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Incorporating Riverine Flow Requirements into Stormwater Management using LID and Environmental Flows

TRIECA 2018

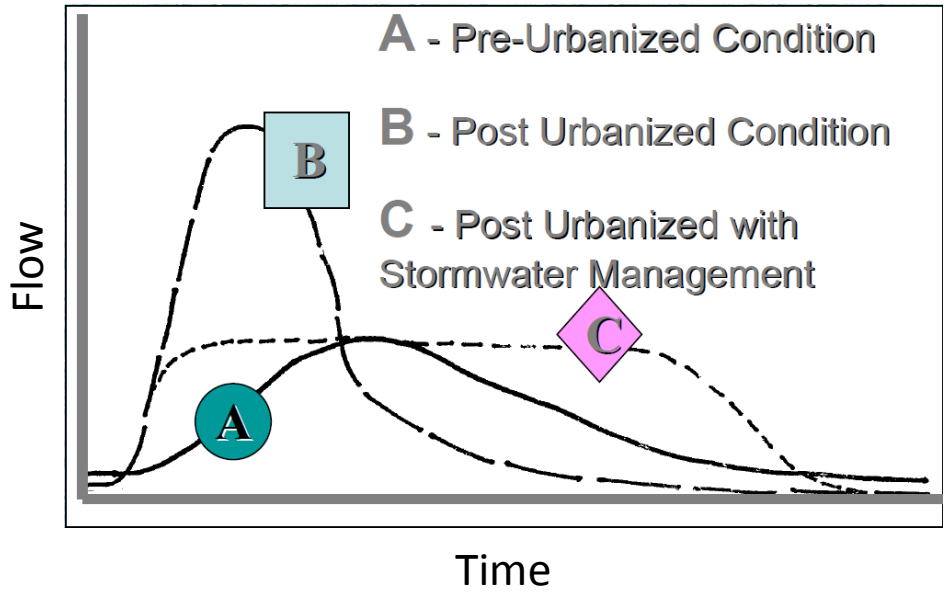
David Lembcke and Lance Aspden

Lake Simcoe Region
conservation authority

Stormwater Management Objectives

What we've been doing

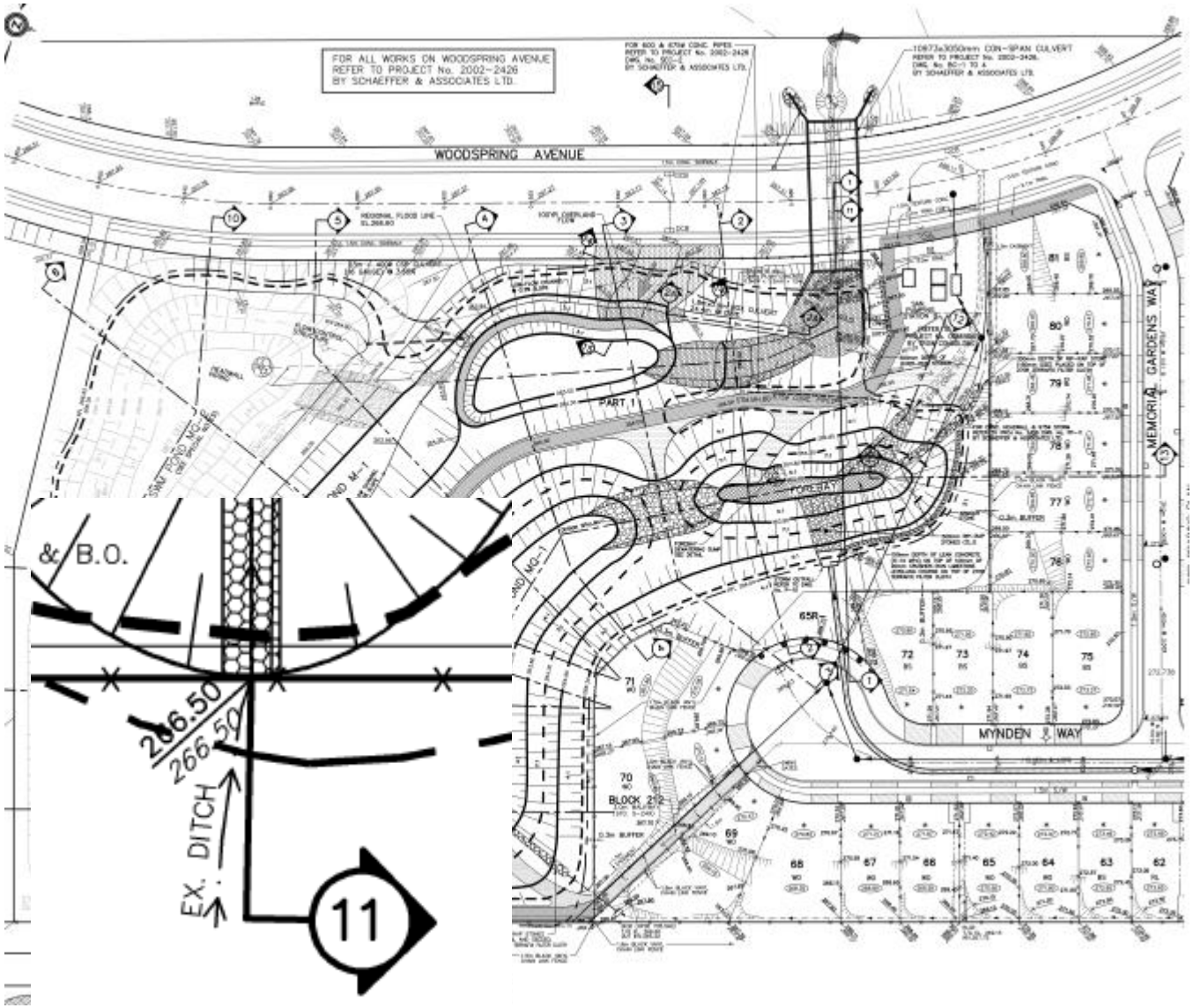
- Flood conveyance and control 1:100
- Peak flow targets
- TSS removal
- End of pipe



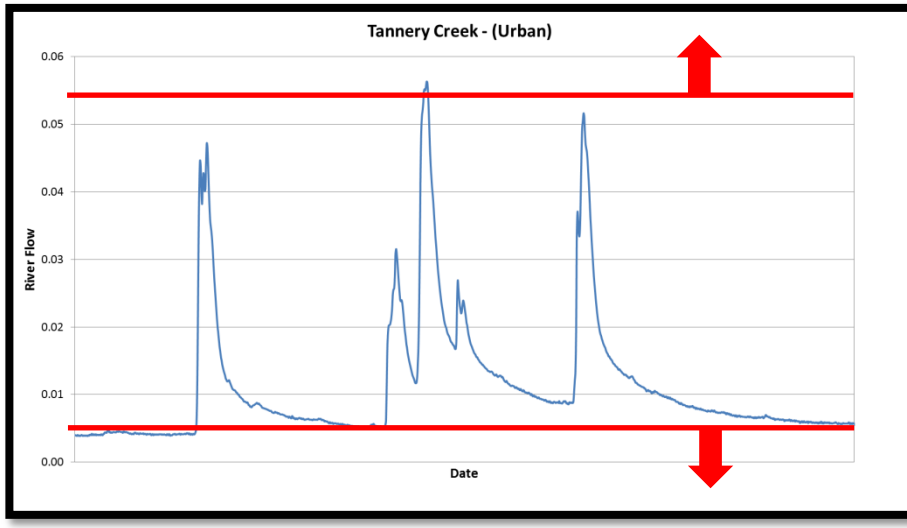
Where we're going

- Flood mitigation
- Mimic natural hydrology
- Water quality improvement
- Implementation of LID

Classic Stormwater Approach



River Flow Management



What we've been doing

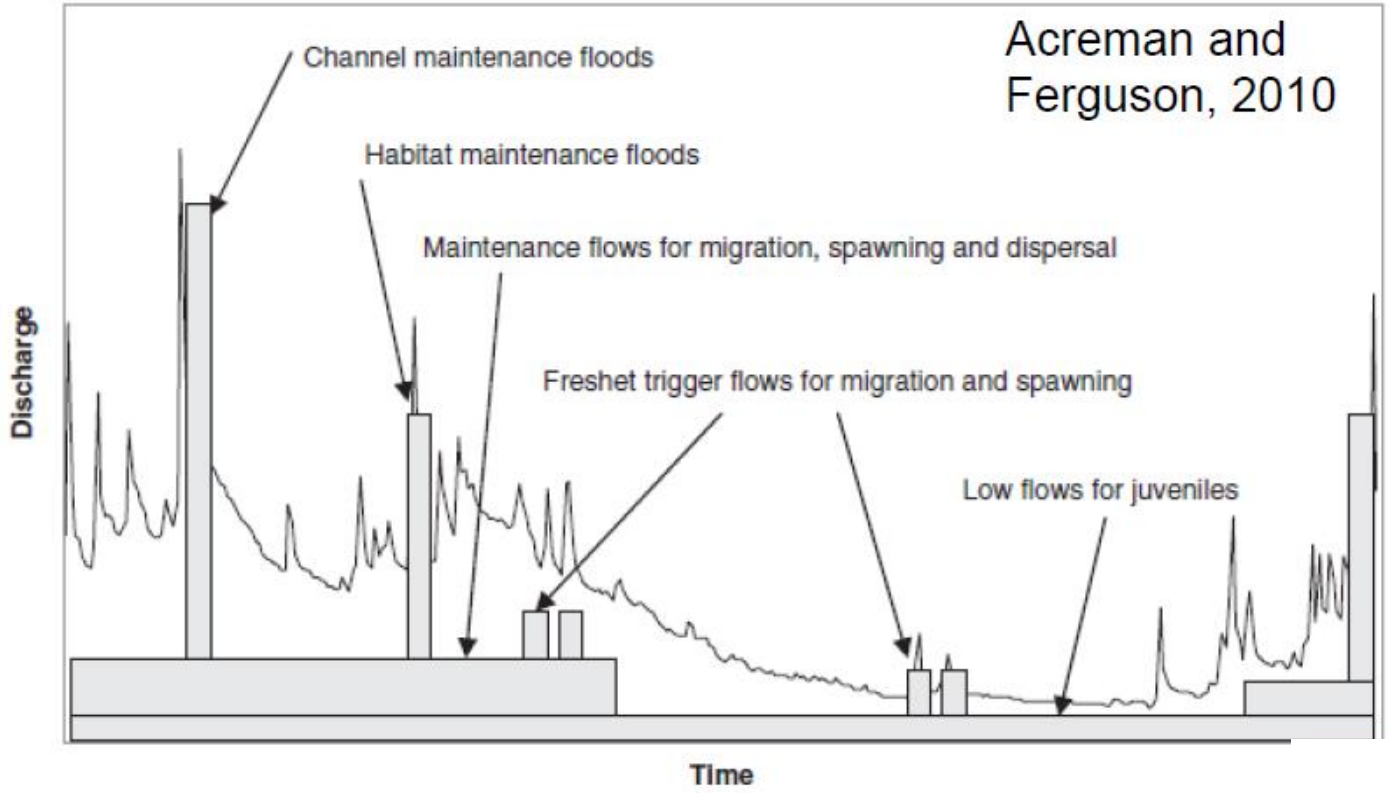
- 7Q5, 7Q10, 7Q20…
- Baseflow separation/ Index
- Ontario Low Water Statistics
- Flood and drought return 1:10, 1:20

Where we're going

- Manage / recognize all aspects or the flow regime
  - Magnitude, duration, timing
- Application of an Environmental Flow approach

What are Environmental Flows?

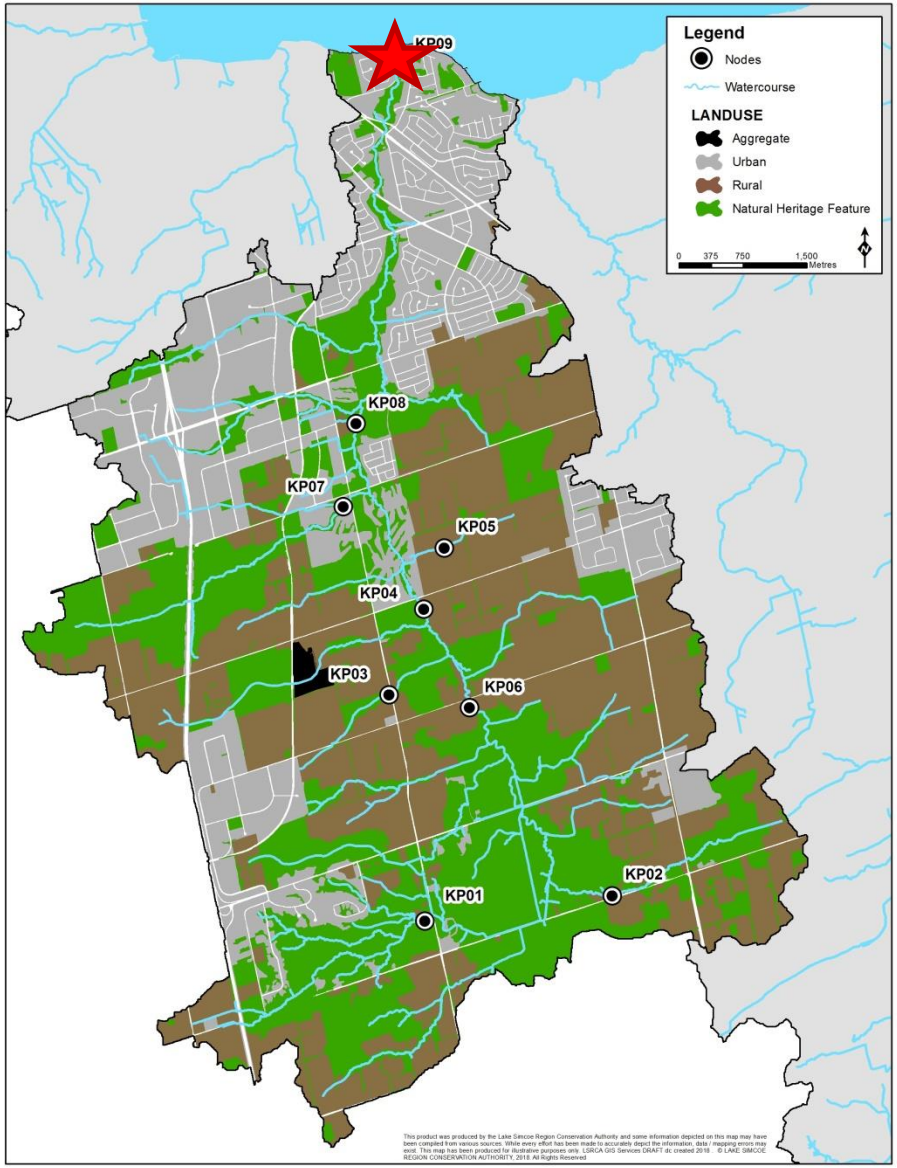
It is now widely recognized that a "dynamic, variable water regime is required to maintain the native biodiversity and ecological processes characteristic of every river and wetland ecosystem." **Brisbane Declaration - 2007**



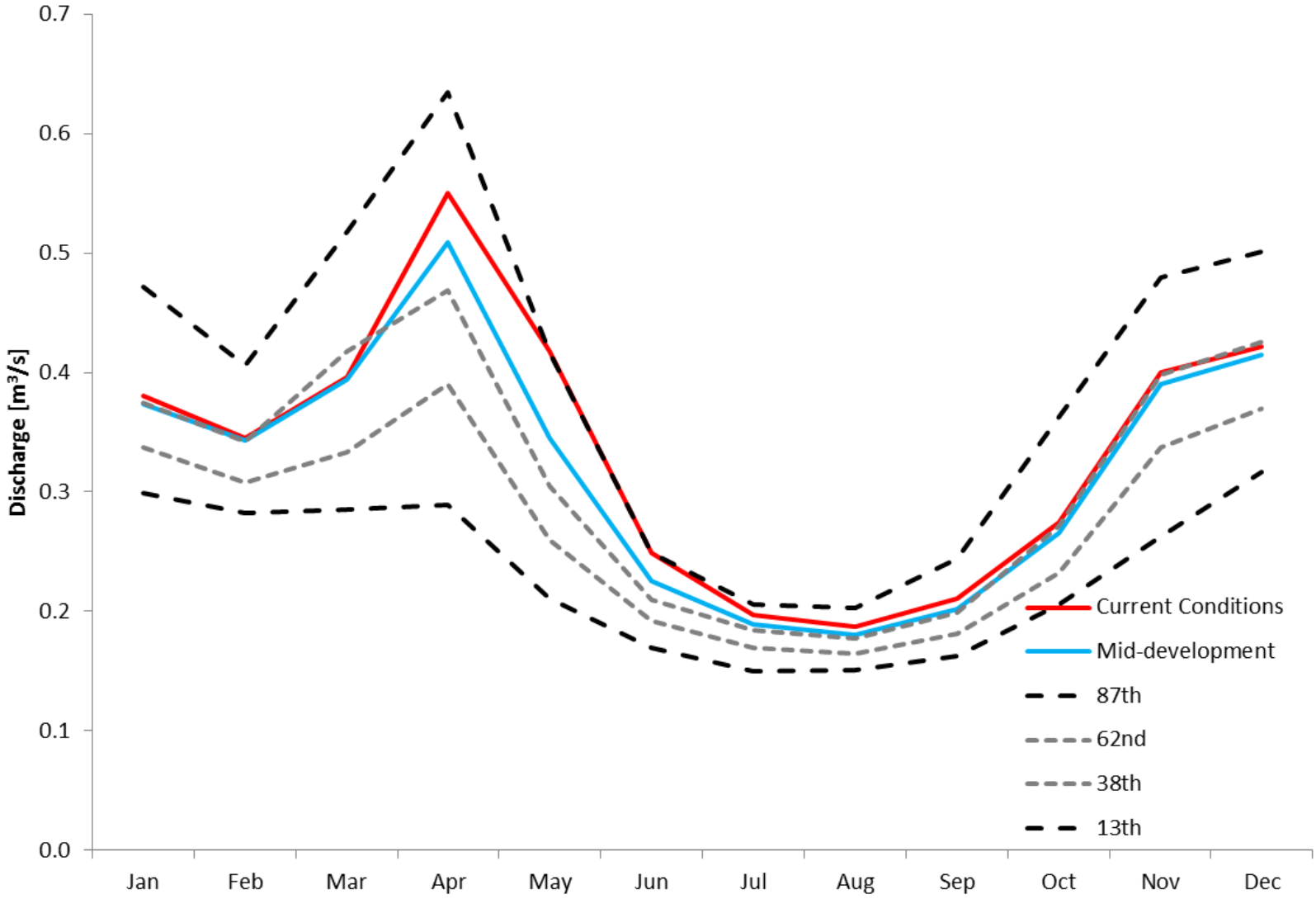
Lovers Creek Eflow Pilot Study – Land Use

- Three Land use states modelled with consistent climate record
  - Pre-settlement
  - Mid-development
  - Current State

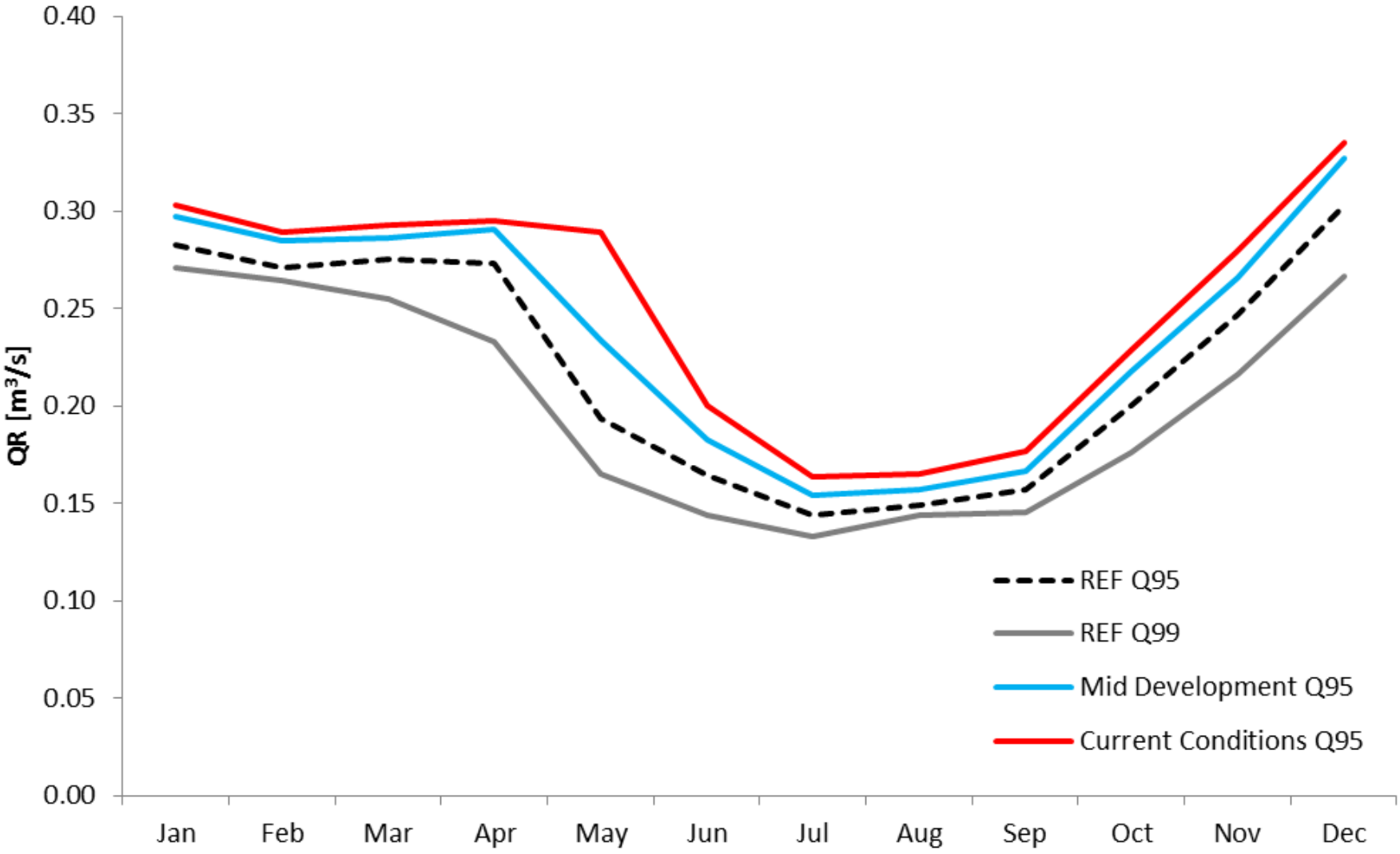
- Streamflow Analysis and Assessment Software
  - Baseflow
  - Subsistence Flow
  - High flow pulses
  - Channel forming flow
  - Riparian flow
  - Rate of change flow



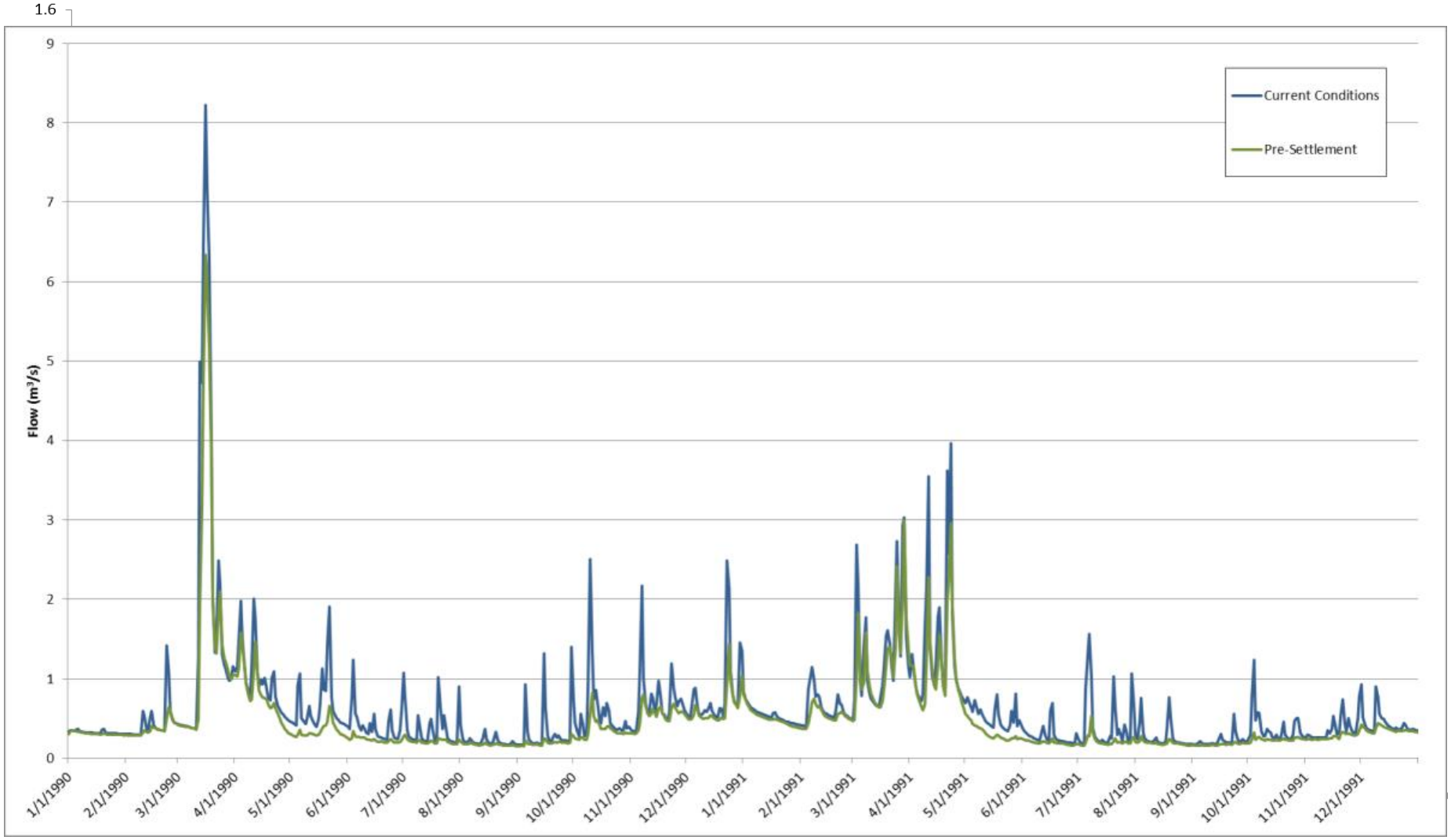
Low Flow – Baseflow



Low Flow – Subsistence Flow



High Flow Pulses



Large Flow – Timing of Q2 Events

Month	Pre-Settlement (days)	Mid-development (days)	Current Condition (days)
January			1
February			
March	2	2	2
April	2	2	2
May	2	2	2
June		1	1.5
July		1	1
August			
September			1
October			
November			1
December	1	1	1

Large Flows – Magnitude

Return Period	Pre-Settlement (m^3/s)	Mid-development (m^3/s)	Current Condition (m^3/s)
2	4.014	4.836	5.7851
5	5.5139	6.3645	7.6121
10	6.4153	7.18	8.6584
20	7.2165	7.8439	9.5596
25	7.4591	8.0341	9.8274
50	8.1753	8.5674	10.6051
100	8.8452	9.0295	11.3155

Lovers Creek - Climate Change Scenarios

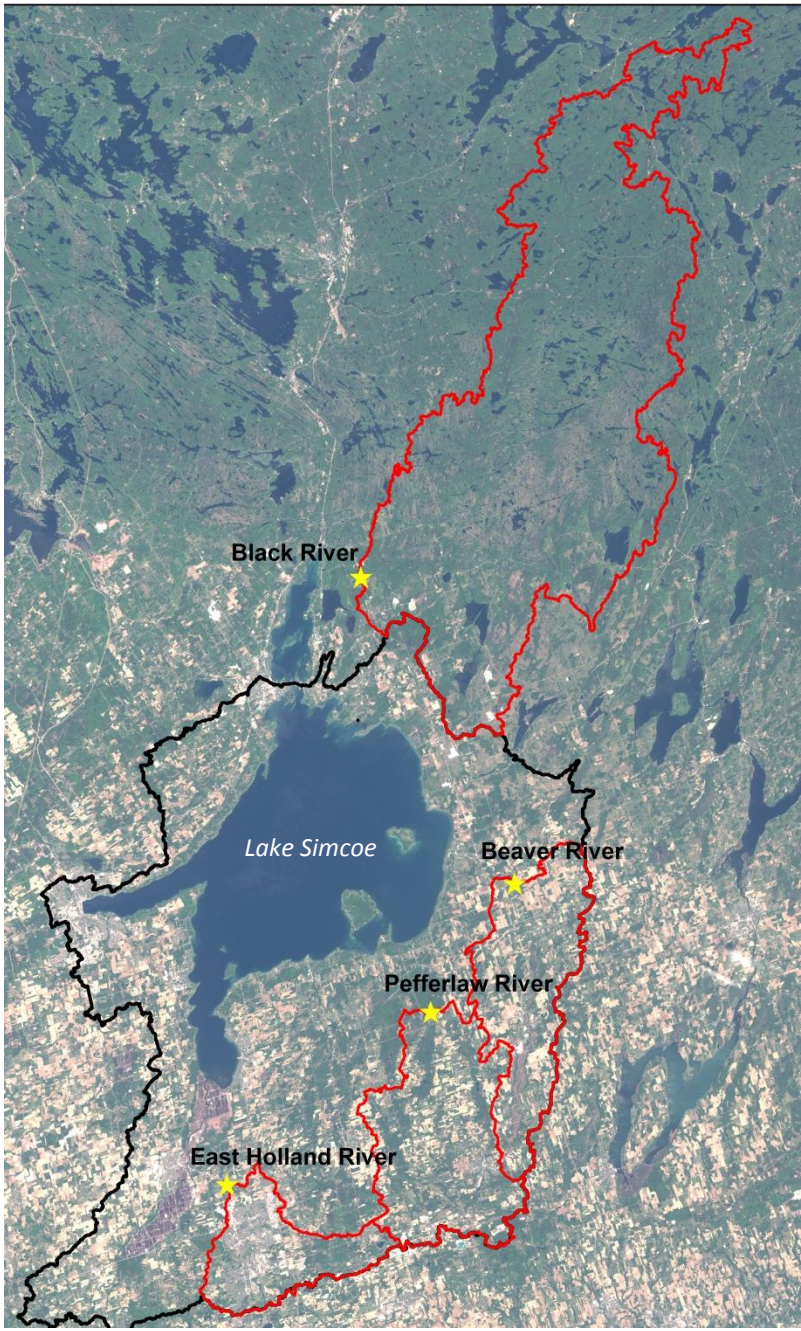
RP	Current	CLM01	CLM02	CLM03	CLM04	CLM05	CLM06	CLM07	CLM08	CLM09	CLM10
1.5	**4.58**	4.16	4.19	3.70	3.60	4.48	4.22	3.48	4.23	4.20	3.33
2	**5.43**	5.04	5.14	4.38	4.24	5.30	5.19	4.24	5.03	5.03	3.92
5	7.44	7.26	**7.75**	6.21	6.12	7.34	7.67	6.35	7.06	7.17	5.58
10	8.69	8.74	**9.67**	7.51	7.63	8.70	9.33	7.94	8.45	8.64	6.83
20	9.84	10.15	**11.63**	8.81	9.29	10.00	10.94	9.60	9.80	10.09	8.16
25	10.19	10.59	**12.28**	9.24	9.87	10.41	11.45	10.15	10.23	10.56	8.61
50	11.25	11.97	**14.36**	10.61	11.81	11.68	13.02	11.95	11.59	12.02	10.08
100	12.26	13.34	**16.56**	12.03	13.99	12.96	14.60	13.89	12.96	13.51	11.68

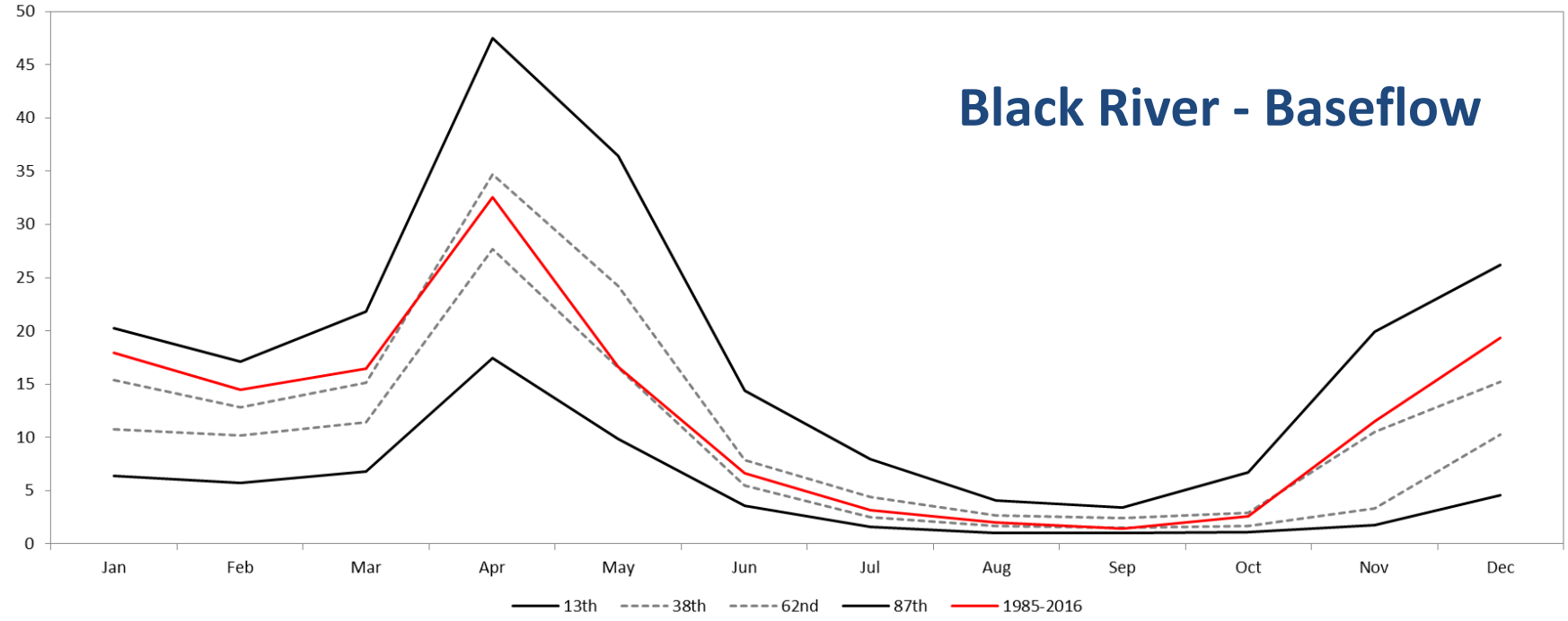
- Max Value

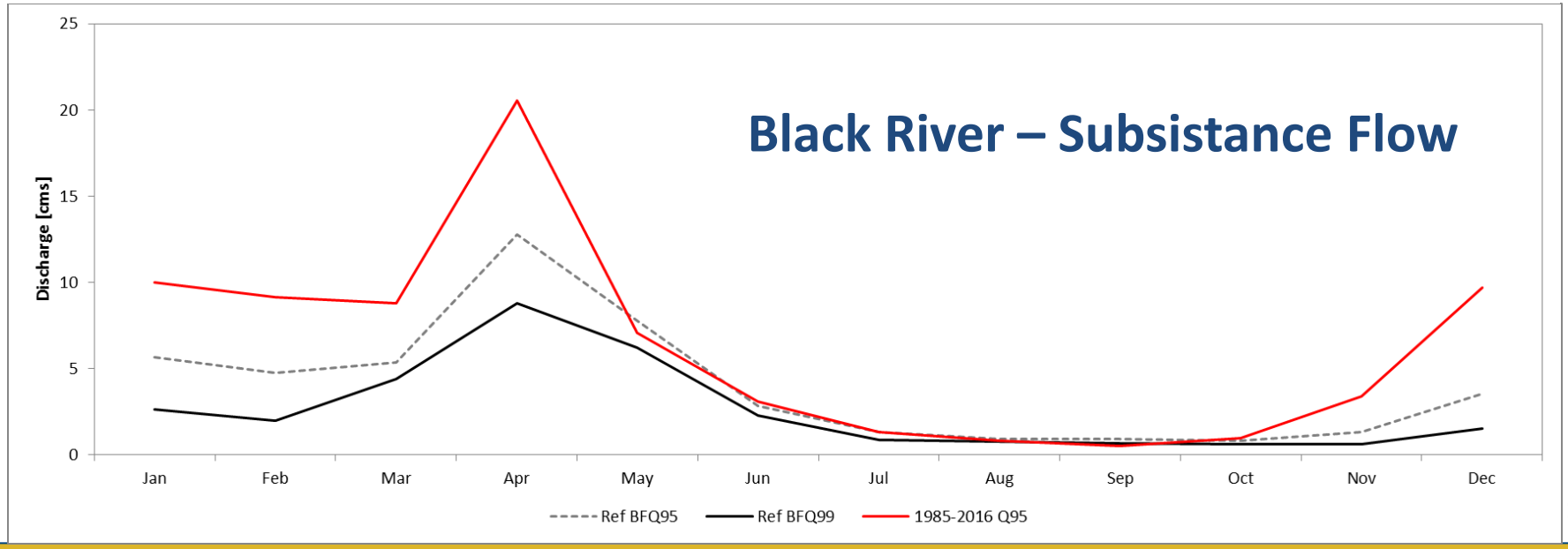
- Exceeds Current Conditions

Black River at Washago- Climate Change Analysis

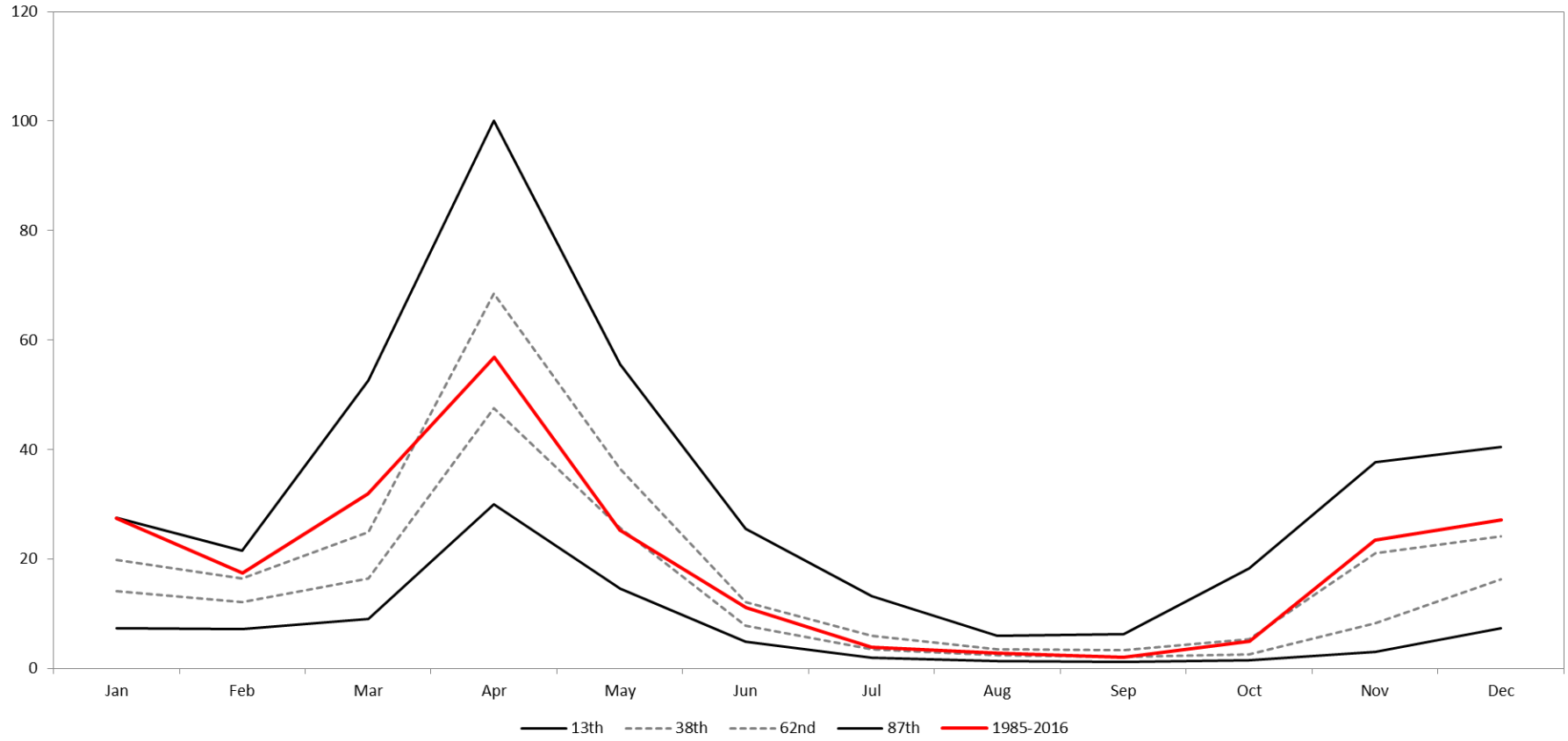
- Large watershed (>1500 km^2), resilient to change/disturbance
- Complete flow data set for a 100yr period of record (1915)!
- Very little land use change over time
- Climate change signal detected ~1980 onward. Consistent with IPCC.
- SAAS analysis 1944-1975 and 1985-2016



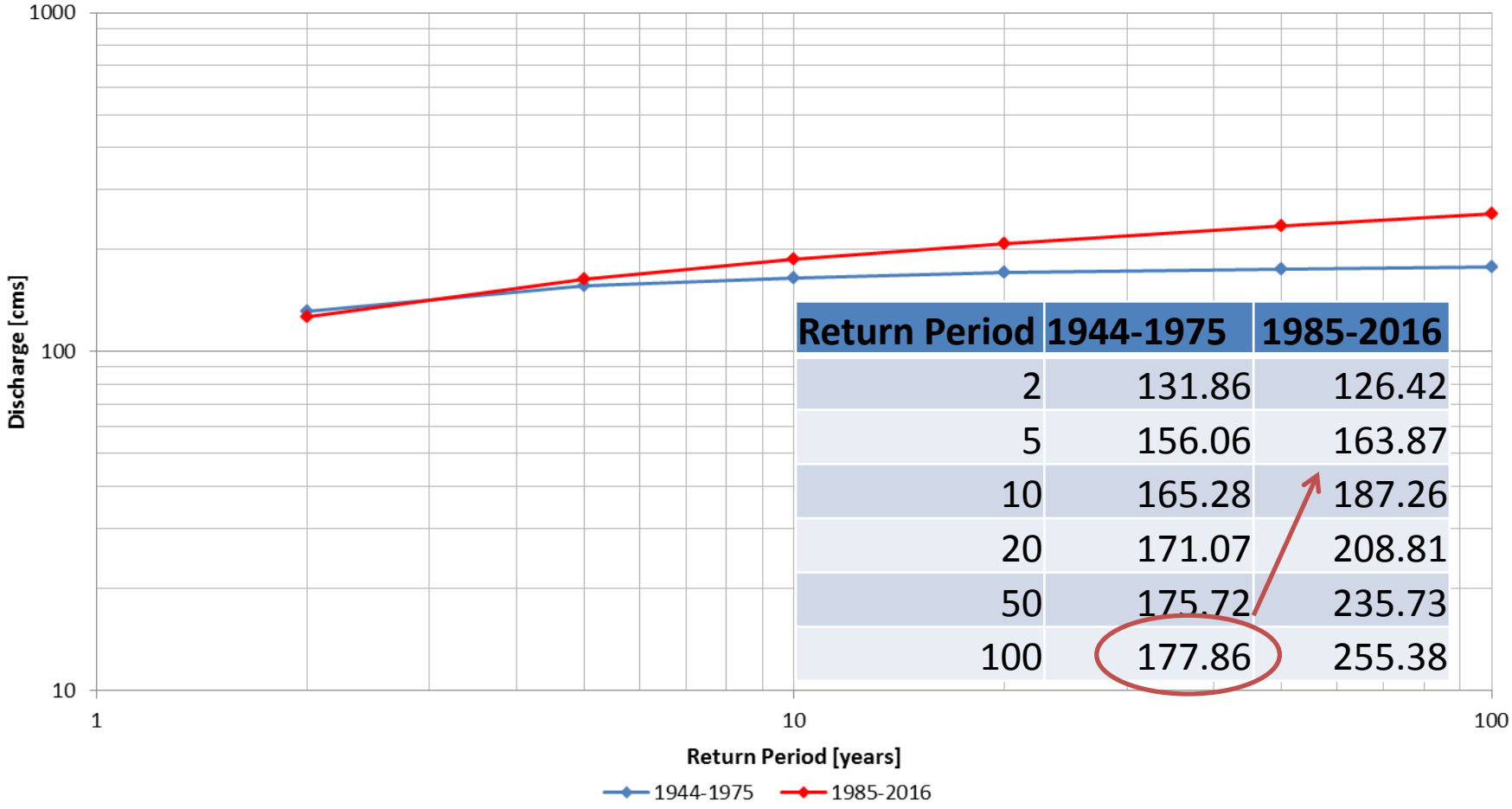

Black River - Baseflow
50
45
40
35
30
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
13th
38th
62nd
87th
1985-2016


Black River – Subsistance Flow
Discharge [cms]
25
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Ref BFQ95
Ref BFQ99
1985-2016 Q95

Black River – High Flow Pulse

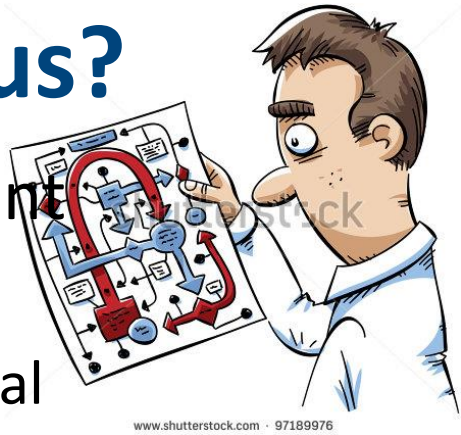


Black River - Flood Frequency Analysis



Return Period	1944-1975	1985-2016
2	131.86	126.42
5	156.06	163.87
10	165.28	187.26
20	171.07	208.81
50	175.72	235.73
100	177.86	255.38

What Does Eflows analysis tell us?



- Baseflow is not the most impacted component of the flow regime
  - Increased baseflow has few detrimental ecological impacts
- Land use changes typical of Southern Ontario are resulting in flow volume increases
- Climate change is resulting in flow volume increases. Happening Now! and more coming!
- Climate change and land use changes compound / complement each other
- Implementation of an Environmental Flow regime in Southern Ontario will require flow reduction not augmentation.

Environmental Flow Objectives = LID Objectives

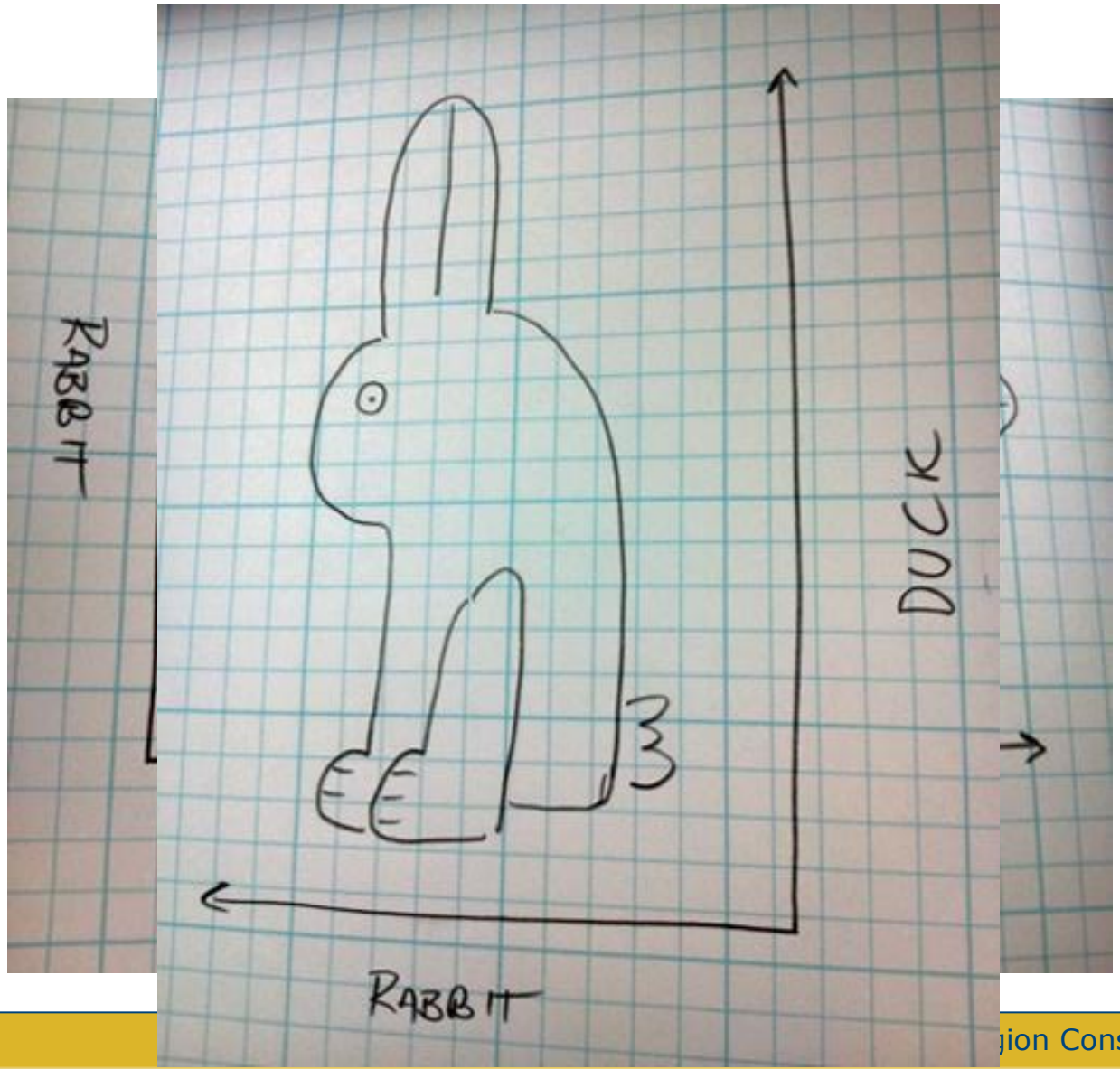
Environmental Flows

- Manage flow regime
- High flow mitigation
- Preserve stream form and function
- Ecological health

Low Impact Development

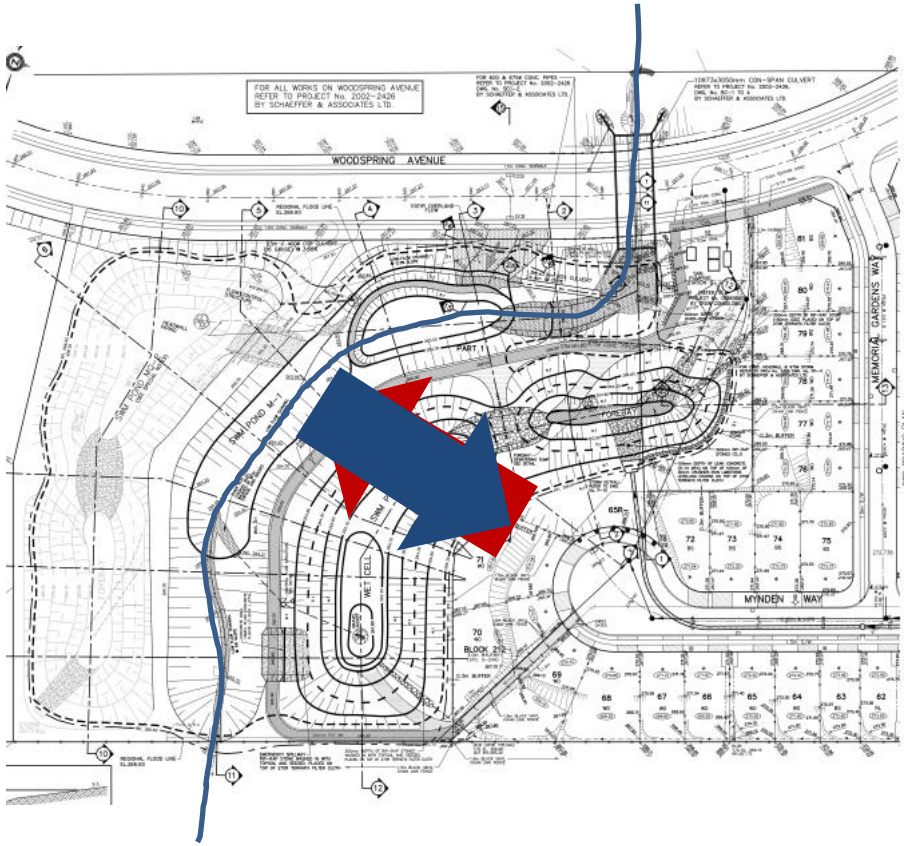
- Mimic natural hydrology
- Flood mitigation
- Reduce erosion
- Improve water quality
- Guide ECA compliance and decisions

How do Environmental Flows inform Stormwater Management?



Next Steps

- Model the impact of LID implementation on the flow regime
- Develop a suitable methodology for data poor systems
- Integrate environmental flow needs into stormwater planning process.
  - Stormwater impacts → receiving watercourse
  - Watercourse needs → stormwater design



Acknowledgements

- Funding support through MOECC
- Pioneering Eflow work of Dr. Andrea Bradford and Andy Beaton
- Technical modelling support of Mason Marchildon
- LSRCA Eflows team
  - Warren Yerex, Shelly Cuddy, Bill Thompson, Shauna Fernandes, Pam Strong, Rob Wilson

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