

Implications of Future Rainfall Trends to Municipal Infrastructure

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E.M.A. of BC

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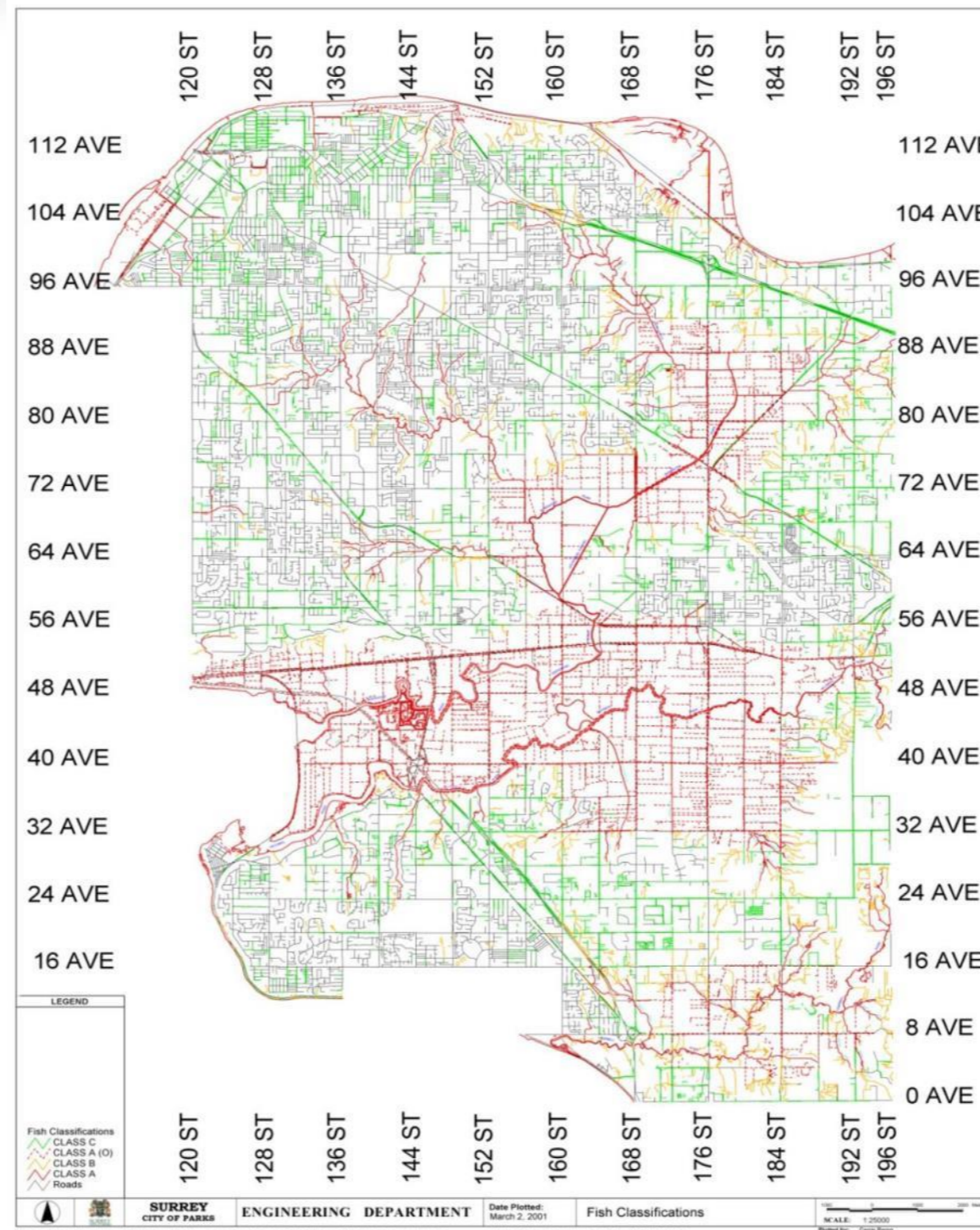
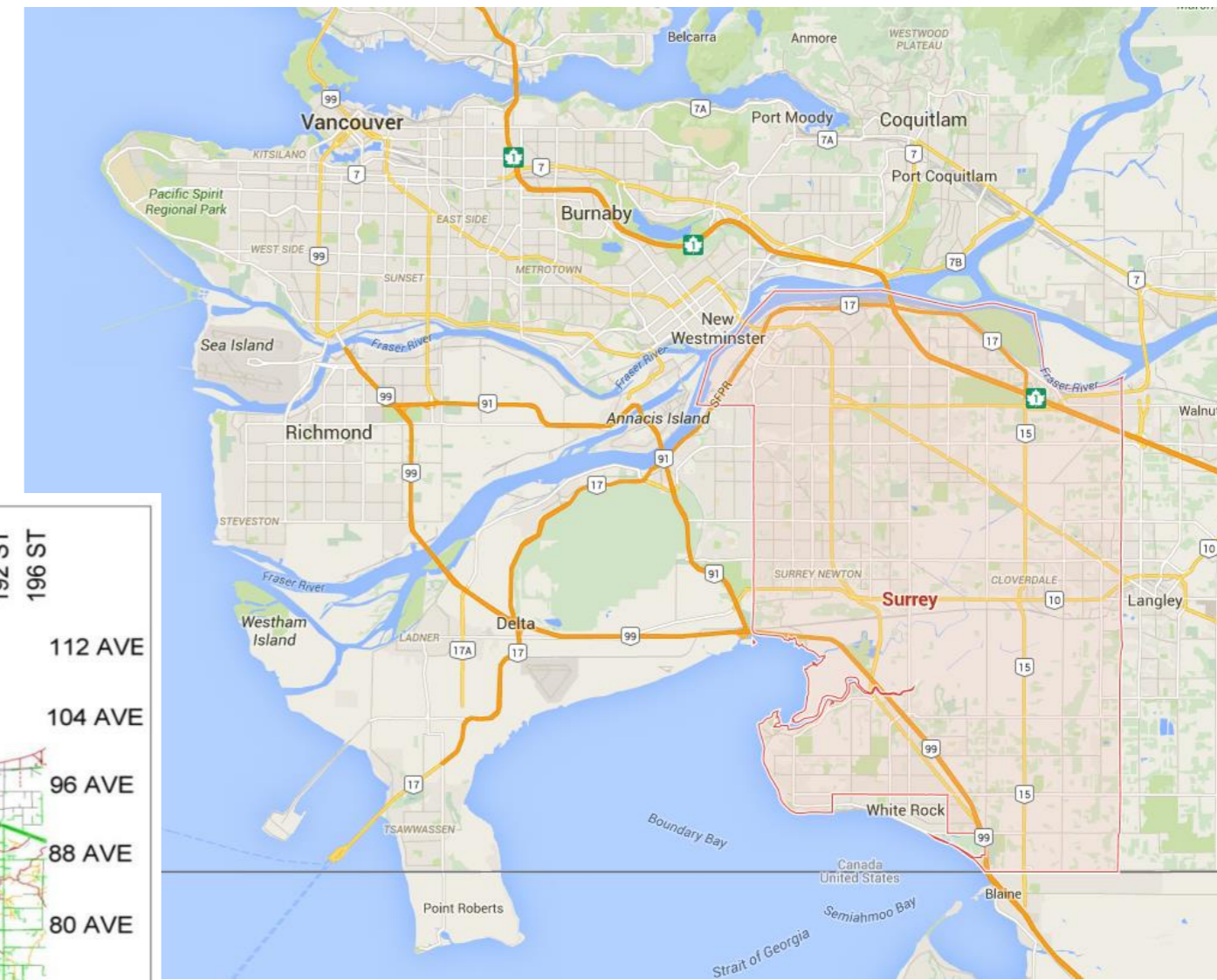
Outline

- 1) Background
- 2) Rainfall Trending Study
- 3) Updated Rainfall IDF Study
- 4) Future Rainfall Projections
- 5) Going Forward



City of Surrey

- Second largest city in BC
- Area: 317 sq.km.
- Population: over 500,000



City Bylaws & Policies



City of Surrey
Climate Adaptation Strategy



Sustainability Charter
a commitment to sustainability

DP2

DEVELOPMENT PERMIT GUIDELINES: **HAZARD LANDS**

The Hazard Lands Development Permit Guidelines are organized into two categories:

- *Steep Slope Hazards*
- *Flood Prone Hazards*

Guidelines within this section may be further explained using graphic images or pictures. Where a particular guideline is graphically illustrated, the notation "*illustr*" will appear at the end of the text.



PLANSURREY2013

BYLAW NO. 18020
20 OCTOBER 2014

OFFICIAL COMMUNITY PLAN

Growth & Development



2001

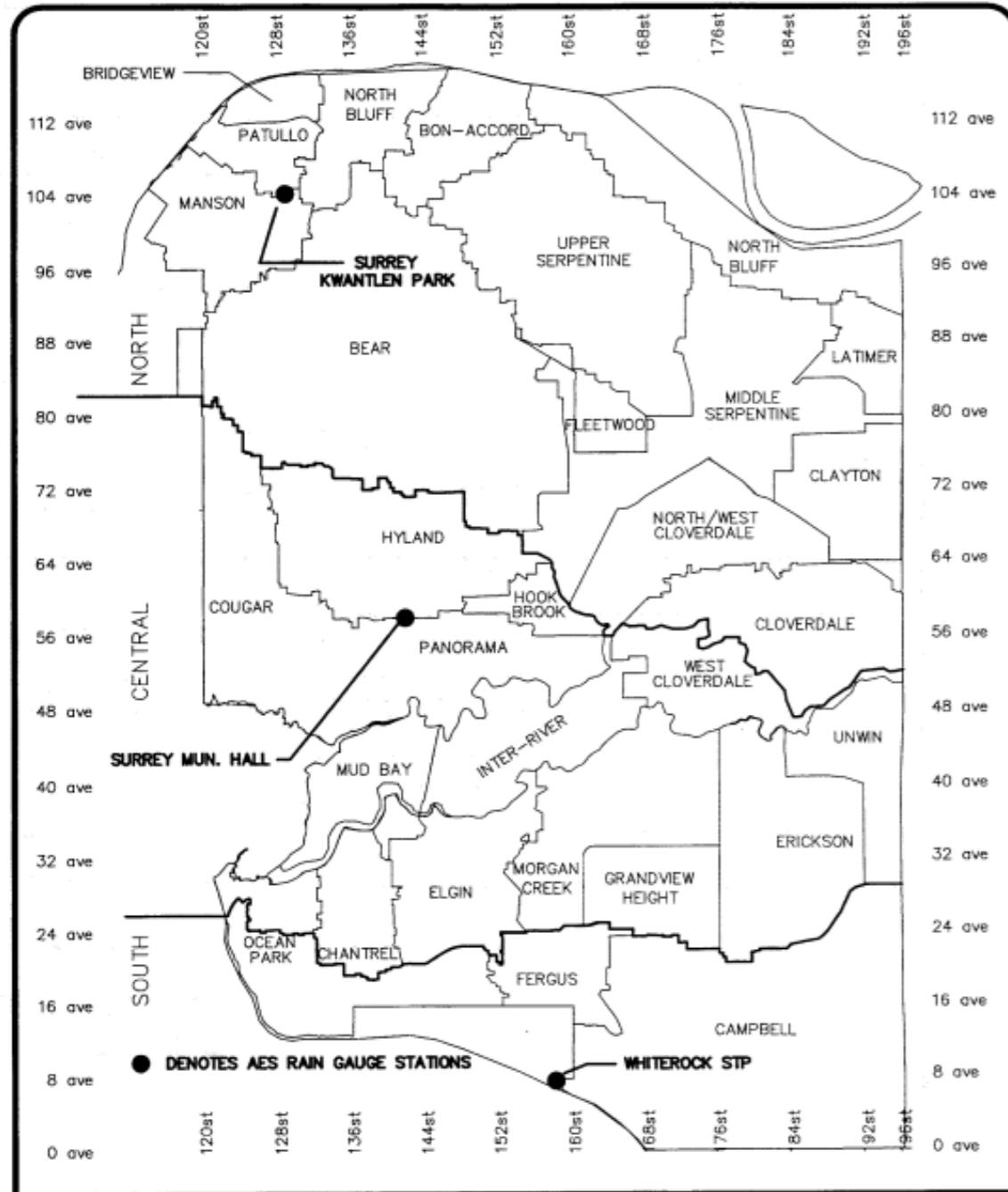


2015

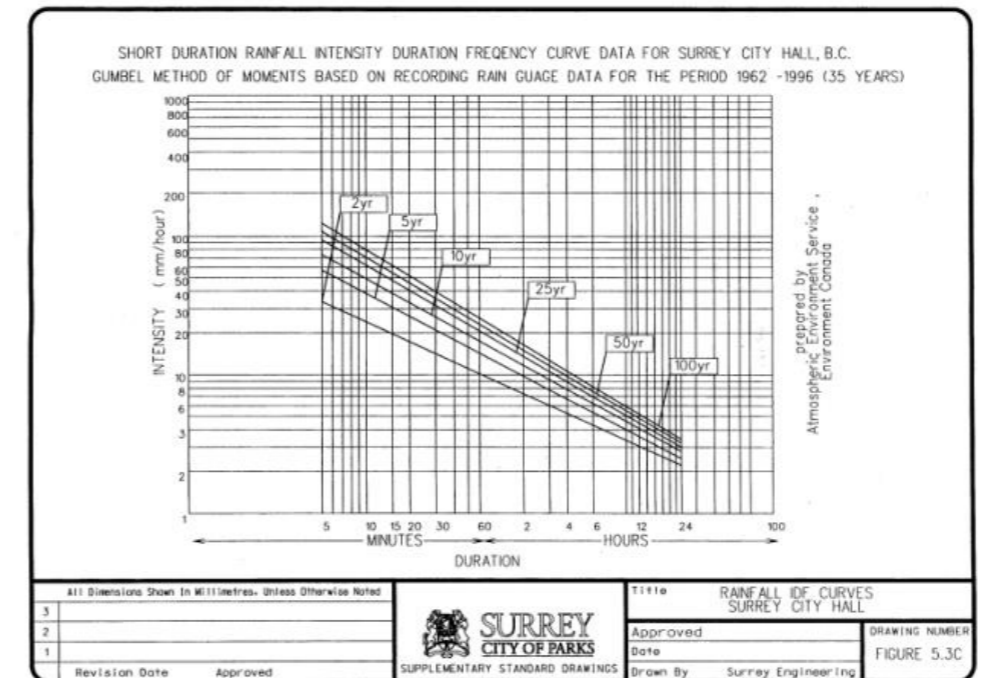
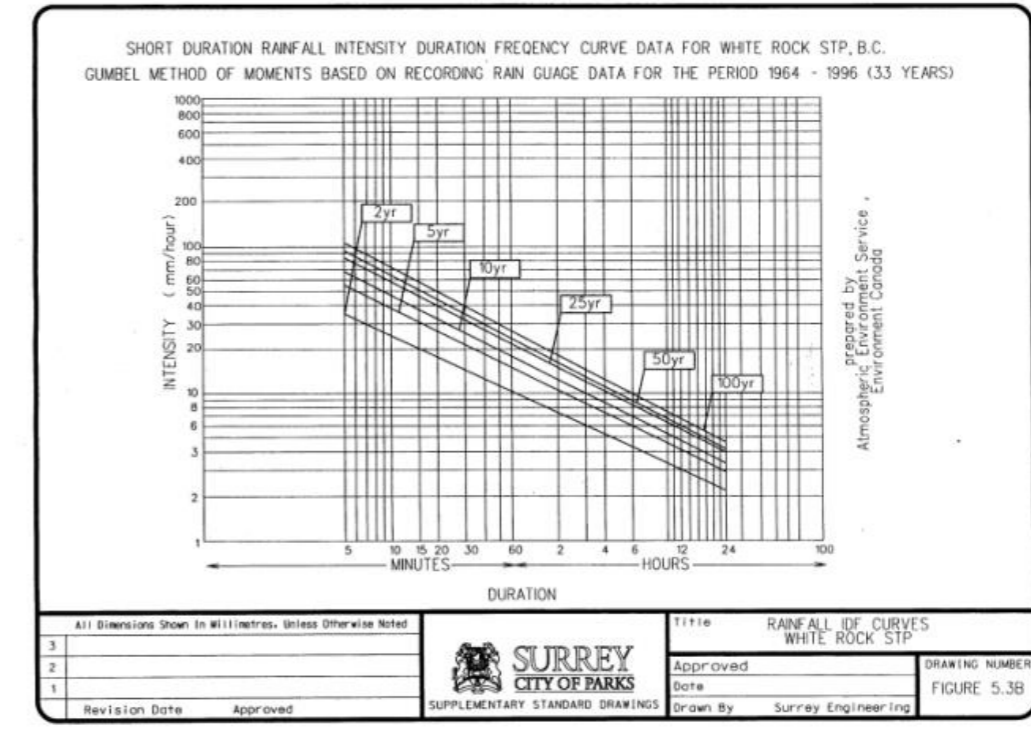
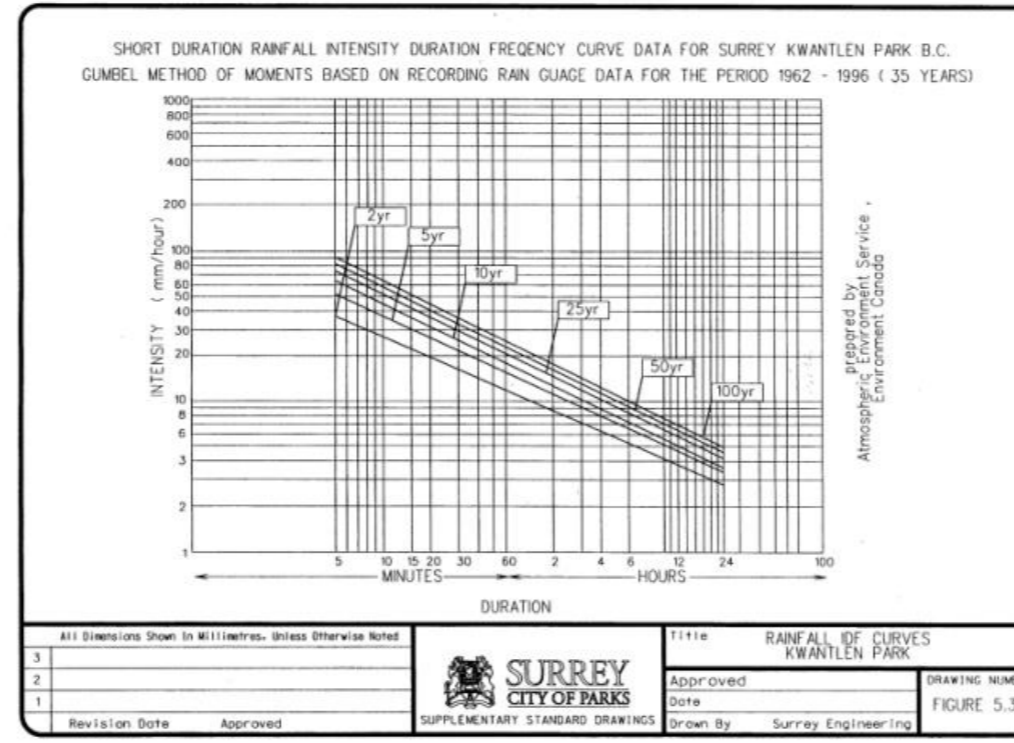
Design Standards

- 2004 Design Criteria Manual referenced 3 stations with period of record to 1999.
- 1997 to present - City continued to collect data and expand network
- IDF = Intensity-Duration-Frequency

Standard IDF Statistics



3	All Dimensions Shown In Millimetres, Unless Otherwise Noted	
2		
1		
Revision Date	Approved	
		Title CITY OF SURREY MASTER DRAINAGE PLAN AND RAINFALL BOUNDARIES Approved _____ Date AUGUST 1998 Drawn By Surrey Engineering
		DRAWING NUMBER FIGURE 5.2

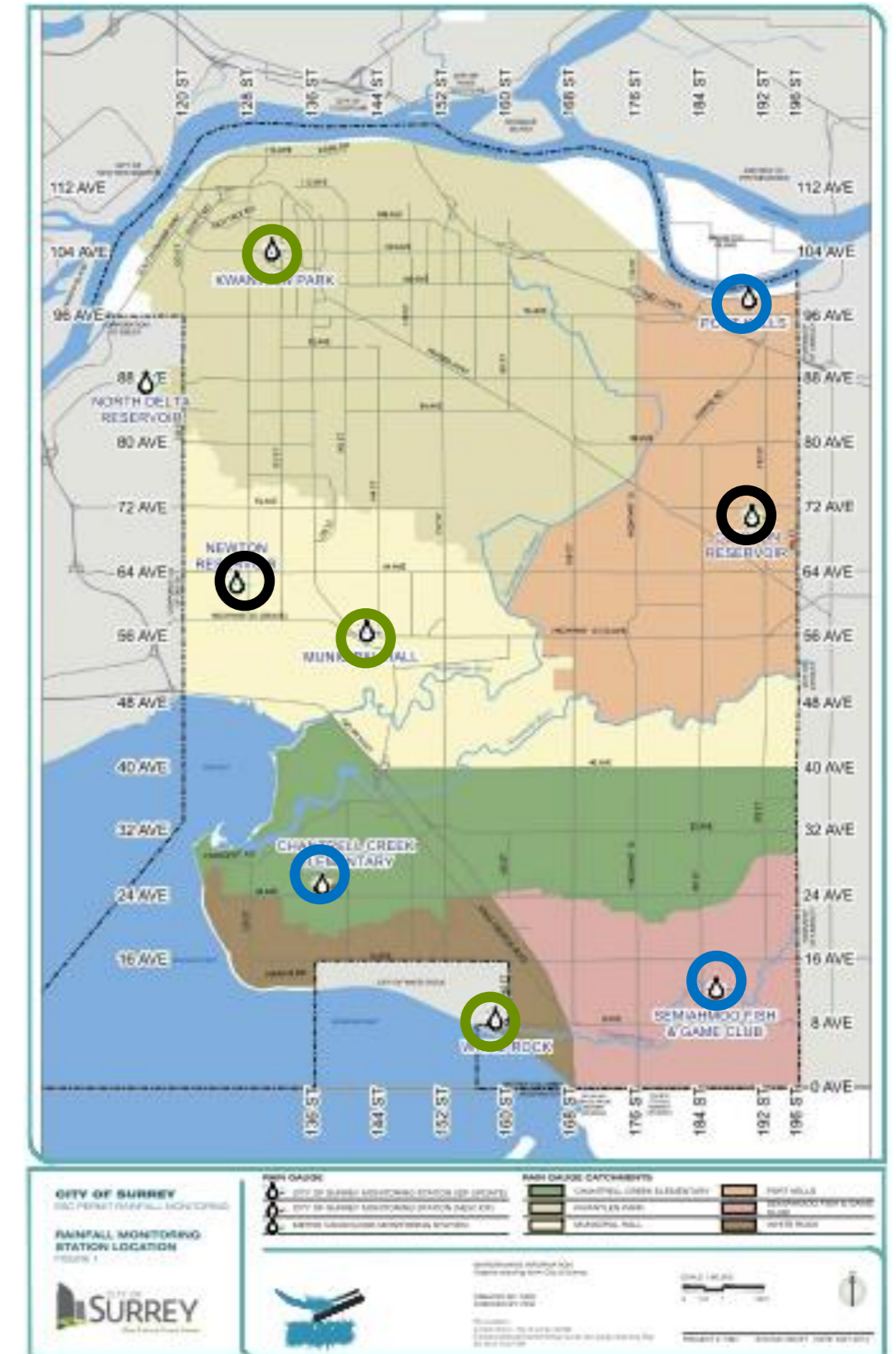


Rainfall Monitoring Stations

3 Primary Stations (Long-term stations)

3 New Stations (Subject to analysis for the first time)

Additional Stations (for reference and gap-infilling)



Question...

Since 1999, have rainfall trends and statistics changed?

Rainfall Studies

To improve the City's understanding of present-day & future rainfall:

1. Rainfall Trending Study (July 2013)
2. IDF Update Study (October 2014)
3. Development of Future IDF Statistics (May 2015)

Updated IDF Statistics for the City of Surrey

Development of Future IDF Statistics for the City of Surrey
Final Report
File No. 14-1395

Submitted to:
City of Surrey
Engineering Department

DILLON CONSULTING

REPORT

Rainfall Trend Analysis for the City of Surrey - DRAFT
Project 12-7174 July 25, 2013

Prepared for:
City of Surrey

Prepared by:
Dillon Consulting Limited
1155 North Service Road, Unit 14
Oakville, Ontario
L6M 3E3

CITY OF SURREY
the future lives here.

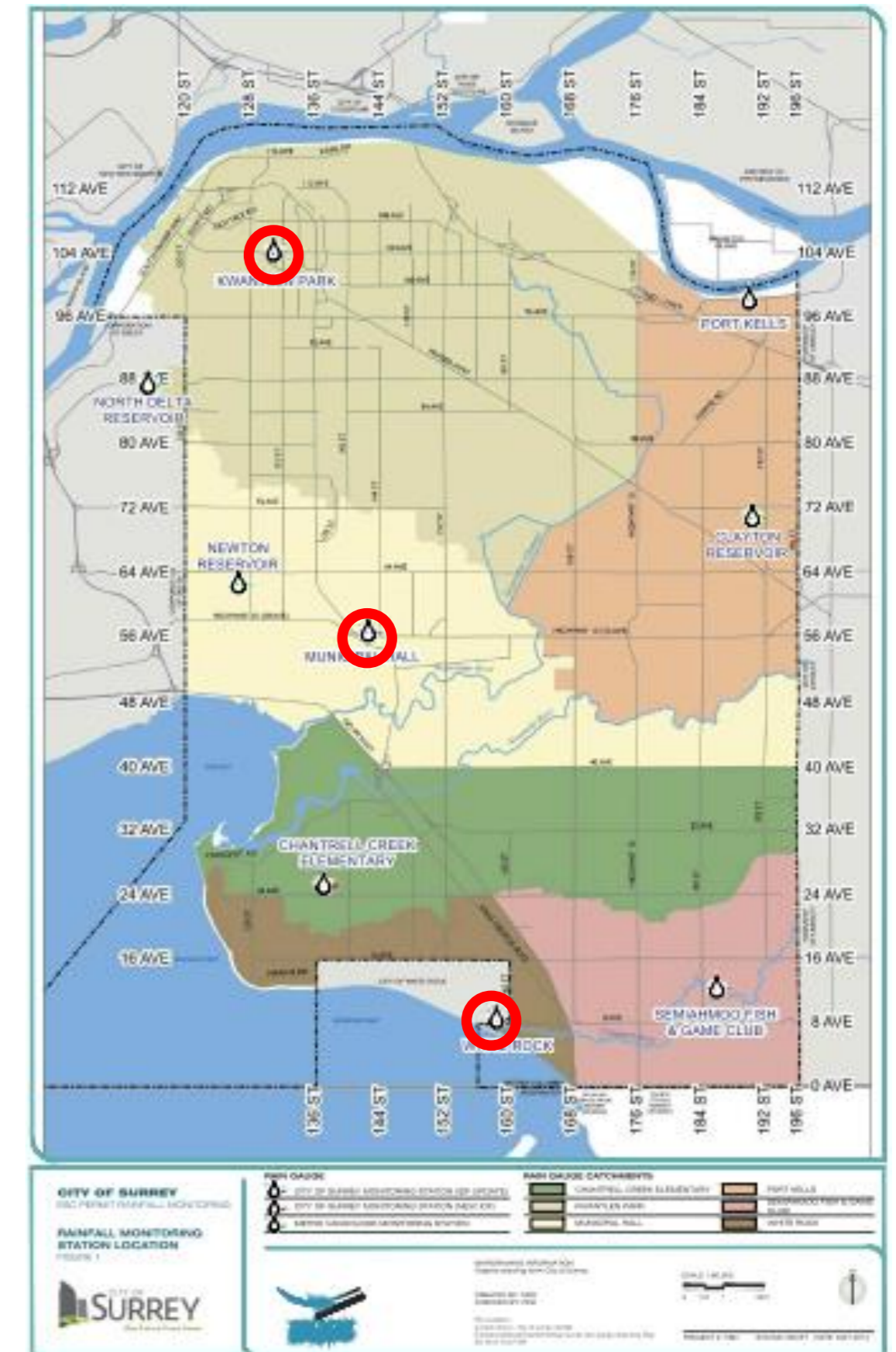
the future lives here.

Rainfall Trending Study

Primary (Long-Term) Climate Stations only:

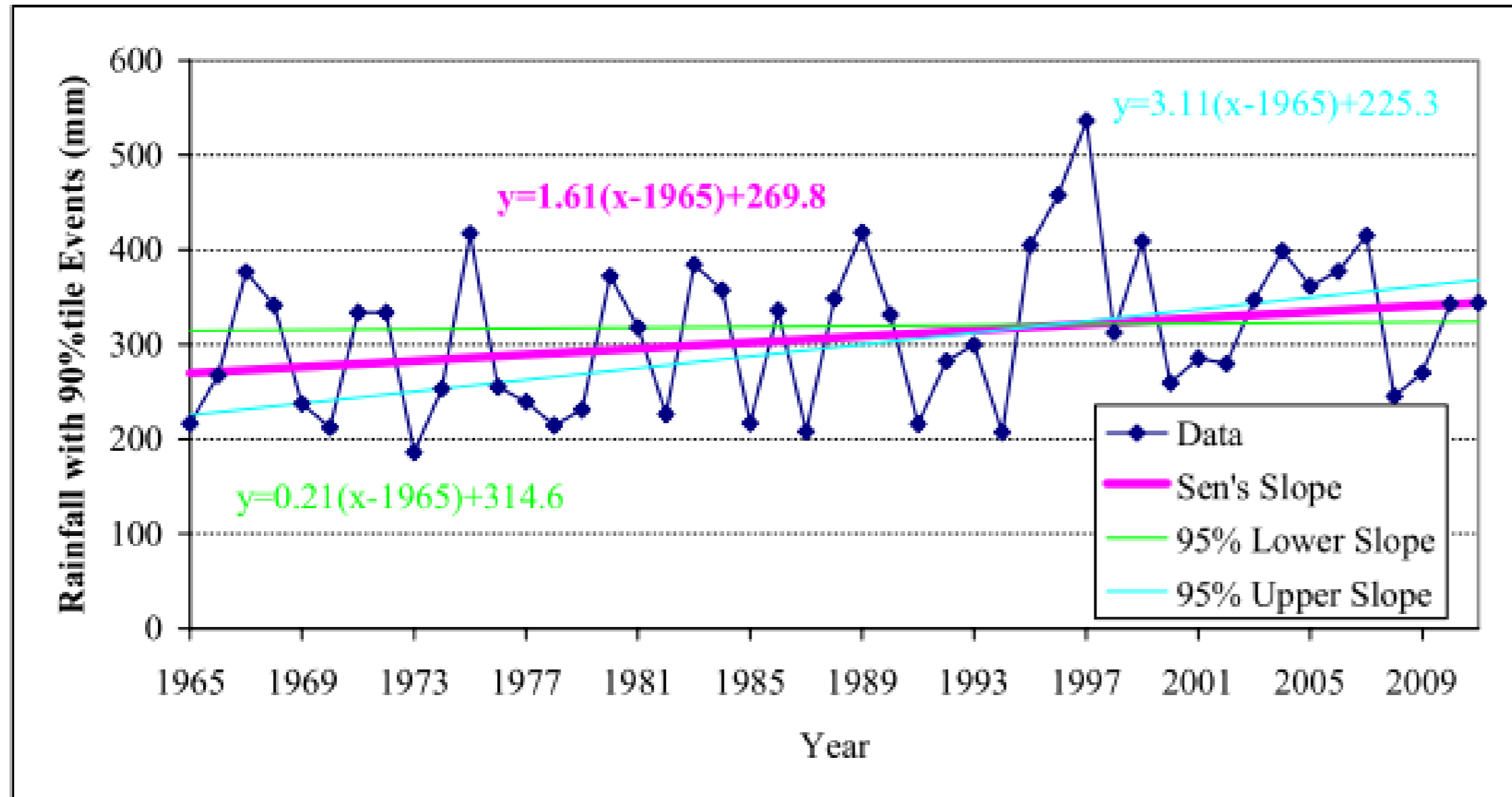
1. Kwantlen Park (1962 - 2013)
2. Old Municipal Hall (1963 - 2013)
3. White Rock (1964 - 2013)

Data infilling used to complete the historic data sets.



Rainfall Trending Study

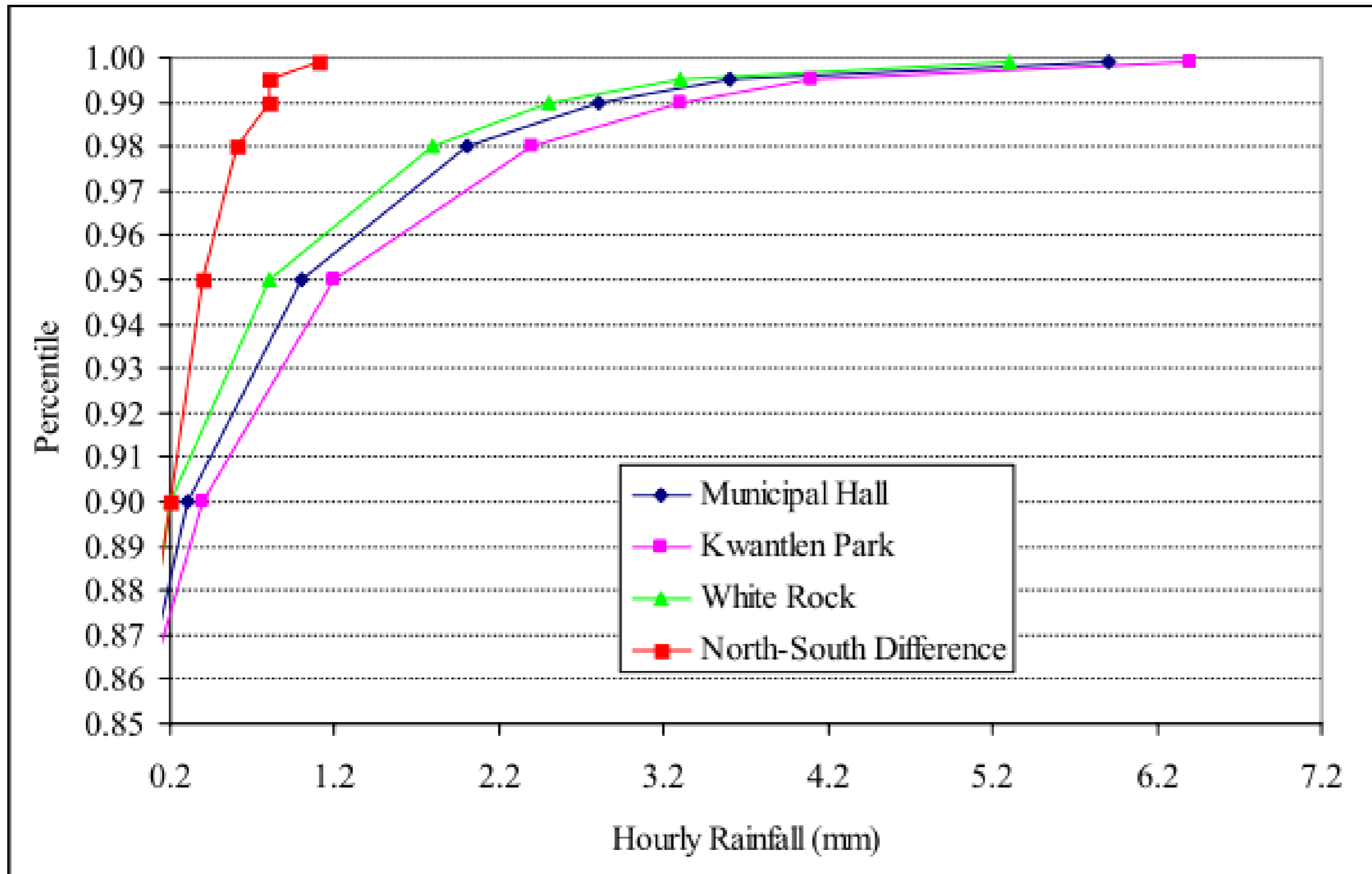
Figure 35: Trend Test for the Total Rainfall of Hourly Rainfall Events Exceeding the 99%tile Value at White Rock Station



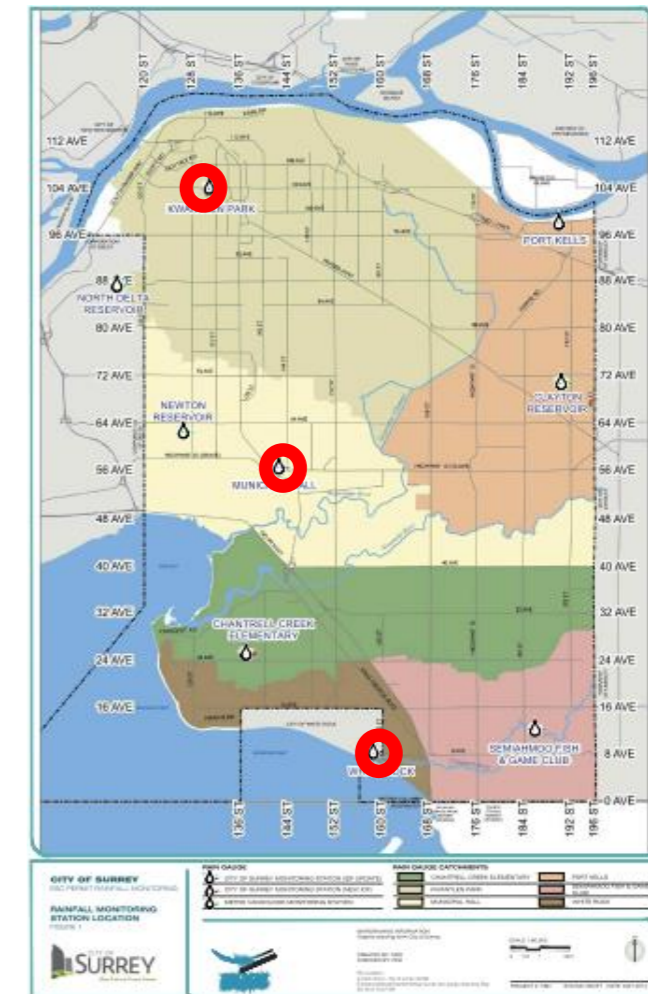
Rainfall Temporal Variability

Rainfall Trending Study

Figure 37: Hourly Rainfall Distributions for Heavy Rainfall Events



Rainfall Spatial Variability



Rainfall Trending Study

MORE...

Annual rainfall is increasing.

Monthly rainfall is increasing.

January is most significantly getting wetter.

Increasing rainfall depths for shorter duration storms in the north.

Increasing rainfall depths for long duration storms in the south.

LESS...

Number of dry days is decreasing.

Rainfall Trending Study

MORE...

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Getting WETTER

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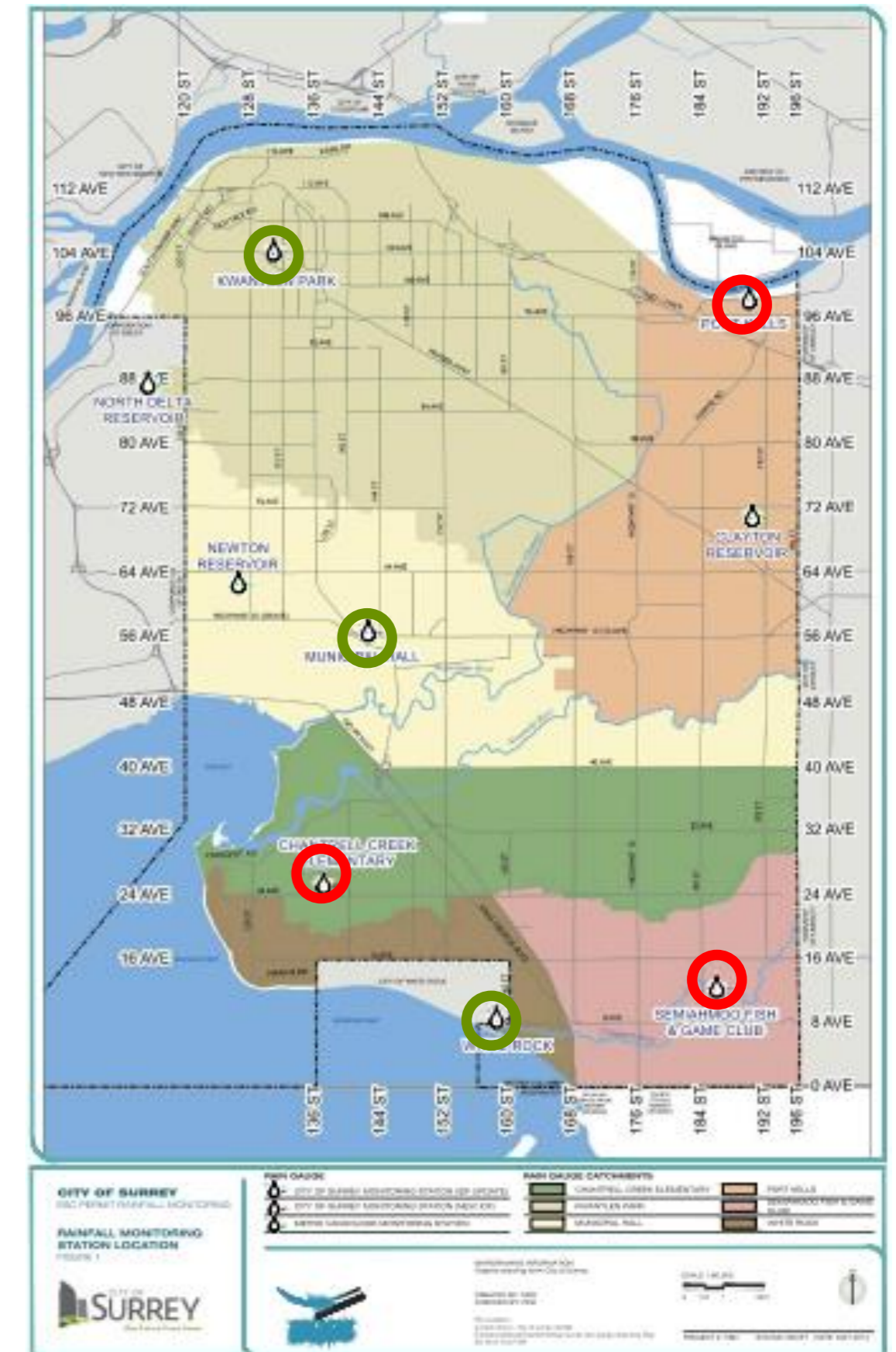
IDF Update Study

Stations for Updated IDF Analysis

- Kwantlen Park (1962 -2013)
- Municipal Hall (1963 - 2013)
- White Rock (1964 - 2013)

Additional New Stations for IDF Analysis

- Chantrell Creek Elementary School (2000 - 2013)
- Port Kells (2004 - 2013)
- Semiahmoo Fish & Game Club (2000 - 2013)



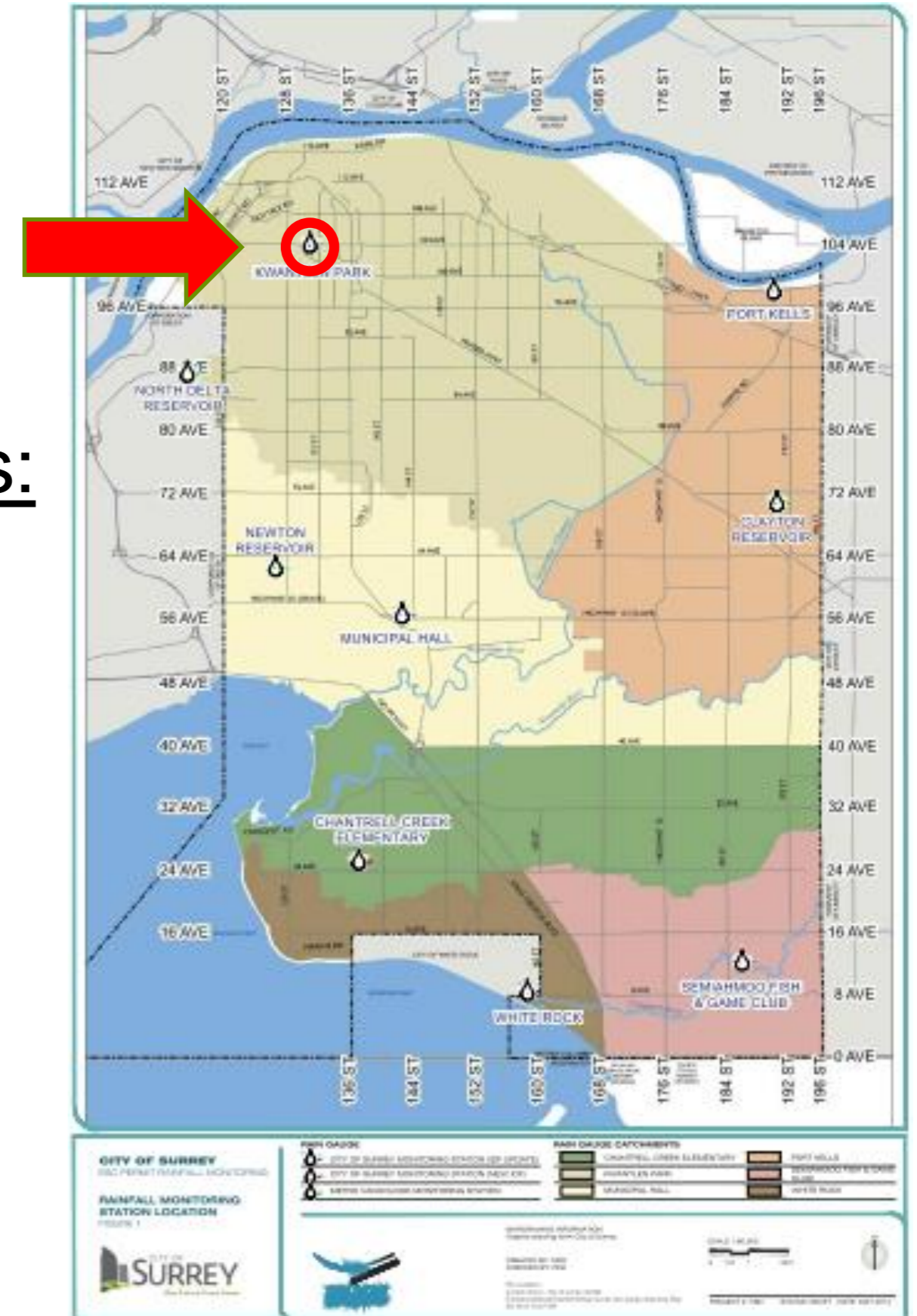
IDF Update Study

- Infilling of data gaps by correlation with relevant stations.
- For consistency, data management and statistical analysis was maintained with the historic Environment Canada rainfall analysis.

2004 vs. Updated

Updating of the Kwantlen Park Station IDF Statistics:

- ↑ Overall increase in IDF rainfall estimates for the varying durations and frequencies.
(+ 3% to + 31% more).



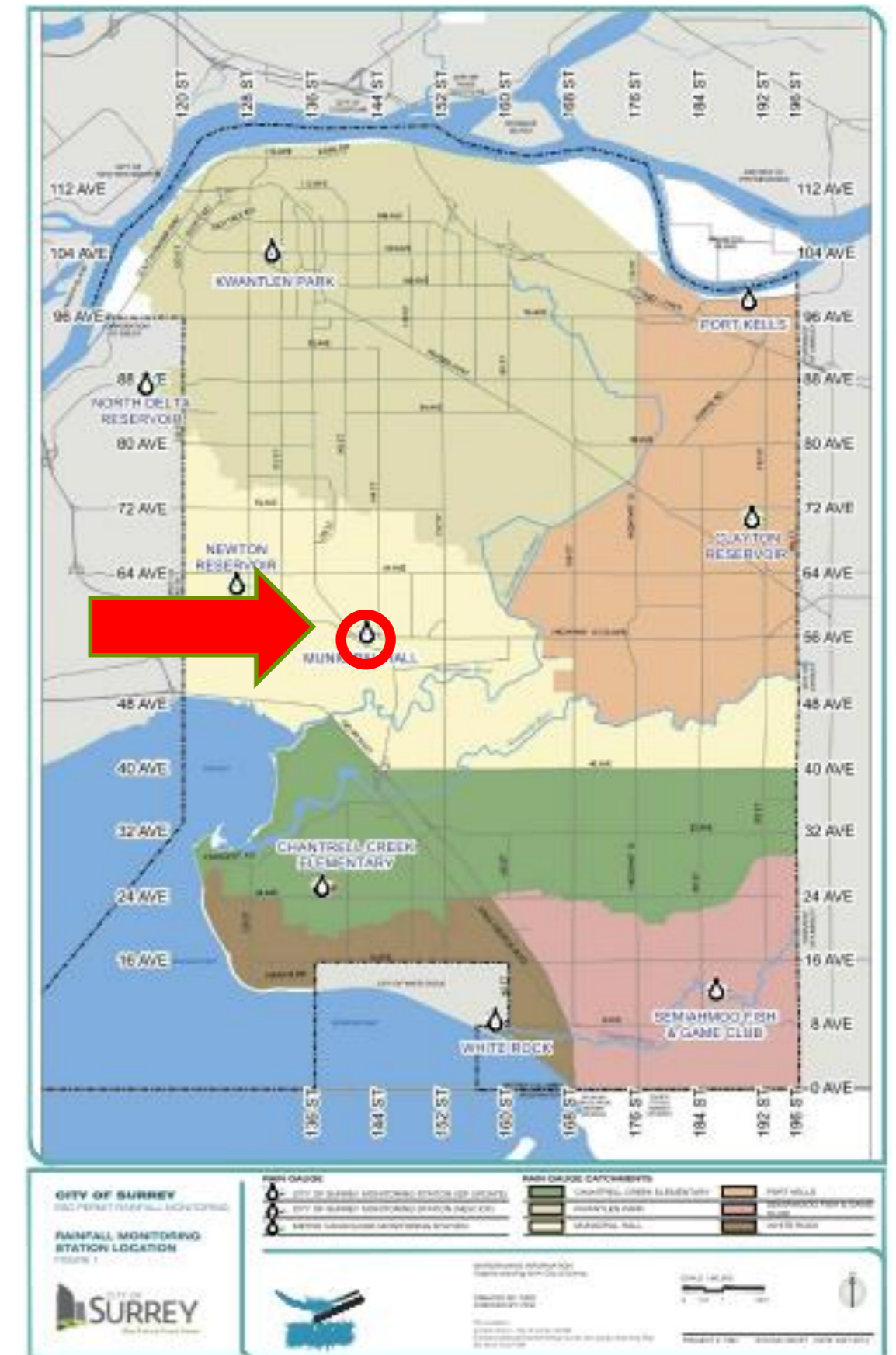
2004 vs. Updated

Updating of the Old Municipal Hall Station IDF Statistics:

↕ There is both a reduction and a significant increase in select IDF rainfall estimates.

(- 7% to + 24%)

↑ Increased variability



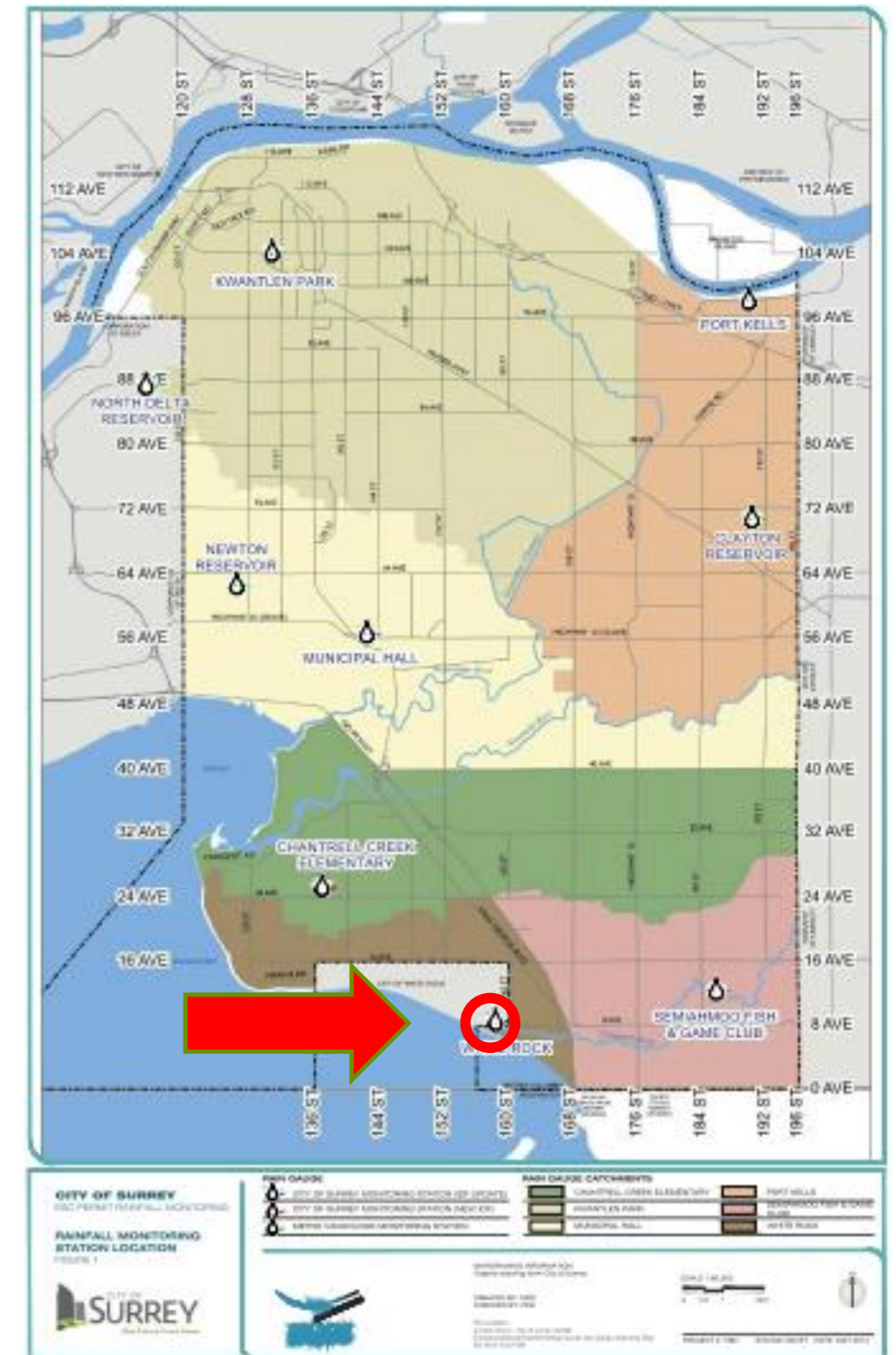
2004 vs. Updated

Updating of the White Rock Station IDF Statistics:

↕ There is both a reduction and a significant increase in select IDF rainfall estimates.

(- 6% to + 44%)

↑ The impact of infilling the data series displayed significant changes in the rainfall statistics ranging from 1% to 23%.



2004 vs. Updated

What does this mean to the IDF Statistics?

- ↑ Rainfall statistics have increased overall; up to 31% more
- ↑ Shorter duration events are showing larger increases
- ↑ Less frequent events are showing larger increases

2004 vs. Updated

What does this mean to the IDF Statistics?

- ↑ Rainfall statistics have increased overall, up to 31% more
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Getting WETTER

Future Climate Change Projections

- 2030, 2050, and 2080 planning horizons at the Old Municipal Hall Station.

Future projections have uncertainties such as:

1. How will society address future global greenhouse gas emissions?
2. Progressing science defining atmospheric processes.
3. Influence on regional and local interactions between the atmosphere and the earth.

Future Climate Change Projections

Projection Process:

1. 29 global circulation models (GCMs) to assess *regional-scale* climate conditions.
2. 4 future greenhouse gas (GHG) emission scenarios.
3. 3 methods to downscale from each GCM to the *local* Surrey condition.
4. Statistical analysis of the **350 projections**.

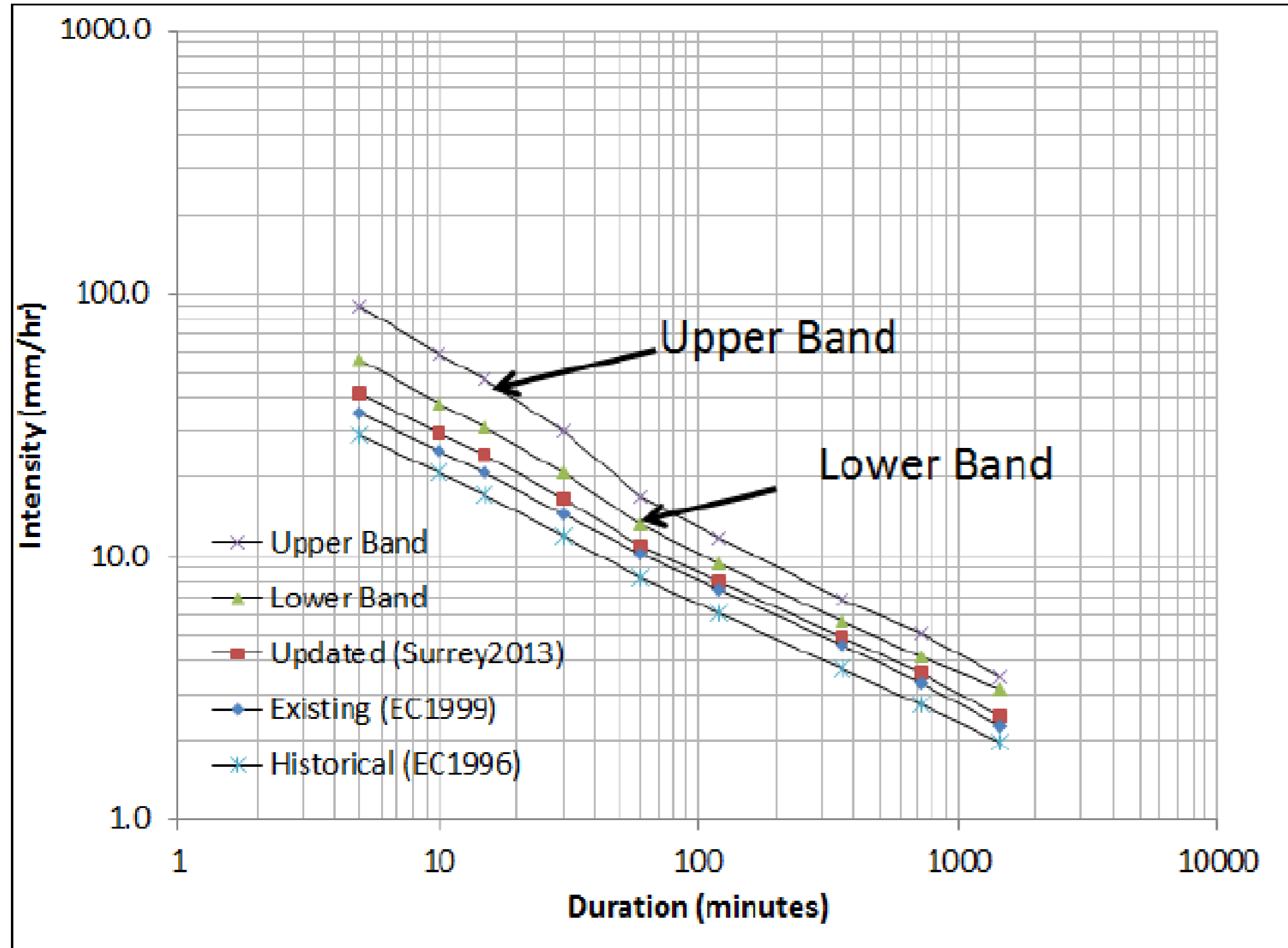
Future Climate Change Projections

What comes from 350 future rainfall projections?

A set of boundaries to contain expected future rainfall projections :

1. Lower band: maximum of the mean values from the 3 downscaling methods
2. Upper band: maximum of the 95th percentile values of the 3 methods

Future Climate Change Projections



EXAMPLE

**2-YEAR RETURN PERIOD
IDF PROJECTION FOR 2030's
AT SURREY MUNICIPAL HALL**

Future Climate Change Projections

Average increase in projected rainfall statistics:

Planning Horizon	Lower Band (max. of means)	Upper Band (max. of 95 %'s)
2030's	20%	72%
2050's	35%	96%
2080's	68%	154%

Climate Change Rainfall Adaptation

➤ **Study is underway**

City adaptations may include:

- Sizing of new infrastructure.
- Level of service for existing drainage infrastructure.
- New servicing standards.
- On-lot servicing requirements.



In Summary

- It's getting wetter
- Data gap infilling: up to 23% more
- Updating the data: up to 31% more
- Projections to 2080: up to 154% more
- Adaptations are required for the future
- Stay tuned



Questions?

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