	6	\$10,800	\$1 800

*EAU: Equivalent Adult Units

For each additional signed and marked crosswalk, the estimated capital cost is \$1,800 and the estimated annual operational and maintenance cost is \$300. Table 5 summarizes the capital costs (one time) as well as operational/maintenance (ongoing) of installing additional crosswalks to meet the revised score level, based on requests in 2014.

The number of warranted crosswalks, based on the current number of requests the traffic group receives, does not increase substantially with a lower warrant threshold. However, the cost implication can be substantial in the case that an unprecedented amount of warrant requests are received in a year.

3.0 New Devices

Two new approaches to providing pedestrian access across intersections are the Rectangular Rapid Flashing Beacon (RRFB) and ladder pavement markings. In the case of RRFB, warrant procedures are being developed by the Transportation Association of Canada and are anticipated for use in the next two years. This device is pedestrian is a pedestrian activated overhead light and costs in the order of \$40,000 per location. Ladder markings are starting to be applied in Calgary draw more attention to crossing locations.

Photo 4 – Rectangular Rapid Flashing Beacon



Photo 5 – Ladder Pavement Markings

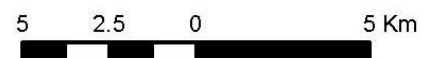
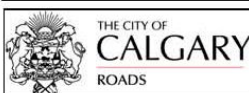
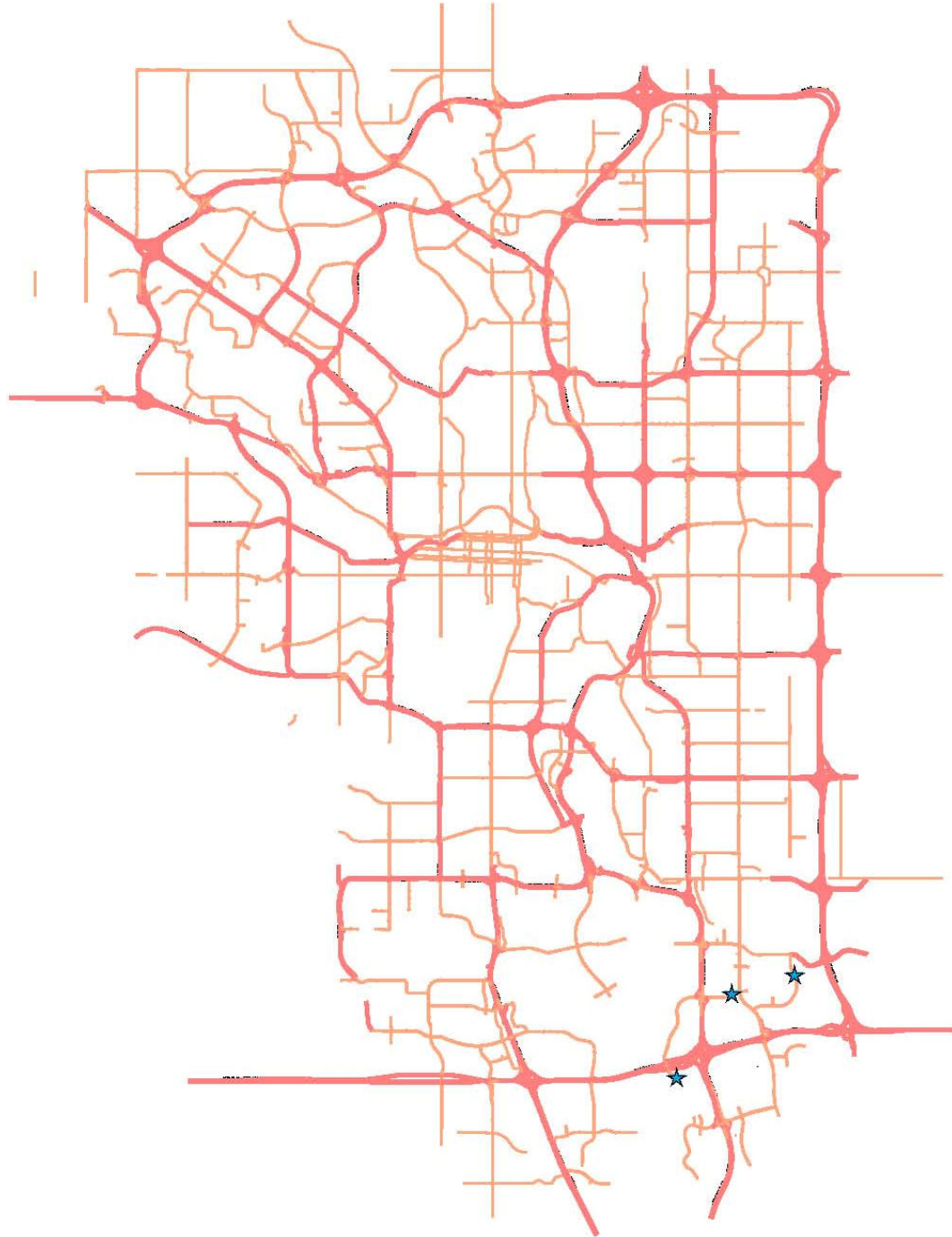


4.0 Conclusions

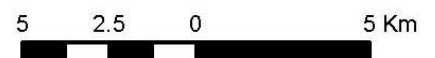
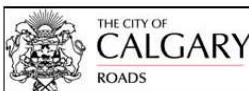
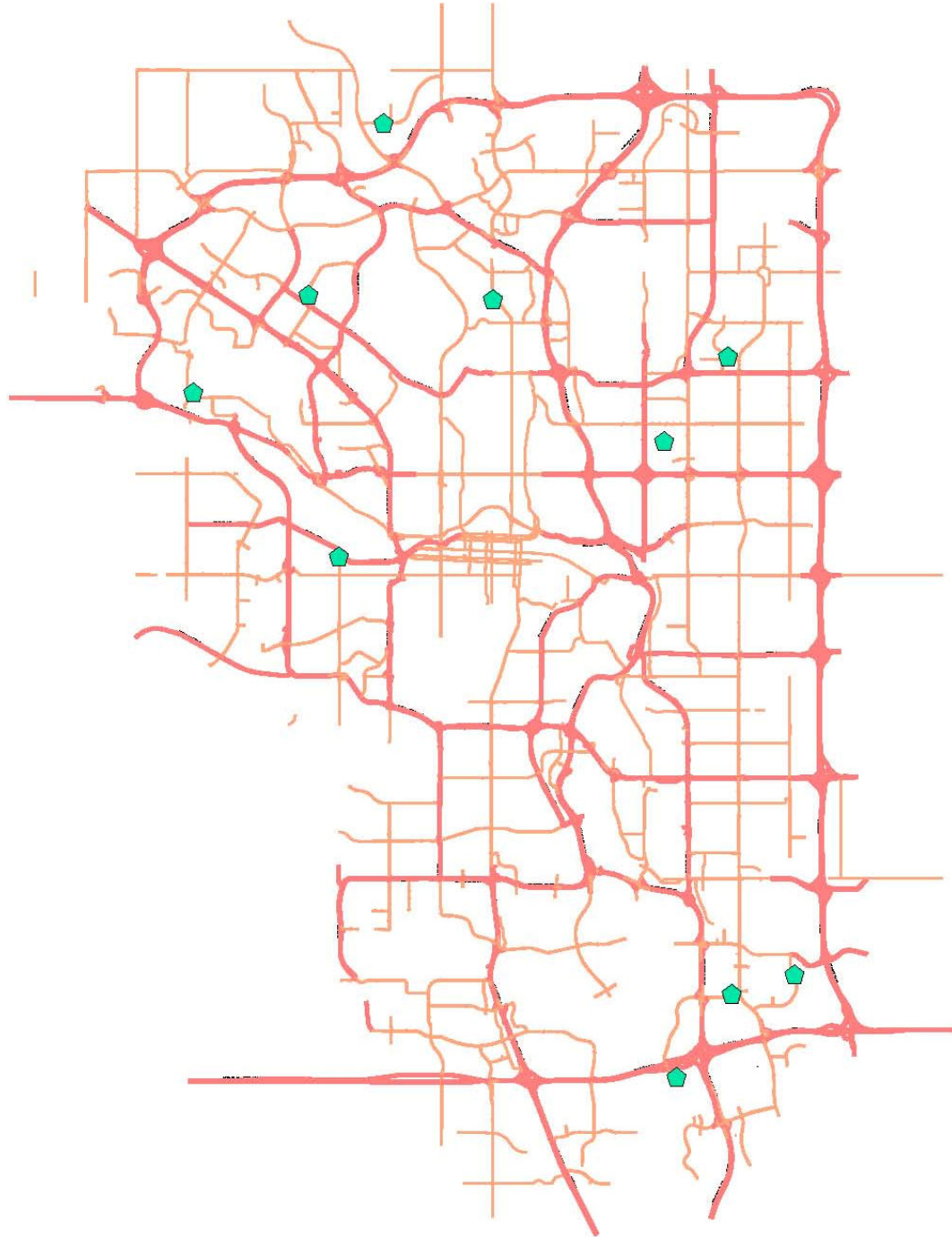
Reducing the warrant scores and thresholds of the warrant methodologies used for Traffic signals, Pedestrian Corridor Signals and Signed and Marked Crosswalks will have varying degrees of impact. The high costs of these devices mean that even significant reductions in warrant score requirements few new installations will be possible within the current budget. Wider application of new approaches – RRFB and ladder pavement markings – will improve the visibility of pedestrians at intersections. RRFB is proven to improve driver yield compliance and detailed installation guidelines are anticipated from the Transportation Association of Canada. Using the existing warrant processes will ensure installations occur according to priority.

APPENDIX A – Extra Warranted Traffic Signals based on Various Minimum Warrant Scores

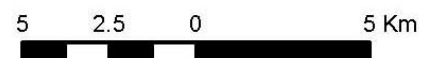
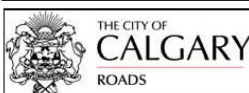
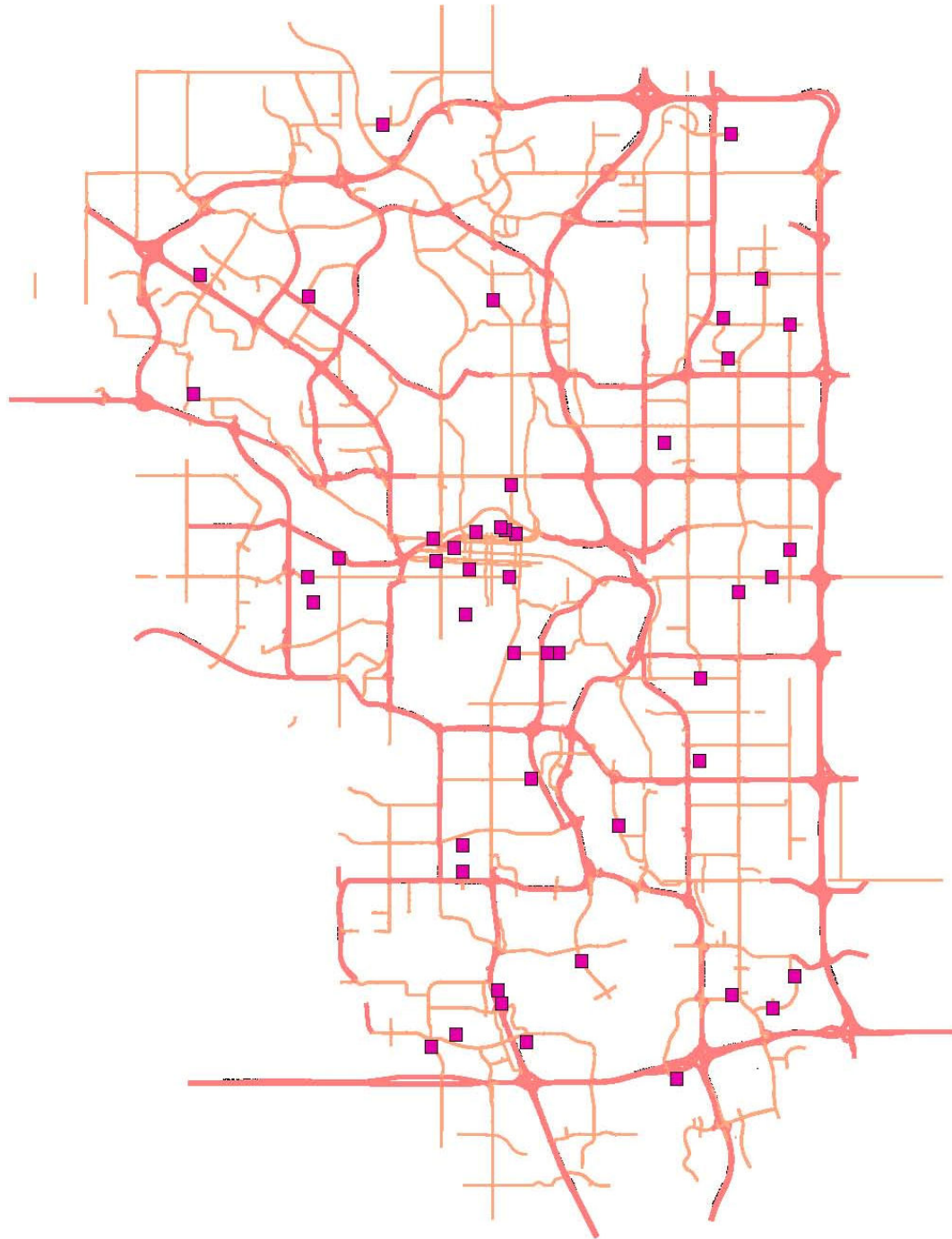
THE CITY OF CALGARY
EXTRA WARRANTED TRAFFIC SIGNALS
BASED ON A REVISED MINIMUM SCORE OF 90



THE CITY OF CALGARY
EXTRA WARRANTED TRAFFIC SIGNALS
BASED ON A REVISED MINIMUM SCORE OF 80

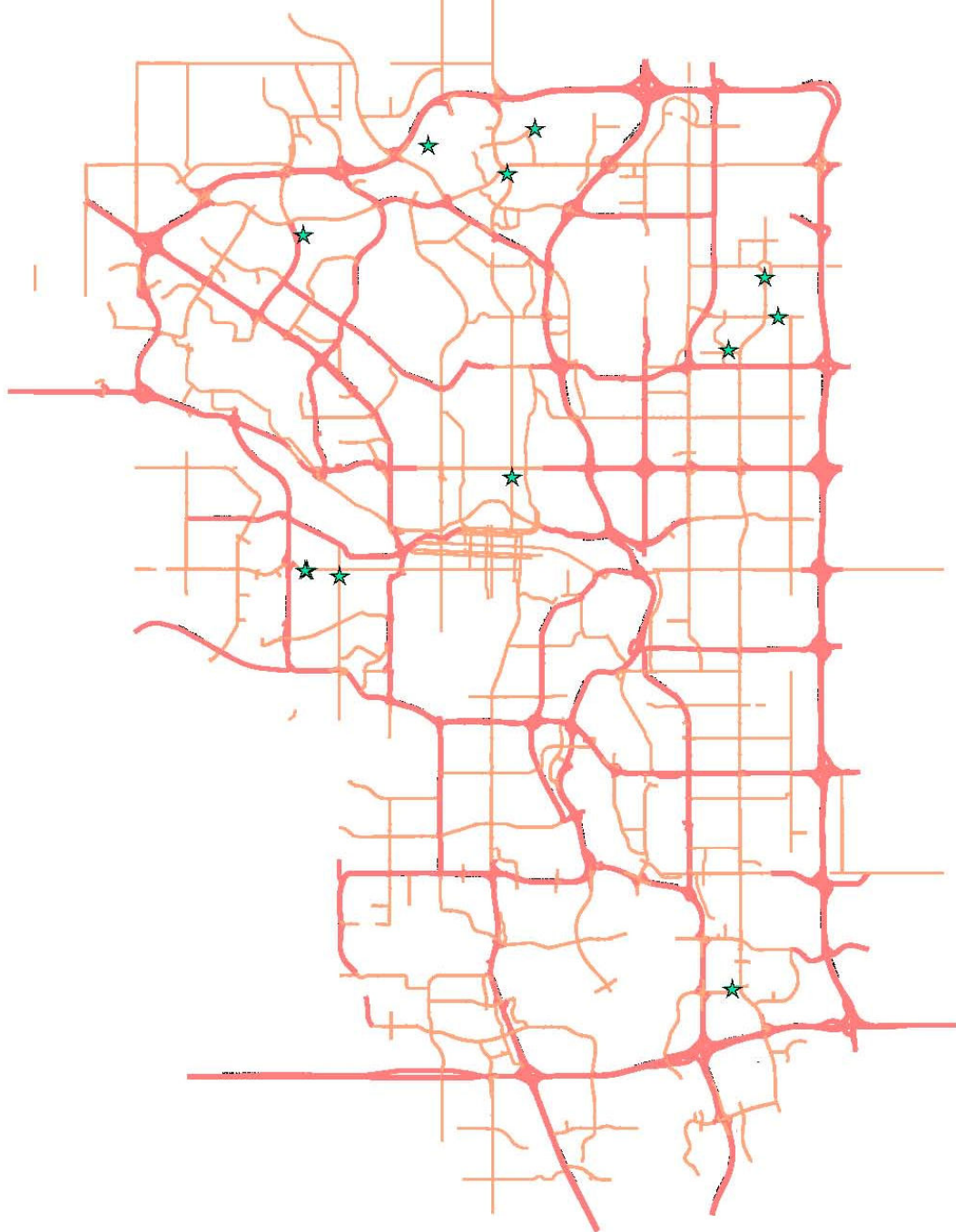


THE CITY OF CALGARY
EXTRA WARRANTED TRAFFIC SIGNALS
BASED ON A REVISED MINIMUM SCORE OF 70



APPENDIX B – Extra Warranted Pedestrian Corridors Based on Various Minimum Warrant Scores

THE CITY OF CALGARY EXTRA WARRANTED PEDESTRIAN CORRIDORS BASED ON A REVISED MINIMUM SCORE OF 70



THE CITY OF CALGARY EXTRA WARRANTED PEDESTRIAN CORRIDORS BASED ON A REVISED MINIMUM SCORE OF 60

