From Rain to Resource
Kelowna, 2010

Why is Rainwater Management a Critical Tool for Adaption to Climate Change?

Chris Johnston, P.Eng.

Kerr Wood Leidal Associates

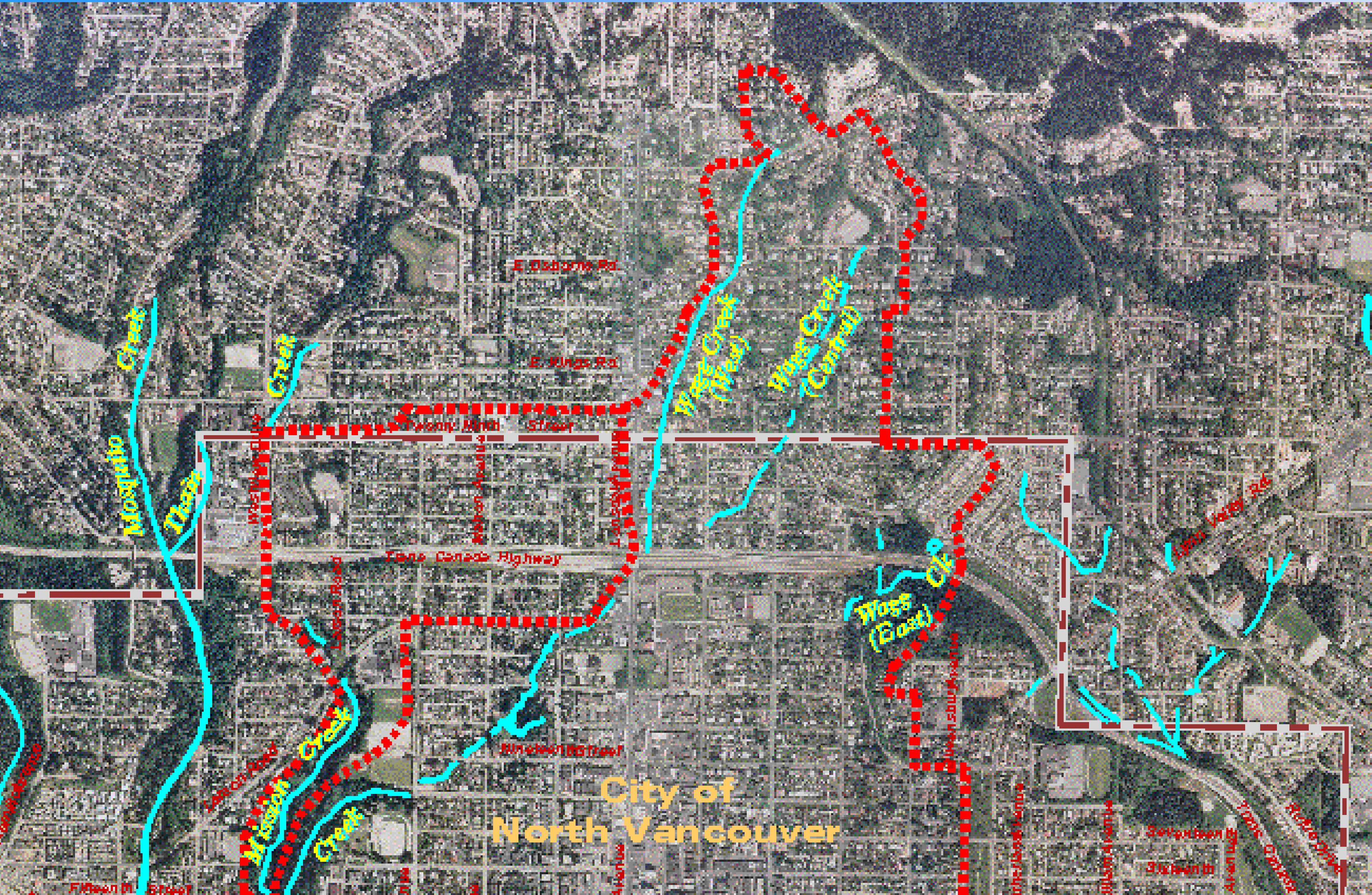
BCWWA
BC WATER & WASTE ASSOCIATION

Mission: Safeguarding public health and environment through sharing of knowledge, education and experience, and providing a voice for the water and waste community.

Outline

1. Rainwater Management Issues
2. What are the Climate Models saying?
3. What is the historical rainfall data saying?
4. How will this impact rainwater and stormwater management?
5. What can be done to lessen the impact?

Impervious Surfaces in our Cities



The Main Rainwater Issues

- **Protection of Property** – runoff from infrequent storm events must be safely conveyed by some form of drainage network
- **Water Quality** – runoff from impervious surfaces carries pollutants to the receiving waters
- **Changes in Hydrology** - runoff damages fish habitat and ecosystems and accelerates the erosion process

Depending on your geographical location, **Climate Change** will likely increase rainfall intensities over time, amplifying the above issues.

BCWWA
BC WATER & WASTE ASSOCIATION

Climate Modelling Studies – Rainwater Focused (Metro Vancouver)

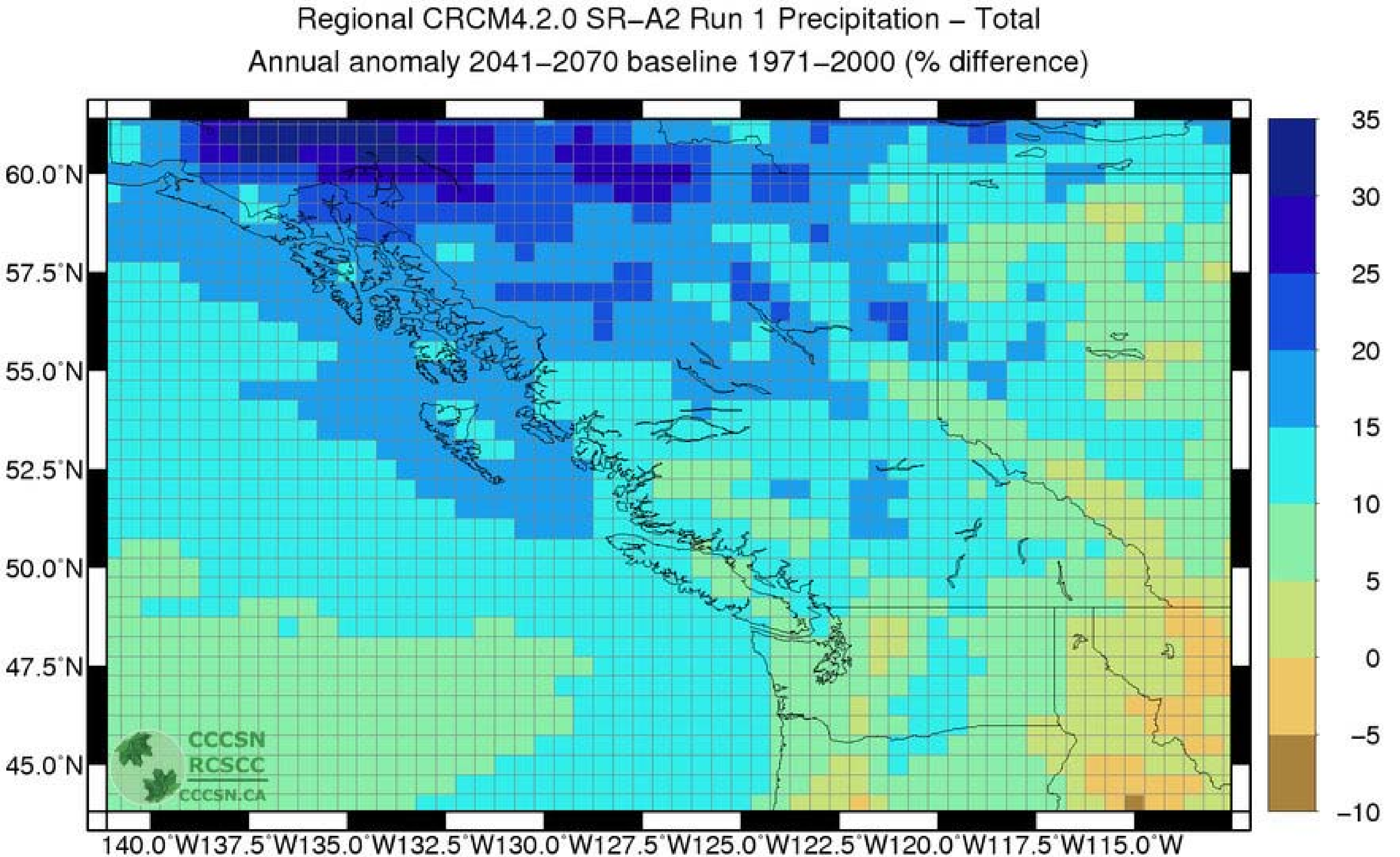
- *Vulnerability of Vancouver Sewerage Area Infrastructure to Climate Change*, Metro Vancouver, March 2008 (KWL, AE, Engineers Canada,Ouranos, PCIC)
- *Development of GVRD Precipitation Scenarios*, Metro Vancouver, October 2002 (KWL)
- *GVRD Historical and Future Rainfall Analysis Update, Metro Vancouver,* August 2007 (PCIC)
- *Climate Change (2050) Adjusted IDF Curves*, Metro Vancouver, May 2009 (BGC)

BCWWA
BC WATER & WASTE ASSOCIATION

What are the Global Circulation Models Saying?

- There are many different climate models coupled with many different model runs under many different model scenarios.
- Most models can predict seasonal and total precipitation and changes within a grid cell. Some can predict maximum daily precipitation difference.
- It is difficult for GCMs to predict changes in intensities within a 24-hour period
- However, approximations can be used based on historically based rainfall relationships

Regional Climate Modelling



Results of Climate Modeling

Estimated Change in Precip. From Climate Modelling	
Event	Avg. Change year 2050 (%)
Avg. Ann. 24-hour Precip.	+ 17%
Total Annual Precip.	+ 14%
Source: Vulnerability to Climate Change Report, Metro Vancouver, March 2008	

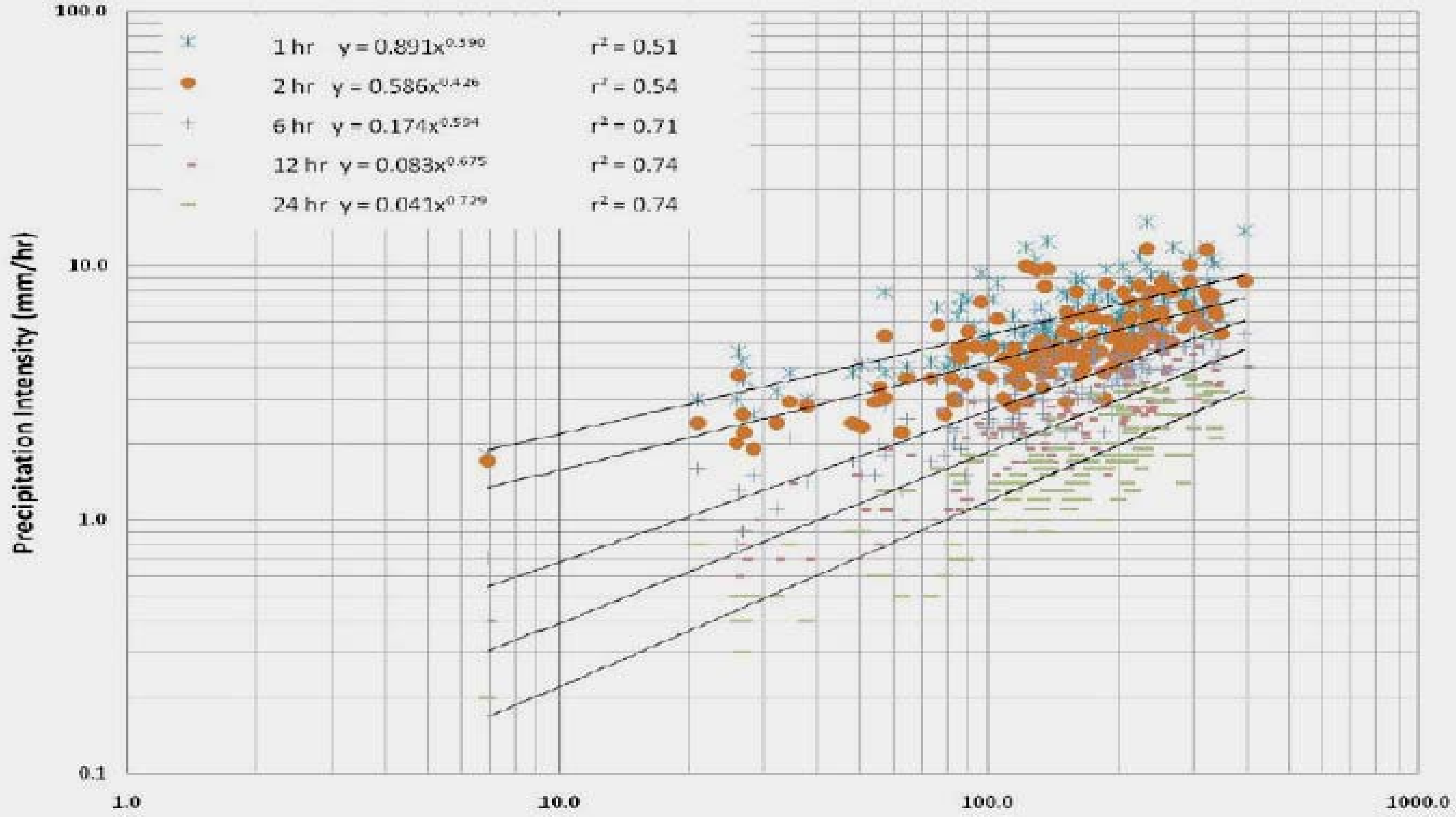
- Uses CRCM 4.2.0 driven by the CGCM3 using the A2 GHG emission scenario
- Study area selected were the grids within the Metro Vancouver area
- Same analysis can be done for any region

BCWWA
BC WATER & WASTE ASSOCIATION

Turning Daily Precipitation Changes into Hourly Changes

- The *Climate Change (2050) Adjusted IDF Curves*, Metro Vancouver, May 2009 (BGC) study took the GCM results then used relationships based on historical rainfall patterns to build 5-min to 24 hour intensities.
- From this, a prediction can be made on how Intensity-Duration-Frequency Curves will be impacted by climate change

Precipitation Intensity vs. Monthly Precipitation



BGC, May 2009

Figure 3-1. Precipitation Intensity versus Total Monthly Precipitation, Station CW09

Example of IDF Changes - VA28 - Kent Pump Station (Vancouver)

DURATION	RETURN PERIOD											
	2 year		5 year		10 year		25 year		50 year		100 year	
	Existing	2050, 2 yr, 21% Monthly Rainfall Increase	Existing	2050, 5 yr, 21% Monthly Rainfall Increase	Existing	2050, 10 yr, 21% Monthly Rainfall Increase	Existing	2050, 25 yr, 21% Monthly Rainfall Increase	Existing	2050, 50 yr, 21% Monthly Rainfall Increase	Existing	2050, 100 yr, 21% Monthly Rainfall Increase
1	10.1	11.0	13.7	15.0	16.1	17.6	19.2	20.9	21.5	23.4	23.7	25.8
2	7.2	7.9	9.9	10.9	11.7	12.9	14.0	15.4	15.7	17.3	17.4	19.2
6	4.2	4.7	5.9	6.6	7.1	7.9	8.5	9.5	9.6	10.7	10.7	11.9
12	3.0	3.4	4.3	4.8	5.1	5.8	6.2	7.0	7.0	7.9	7.8	8.9
24	2.1	2.4	3.1	3.5	3.7	4.3	4.5	5.2	5.1	5.9	5.7	6.6
48	1.5	1.7	2.2	2.6	2.7	3.1	3.3	3.8	3.8	4.4	4.2	4.9
72	1.2	1.4	1.8	2.1	2.2	2.6	2.8	3.2	3.1	3.7	3.5	4.1

(for example, the existing 100-year, 2-hour intensity becomes the new 50-year intensity)

BGC, May 2009

What is the Historical Rainfall Data Saying?

- By analyzing long term rainfall trends, it may be possible to see if climate change is already happening
- Two studies were done for Metro Vancouver on this subject. The first in 2002, and then an update in 2007. *(Development of GVRD Precipitation Scenarios*, Metro Vancouver, October 2002 (KWL) and *GVRD Historical and Future Rainfall Analysis Update, Metro Vancouver,* August 2007 (PCIC)

Trends in Historical Annual Max. Rainfall Intensity Records (PCIC, 2009)

Current Trends in Existing Data Sets	
Rainfall Duration	**Rise in Significant Trends (mm/hr/century)**
5 min	34-64
10 min	17-46
15 min	14-38
30 min	5-20
1 hour	4-10
2 hour	4-7
6 hour	3
12 hour	2-3
24 hour	2

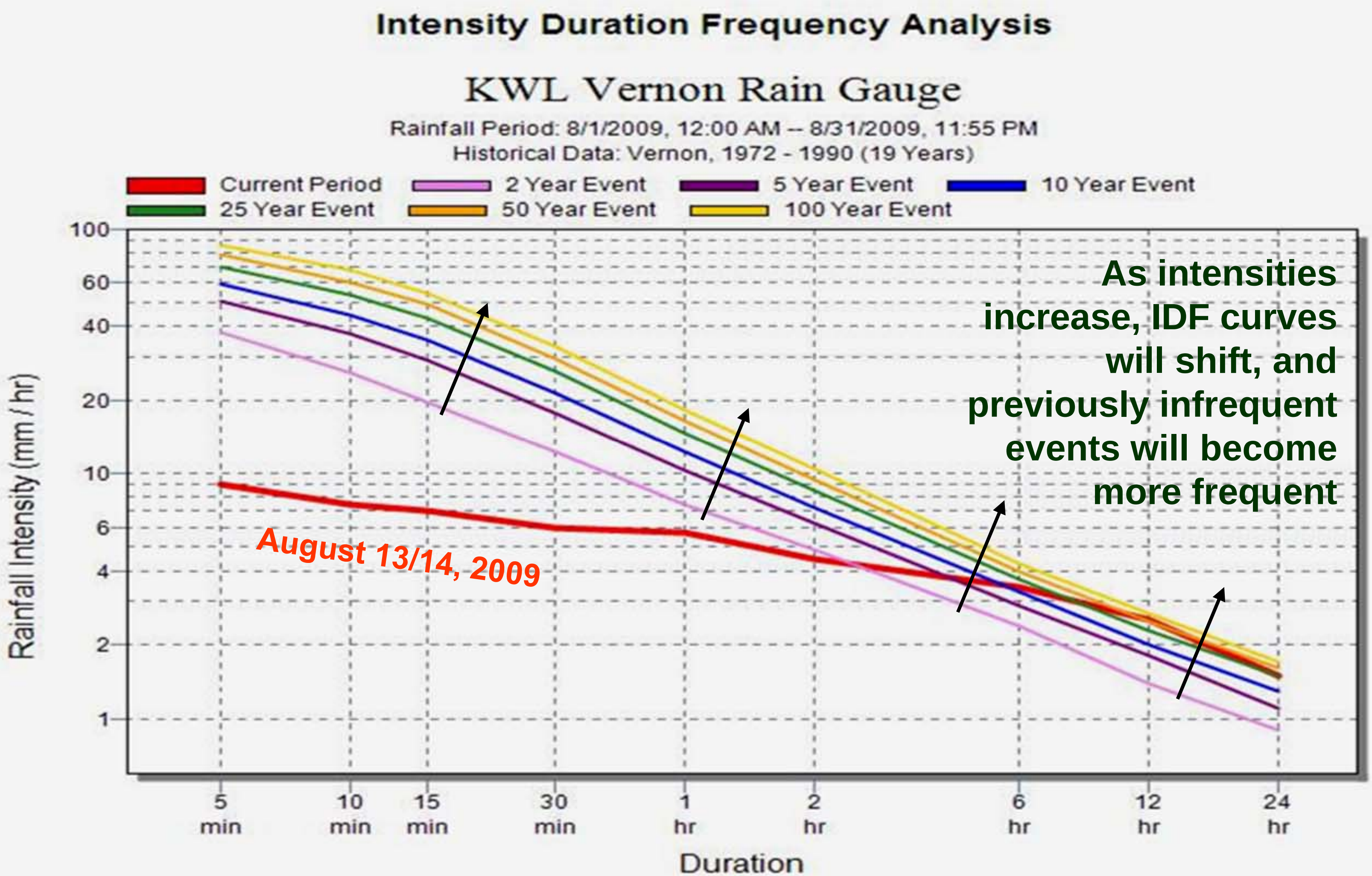
Source: Vulnerability to Climate Change Report, Metro Vancouver, March 2008

BCWWA
BC WATER & WASTE ASSOCIATION

How do the GCM predictions line up with the Historical Trend?

- 2-hour, 100-year intensity is forecasted to rise from 17.4 mm/hr to 19.2 mm/hr (1.8 mm/hr) at the Kent P.S. in Vancouver by 2050.
- Observed Values show that the trend is increasing at 4-7 mm/hr/century meaning that the expected increase is 2-3.5 mm/hr by 2050.
- Suggests that the observed trend already exceeds the forecasted climate model trend

Impact on Existing Infrastructure



Impact on Existing Infrastructure

- Existing storm sewer previously sized to convey the 5 year storm, it may only be able to convey the 2 year storm in 50 years time.
- Major overland floodway may have their level of protection reduced from a 1:100 year level to 1:50 year.

BCWWA
BC WATER & WASTE ASSOCIATION

Summary – Climate Change

- As rainfall intensities increase over time, previous design criteria may not be sufficient to meet accepted service levels
- The objective is to disconnect impervious surfaces from the storm sewer collection system either at the lot level (preferably), or community level. This will not only remove a portion of rainwater from the system, but will increase the travel time (Tc) thus lowering the flows. The intent is to counter-react the climate change increase.
- This could provide the additional capacity required to avoid upgrading programs or drop in service levels

BCWWA
BC WATER & WASTE ASSOCIATION

Re-Occurring Theme

"Disconnect impervious surfaces and build our cities differently"

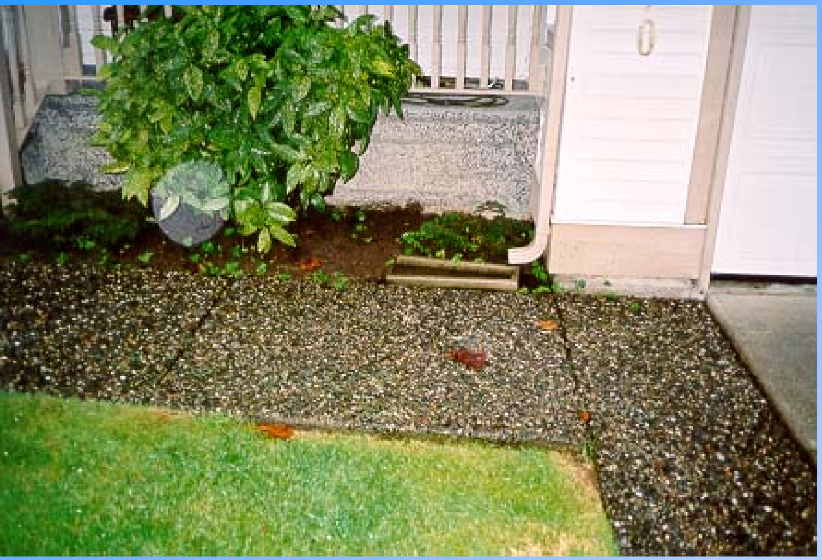
- Whether it's reducing the increases in peak flows due to climate change, capturing pollutants from road surfaces, or infiltrating and re-using rainfall to decrease the erosive impacts on creek systems and aquatic habitat, source controls can play a major role.

BCWWA
BC WATER & WASTE ASSOCIATION

Example - Mitigating Street Runoff

Example – Mitigating Parking Lot Runoff

Example - Single Family Residential Lots



Disconnected Roof Leaders

Rock Pits or Infil. Vaults

Rain Barrels /Re-Use

The Benefits

- Allows existing drainage infrastructure to accommodate larger storm events due to climate change by removing water from the system and increasing travel times (Tc)
- Improves receiving water quality, fish habitat, and decreases erosive energy.
- Recharges groundwater aquifers
- Reduces risk that these issues will be amplified due to climate change

Concluding Remarks

- Many B.C. communities continue to be leaders in developing rainwater and stormwater management programs.
- There are many local examples that highlight what can be achieved.
- However, rainwater management is still not considered to be mainstream.
- Climate change will likely amplify the issues, and force more re-active measures

Questions ?

Chris Johnston

Kerr Wood Leidal Associates Ltd.

cjohnston@kwl.ca

604 209 5070