Attachment 2

Surface Flooding Control Strategy Report

Storm Water Management

Saskatoon Water
Transportation & Utilities Department

City of Saskatoon

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

BACKGROUND

The storm sewer in Saskatoon is designed to fill and flood onto the street during major rain events. In neighbourhoods constructed after 1989, the water in the street was accounted for as part of the design to try and limit property damage. However, many areas in Saskatoon constructed before 1989 were not designed with the same provision. Therefore, many residents are concerned about property damage as a result of a major rain event.

To add to the problem, Saskatoon has recently received more precipitation than any other similar period, dating back to 1900. This precipitation has led to an increase in ground water elevation which has caused a higher level of saturation in the soil. As well, the rainfall intensity and frequency has increased the risk of property damage in many areas of Saskatoon.

In response, the Storm Water Management Group within Saskatoon Water has developed a surface flooding control strategy. The strategy is to prioritize all the known flooding locations and investigate possible remedial options. Thirty flood zones have been assessed and the top five have been identified to address first.

INTRODUCTION

The 2007 city-wide model produced flood contours for four different storms with the following return periods: 2 year, 5 year, 10 year, and 100 year.

METHODOLOGY

Site Risk

Site Risk is an indicator of the probability that any given site will flood within a specific flood zone. For each of the flood zones, the number of residential flooded sites and the number of commercial flooded sites were counted for each of the four storms. A site was assumed to be flooded if any amount of water touched or surpassed its boundaries. As well, it should be noted that residential sites are those sites with a subclass of RES (residential), MRES (multi-residential), or COND (condominium), while commercial sites are those sites with a subclass of COMM (commercial). For this analysis, residential property is considered to be more important that commercial property. Therefore, the following formula was used to determine the total number of flooded sites within a flood zone:

$$\text{Number of Flooded Sites} = 2 \times \left(\text{Number of Residential Flooded Sites}\right) + \left(\text{Number of Commercial Flooded Sites}\right) \quad (1)$$

The above formula resulted in four values for each flood zone, one for every storm event. These values were then used in the following formula to determine the Site Risk for each storm within each flood zone:

$$\text{Site Risk} = \frac{\text{Number of Flooded Sites}}{\text{Return Period of Storm}} \quad (2)$$

This resulted in four Site Risk values for each flood zone, one for each storm event. Finally, the Site Risk for each flood zone was determined to be the largest of the four resulting values.

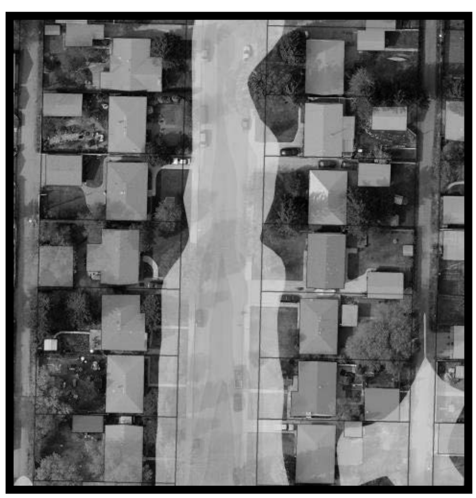

Figure 1: An example of flooded sites during a 5 year storm.

METHODOLOGY

Building Risk

Similar to Site Risk, Building Risk is an indicator of the probability that a building will flood within a specific flood zone. For each of the flood zones, the number of residential flooded buildings and the number of commercial flooded buildings were counted for each of the four storms. A building was assumed to flood if any amount of water touched or surpassed the boundaries of the building. It was also assumed that a building was residential if it was located on a site with a subclass of RES, MRES, or COND. Commercial buildings were those buildings located on sites with a subclass of COMM. Once again, this analysis assumed that residential property was more important than commercial property. Therefore, the following formula was used to determine the total number of flooded buildings within a flood zone:

$$\begin{matrix}\text{Number of}\\ \text{Flooded Buildings}\end{matrix} = 2 \times \left(\begin{matrix}\text{Number of Residential}\\ \text{Flooded Building}\end{matrix}\right) + \left(\begin{matrix}\text{Number of Commercial}\\ \text{Flooded Buildings}\end{matrix}\right) \quad (3)$$

The above formula resulted in four values for each flood zone, one for every storm event. These values were then used in the following formula to determine the Building Risk for each storm within each flood zone:

$$\text{Building Risk} = \frac{\text{Number of Flooded Buildings}}{\text{Return Period of Storm}} \quad (4)$$

This resulted in four Building Risk values for each flood zone, one for each storm event. Finally, the Building Risk for each flood zone was determined to be the largest of the four resulting values.

Figure 2: An example of flooded buildings during a 5 year storm.

METHODOLOGY

Road Risk

Throughout Saskatoon, there are eight different road types, each classified based on their importance to and impact on the public. For this analysis, each road type was assigned a value between one and eight to indicate how the public would be affected if the road was flooded. An eight indicates that the majority of the public would be affected if the road was flooded, while a one indicates that very few people would be affected if the road was flooded. This value is referred to as Road Criticality. It should be noted that a road was considered to be flooded if any amount of water was on the road. A summary of the different road types, and their corresponding Road Criticality values, can be seen below in Table 1.

Table 1: Road Type Summary

Road Type	Road Criticality
Highway	8
Expressway	7
Expressway Ramp	6
Arterial Major	5
Arterial Minor	4
Collector	3
Local	2
Grid Road	1

For each storm event, the total number of roads that experienced flooding were counted for each unique road type within each flood zone. Once this information was collected, the following formula was used to determine the Road Risk for each storm within each flood zone:

$$\text{Road Risk} = \frac{\sum (\text{Road Criticality} \times \text{Number of Flooded Roads})}{\text{Return Period of Storm}} \qquad (5)$$

This resulted in four Road Risk values for each flood zone, one for each storm event. Finally, the Road Risk for each flood zone was determined to be the largest of the four resulting values.

METHODOLOGY

Combined Risk

Finally, a Combined Risk was calculated for each of the flood zones by taking into account Building Risk, Site Risk, and Road Risk. For this analysis, each of the three risk factors were given different levels of importance. Building Risk was considered the most important since damage to a building due to flooding can be costly to fix and has a large impact on the well-being of the public. Road Risk was considered the least important since roadways constructed after 1989 are designed to convey overland flow. The following formula was used to determine the Combined Risk for each flood zone:

$$\text{Combined Risk} = (3 \times \text{Building Risk}) + (2 \times \text{Site Risk}) + \text{Road Risk} \qquad (6)$$

The following Table provides the Combined Risk for each of the thirty flood zones, as well as the resulting priority for each zone.

METHODOLOGY

Table 2: Flood Zone Risk Analysis Results

Priority	Flood Zone	Neighbourhood(s)	Combined Risk
1	Ruth - Cairns	Adelaide / Churchill	103.4
2	1st Street - Dufferin	Haultain / Buena Vista / Queen Elizabeth	80.4
3	Cascade - Dufferin	Avalon	78.4
4	Early - Tucker	Brevoort Park	64.2
5	7th Street - Cairns	Haultain / Holliston	60.4
6	24th Street - 3rd Avenue	City Park / Central Business District	56.6
7	Centennial - Dickey	Pacific Heights	53.6
8	Main - Cumberland	Varsity View / Grosvenor Park / Holliston / Haultain	49.4
9	John A MacDonald - McCully	Confederation Park	47.9
10	Junor - Makaroff	Dundonald / Westview	41.0
11	Louise - Taylor	Holliston	38.6
12	21st Street - Avenue W	Pleasant Hill / Meadowgreen / Mount Royal	38.6
13	King - 5th Avenue	City Park	38.2
14	Confederation - Laurier	Massey Place / Confed Suburban Centre / Confed Park	38.2
15	Meighen Crescent	Confederation Park	36.0
16	East - Louise	Eastview / Nutana Suburban Centre	32.2
17	Kingsmere - Brightsand	Lakeridge	32.0
18	14th Street - Cumberland	U of S South Area / Varsity View / Grosvenor Park	30.9
19	Eastview Streets	Eastview	30.2
20	Grosvenor - Taylor	Holliston	28.3
21	Eastlake - Willow	Queen Elizabeth	26.6
22	1st Avenue - 46th Street	North Industrial	22.0
23	Byers - Selkirk	Westview / Hampton Village	21.2
24	Ruth - York	Avalon / Queen Elizabeth	19.4
25	Albert - Bute	Avalon / Adelaide / Churchill	17.6
26	Idylwyld - Circle	North Industrial / Airport Business Area	17.3
27	Kingsmere - Wakaw	Lakeview	14.6
28	Smith - McCormack	Parkridge	11.0
29	1st Avenue - 50th Street	North Industrial	9.5
30	Northumberland - Mackie	Massey Place	6.6