



# Adapting to Climate Change in Prince George

BCWWA Rain to Resource Workshop

October 28-29, 2010

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# Adaptation Underway in Prince George

## Today's Presentation

- City staff and community awareness
- Trends and projections for Prince George region
- A climate change adaptation strategy
- Implementing the strategy
- Impacts: water supply, flooding, storm water
- Stepping forward



# Credits

- Pacific Climate Impact Consortium
- University of Northern BC – Ian Picketts
- Fraser Basin Council
- Northwest Hydraulic Consultants

# Mountain Pine Beetle



**Initial  
awareness**

**Concern**



**Hazard  
trees  
removed**





# Potential Impacts



**More freeze-thaw  
cycles expected**

**Add more salt? Or ??**

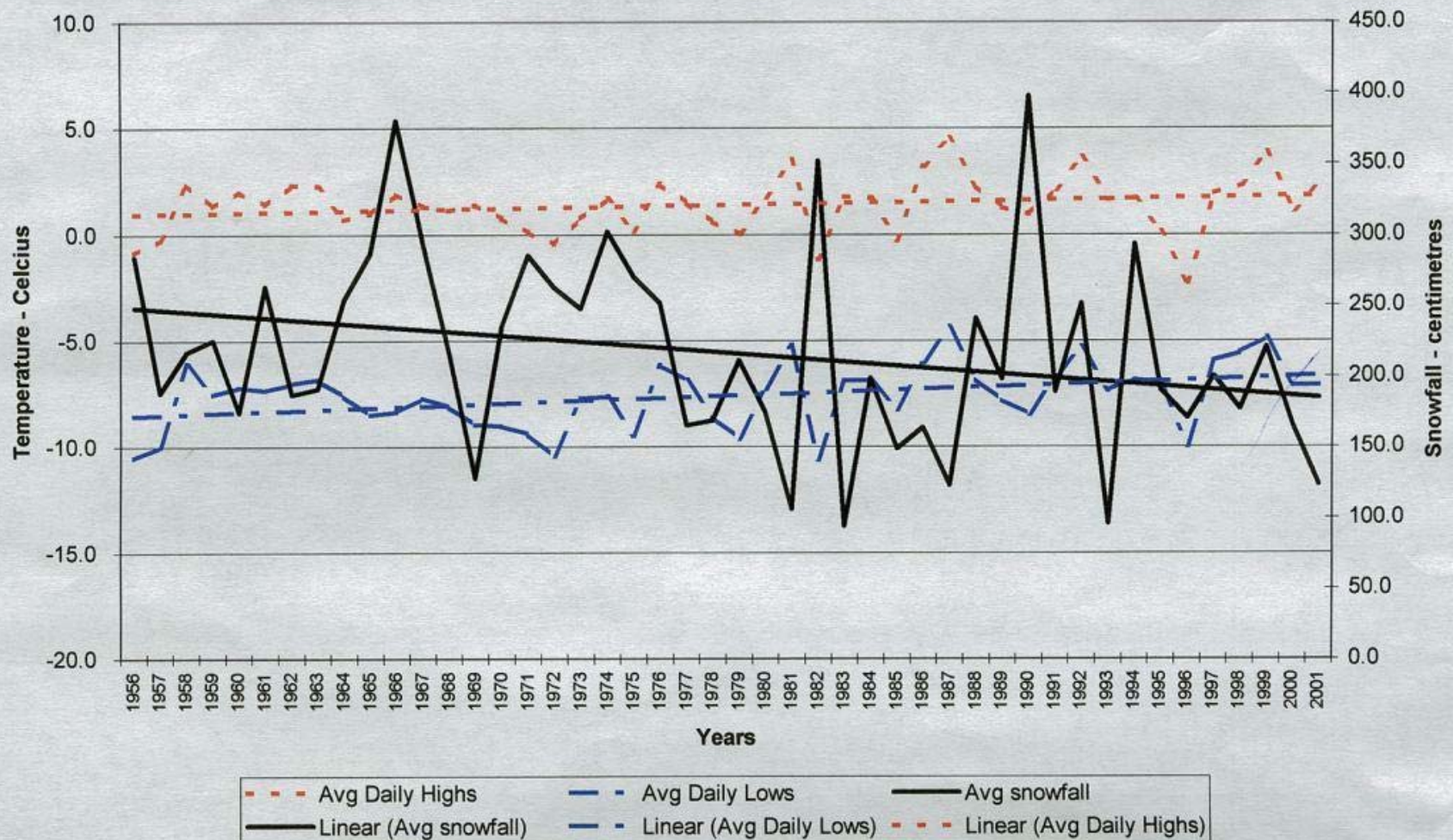
**Floods: Ice-related  
and Freshet**

**Can we expect a higher  
frequency?**



# Local Awareness

## Winter Records 1956-2001

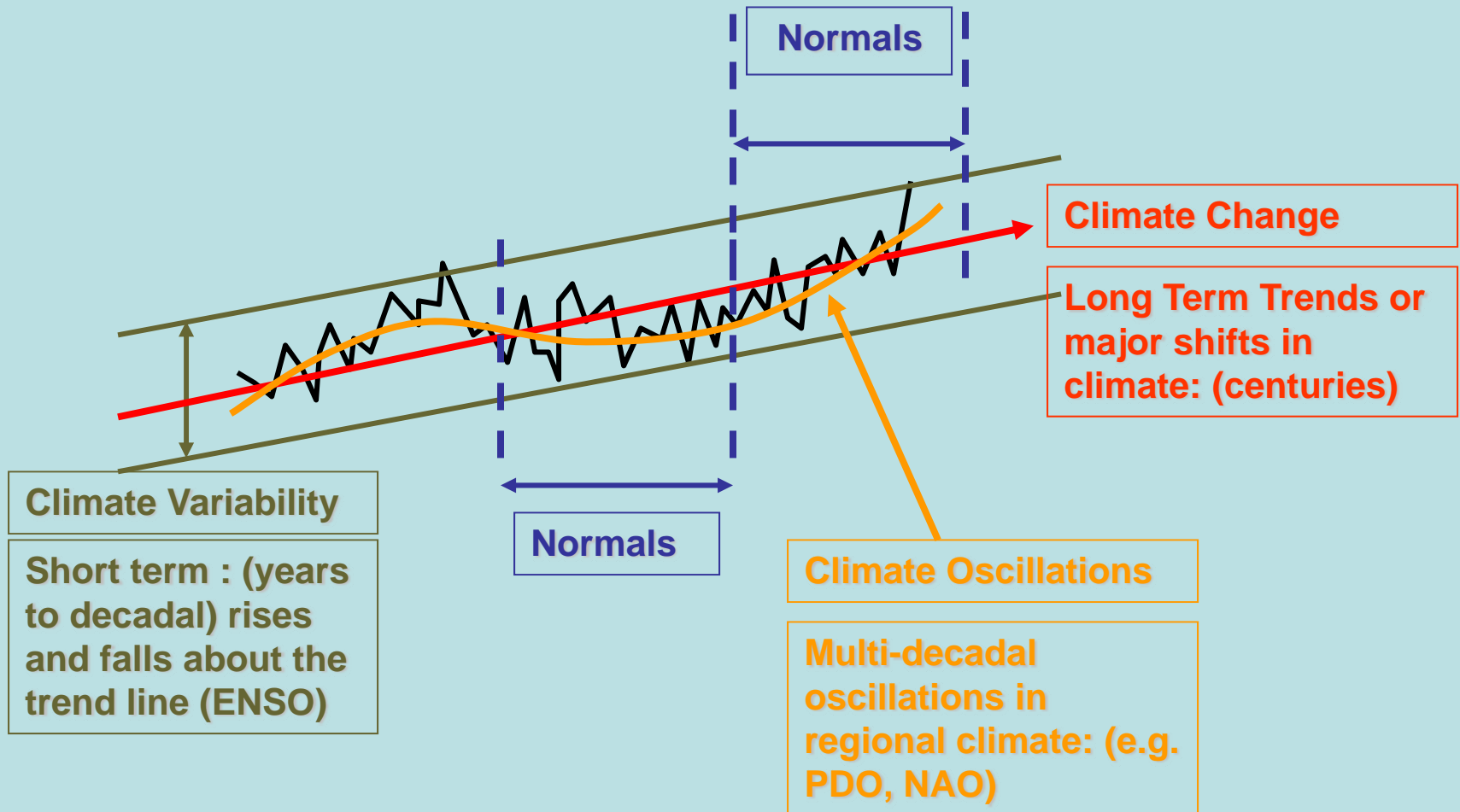


# Two Reports Completed

- Pacific Climate Impacts Consortium (PCIC):  
Climate Change in Prince George – Summary of Past Trends and Future Projections, August 2009
- University of Northern BC and City of PG:  
Adapting to Climate Change in Prince George: An overview of adaptation priorities, October 2009

# PCIC Report:

## Climate Variability & Climate Change







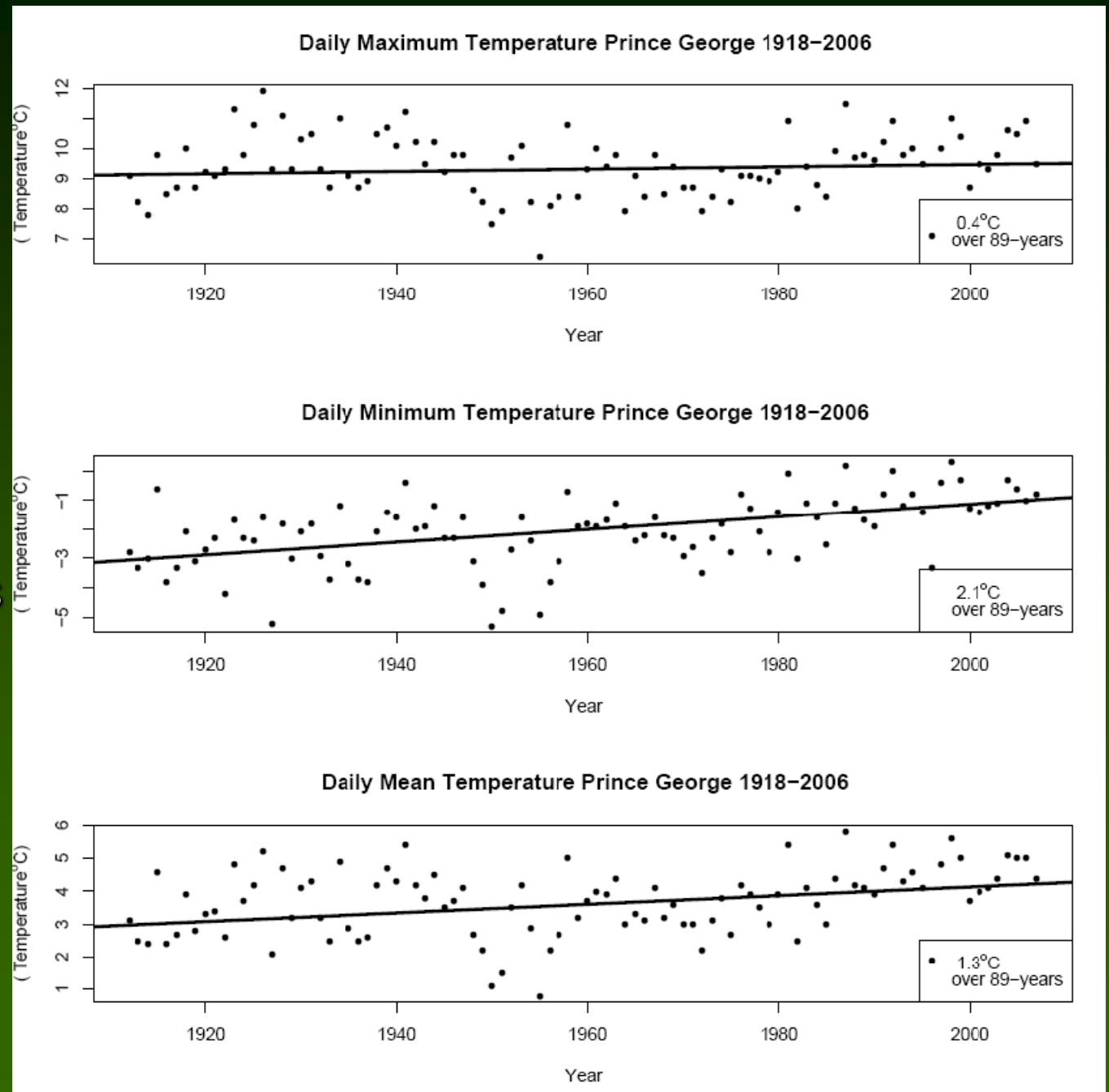
# Past Climate Changes

Temperature has increased since 1918

Daily Max + 0.4°C

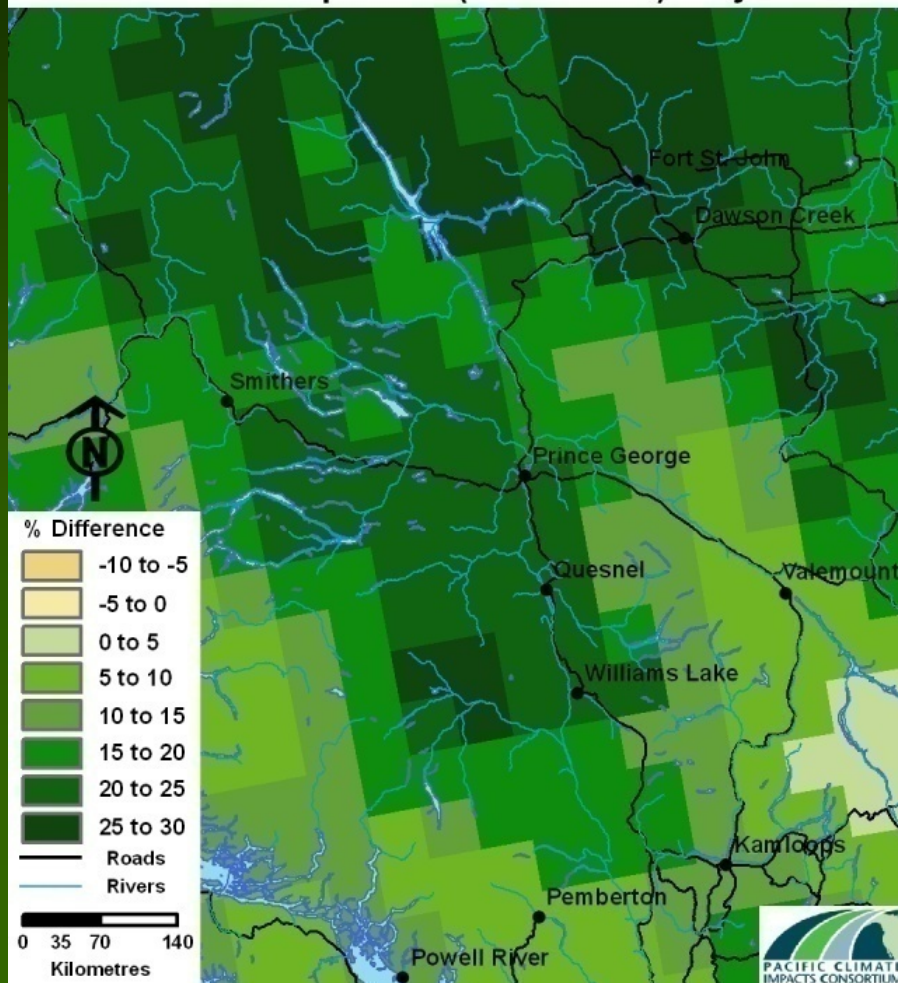
Daily Min + 2.1°C

Daily Mean +1.3°C

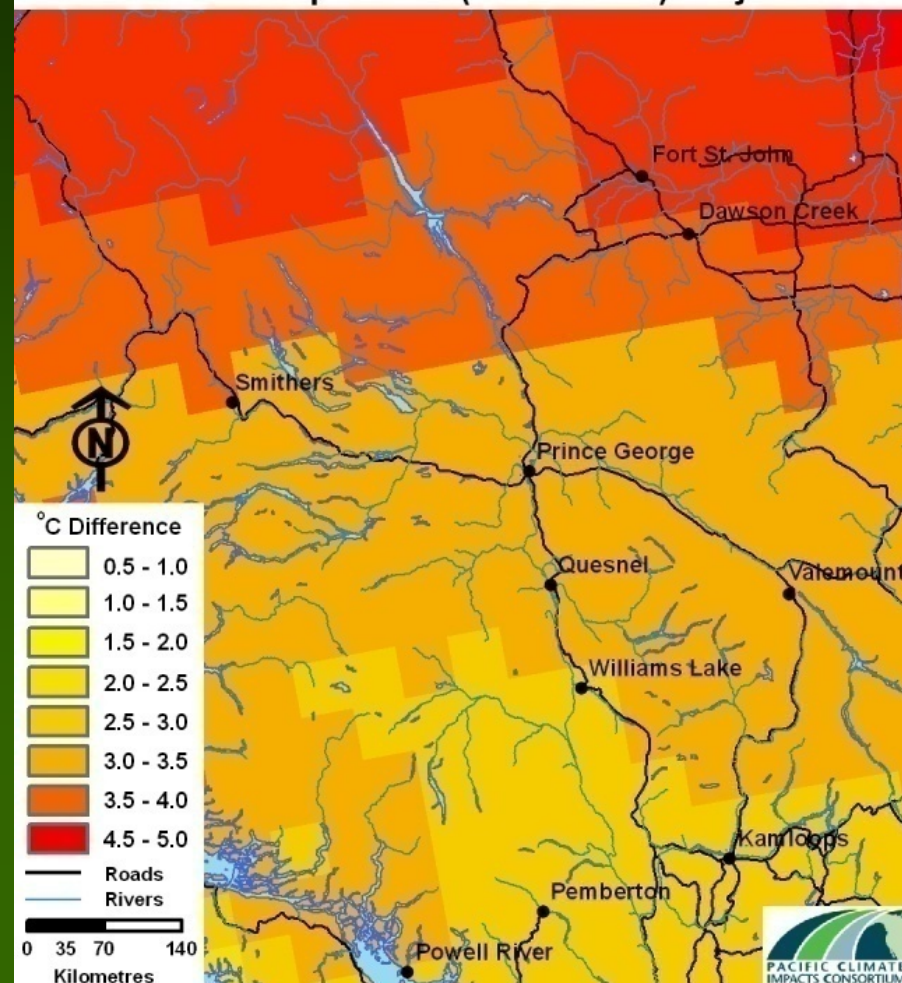


# Climate Projections

Winter Mean Precipitation (2041 - 2070) Projection



Winter Mean Temperature (2041 - 2070) Projection



# Climate Change Projections by 2050

- Temperature to increase by 1.6°C to 2.5°C
- Precipitation to increase by 3% to 10%
- Greater precipitation increase in winter,  
may increase or decrease in summer
- Growing Degree Days to increase from  
1000-1500 to 1500-2000
- River flow may increase but peak flows may  
not – depends on the watershed location



# UNBC Report: Envisioning an Adaptation Strategy for Prince George

- 2008 Quality of Life Survey
- Work With Smart Growth on the Ground
- Planning Institute of BC Workshop
- City of Prince George Workshop
- Partnership with Pacific Climate Impacts Consortium



<u>Level of Priority</u>		<u>Impact</u>	<u>Vulnerabilities</u>
Top Priorities	1	Forests	Increased forest fires and insect outbreaks
	2	Flooding	Property damage with more frequent floods
High Priorities	3	Transportation infrastructure	More potholes with increased freeze thaw events
	4	Severe weather / emergency response	Maintenance of transportation infrastructure during severe weather events
	5	Water supply	Water shortages as a result of drought

<u>Level of Priority</u>		<u>Impact</u>	<u>Vulnerabilities</u>
Medium Priorities	6	Slope stability	Threat of erosion and landslides
	7	Stormwater	Threat of overflowing systems during storm events
	8	Buildings and Utilities	Impacts of higher temperatures on building materials and structural stability
Other Priorities	9	Health	Increased heat waves threatening vulnerable populations
	10	Agriculture	Increased agriculture opportunities in the region
	11	New Residents and Businesses	Population growth as a result of 'climate refugees' migrating north

# Implementing the Climate Change Adaptation Strategy

- Incorporating adaptation into **myPG**, the City's Integrated Community Sustainability Plan
  - Climate change scenarios
  - Strategy workshops
  - Impact on economy (e.g. pine beetle)
  - Link to myPG website from [www.city.pg.bc.ca](http://www.city.pg.bc.ca)
- Including climate change policy in the current update of the **Official Community Plan**
- Piggy-back on existing community engagement processes



# Implementing the Climate Change Adaptation Strategy

- Update standards – infrastructure resilient to climate change
- Include adaptation in City Operations
  - Asset management
  - Annual budgets



# CLIMATE CHANGE ADAPTATION IMPLEMENTATION

## Vision & Leadership

- myPG
- OCP
- community input
- bylaw updates
- Operations

## Other

- health impacts
- agriculture
- tourism
- migration

## Natural Systems and Hazards

- flooding
- forests
- storm water
- slope stability
- erosion
- eco-systems

## Infrastructure Design

- development servicing
- streetscape guidelines
- onsite development  
guidelines
- local area service  
options

## Infrastructure Management

- road maintenance
- road  
improvements
- drainage systems
- water & sewer
- power & comm
- energy systems

## Climate Impacts – Water Supply

- 90% of City water is supplied by 3 high volume radial collector wells located on the Nechako River – capacity of each well 90 million litres/d
- 80% of the water aquifer serving wells are charged by the Nechako River
- Maximum capacity of wells would draw volume equivalent of 1 to 2% of the lowest flow in river (City draws 25% of capacity)
- Climate change projections suggest precipitation to increase:

So... water supply likely OK

## Climate Impacts - Flooding

1. Does more precipitation mean an increase in flooding frequencies?
2. Does more precipitation + warmer temperatures = more extremes (greater fluctuations)?
3. What impact does the pine beetle infestation have on river flow with the addition of more precipitation?
4. Will freeze-thaw cycles increase and affect ice jamming characteristics?
5. If flooding increases (both freshet and ice jams) will more sedimentation at the confluence cause more river migration?

# Climate Impacts - Flooding

- Climate change was considered in flood level analysis.
- Consultant analysis:
  - Effect of pine beetle infestation non-conclusive ... more research in works by others
  - Conducted a sensitivity analysis – 10-20% freshet flow increases over 1 in 200 year
  - Recommended City consider increasing freeboard by using 1 m instead of 0.6m



# **Schedule A to Bylaw No. 8285 Schedule A Flood Plain Mapping Fraser & Nechako Rivers at Prince George**

City Boundary	Rail Line	Spot Heights
Building Outline	Bridges	Contours 2009
Hydrography	Im Interval	In Interval
	Water	

## **Flood Plain Mapping**

Study Limits	Survey Connections with Marks	Flood Construction Level (FCL)
FCL - Thawing Intersection	Flood Construction Level (FCL)	Flood Construction Level (FCL)
Flood Construction Level (FCL)	Flood Construction Level (FCL)	Flood Construction Level (FCL)

## **Flood Plain Areas:**

Flood Plain Area 1	Flood Plain Area 2	Flood Plain Area 3
Flood Plain Area 4	Flood Plain Area 5	Flood Plain Area 6

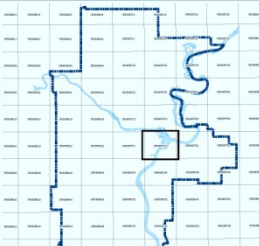
All elevations are in metres (ICG)

## **Limitations of Flood Plain Maps:**

1. The flood hazard maps are based on river surveys conducted in 2008, 1995 and 1979, and LIDAR surveys from 2009 and 2008. The maps show flood conditions at the time of the surveys. Changes to the channel, flood plain, or climate will affect the flood levels and render site-specific map information obsolete.
2. Flood hazard maps are administrative tools that show the minimum designated flood elevation and flood plain boundaries. Flooding may occur outside of the designated boundaries. Northwest Hydraulic Consultants Ltd. (NHCL) do not assume any liability by reason of the designation or failure to designate areas on the map.
3. Flood hazard maps do not provide information on site-specific hazards such as land erosion or sudden shifts in the water courses.
4. Other sources of water, such as creeks, rivers or other barriers can restrict water flow and affect flood levels locally. Channel obstructions, local storm water inflow, groundwater or other land drainage can cause flood levels to exceed those indicated on the map. Lands adjacent to a flood plain may be subject to flooding from tributary streams that are not indicated on the map.
5. The accuracy of the location of a flood plain boundary as shown on this map is limited by the accuracy of the LIDAR data used for generating base contour mapping.
6. Professional assistance and detailed site-specific engineering analysis are required to address any of the above issues.

## **Notes to Users:**

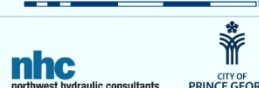
1. The Designated Flood has a statistical return period of 200-years. (There is a one in 200 chance that the Designated Flood could be equaled or exceeded in any one year.)
2. Further flood levels were computed using the hydraulic model HEC-RAS, version 4.0. Ice-related flood levels were derived based on statistical analysis of historic ice floods and corresponding water levels. The technical analysis is described in the report "Flood Risk Evaluation and Flood Control Solutions Phase 1, Final Report", 2009 by NHCL et al.
3. Flood Construction Levels (FCLs) were computed as the 200-year flood level + 0.6 m freeboard and are shown on the maps.
4. Flood levels corresponding to the 20-year flood + 0.6 m freeboard are also indicated.
5. Flood construction boundaries are delineated for the following four conditions:
  - a. The 20-year flood + 0.6 m freeboard.
  - b. Areas directly connected to the river channel, where the 200-year flood depth equals or exceeds 1 m, termed the "Severe Flood Hazard Area".
  - c. Areas where the ground level is less than 2.4 m above the FCL, termed the "Basement Restriction Area". Areas with a horizontal projection of groundwater from the river basement flooding may occur within this zone.
  - d. The flood boundaries assume the absence of dike/roadways are not established on the ground by legal survey and, are not delineated for side streams, local drainage or storm water runoff.
7. The required setback of buildings from natural boundaries or water courses is not shown. For setback restrictions and other guidelines, refer to City of Prince George Flood Plain Regulation Bylaw No. 8285.
8. These maps are available from City of Prince George. The City of Prince George does not provide any warranty or guarantee of merchantability or fitness for a particular purpose. The City is not liable for any damages or losses that may result from the use of the information in this document.



Mapsheet: 09JG09712  
Date Printed: May 6, 2010  
Coordinate System: UTM NAD83, Zone 10

Designed by: GDL  
Prepared by: MSN  
Checked by: MH

Scale: 1:5000  
0 55 110 220 330 440 550 Metres

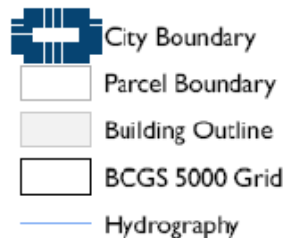




# Schedule A to Bylaw No. 8285

## Flood Plain Mapping

### Fraser & Nechako Rivers at Prince George



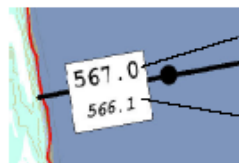
Transportation  
 —+— Rail Line  
 — Bridge  
 Contours 2009  
 — 1m interval  
 — 5m interval

ISM Mon  
 Spot Heights  
 ▲ Definite  
 ▲ Indefinite  
 ▲ Road  
 ▲ Water



#### Flood Plain Mapping

- Study Limit
- Survey Cross-sections with labels
- FCL - Thalweg Intersection
- Flood Construction Level Isoline



Flood Construction Level (FCL)  
 1 in 20 yr Flood Level  
 (+ 0.6 m freeboard)

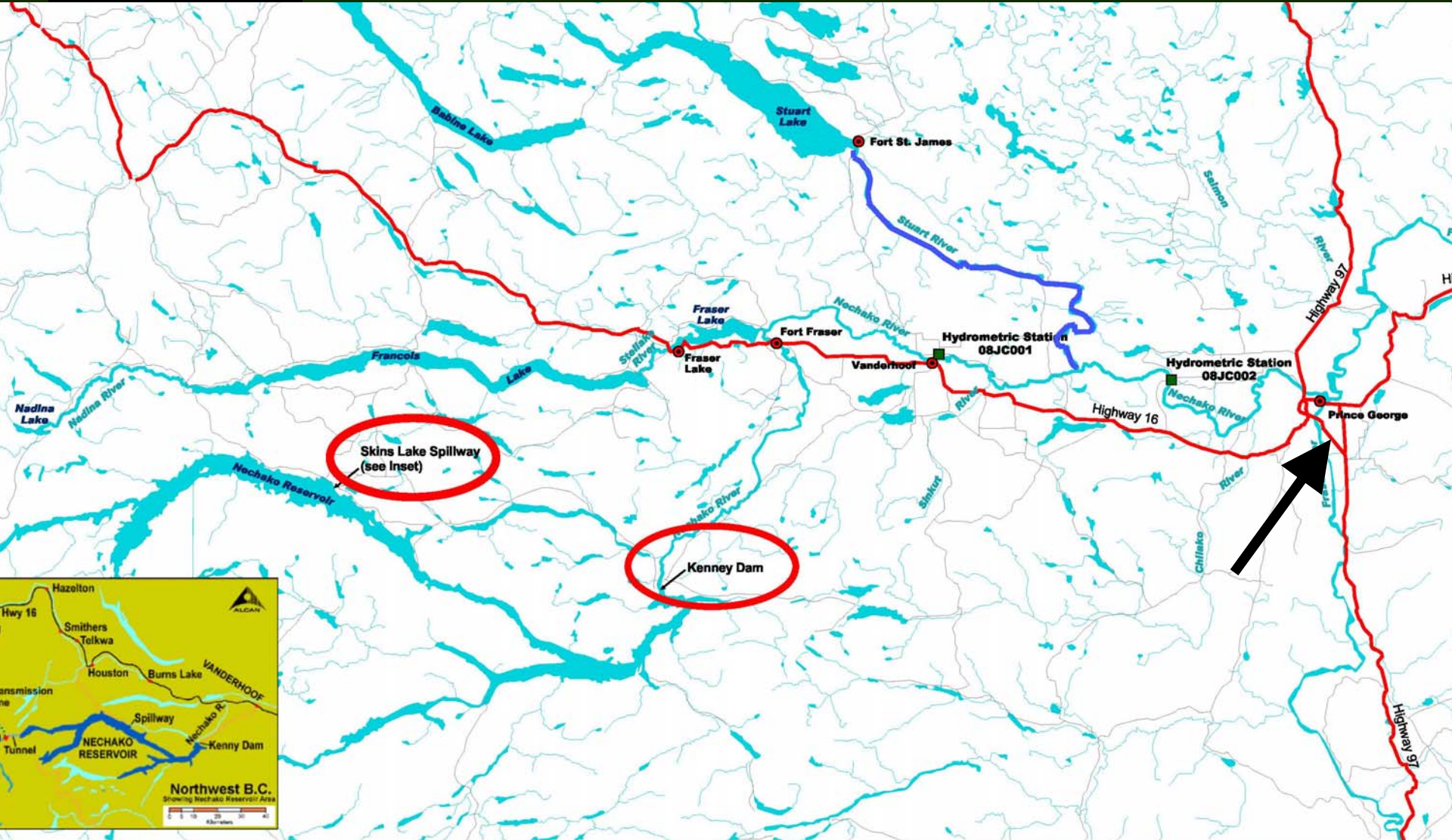
#### Flood Plain Areas:

- 1 in 200 yr Severe Flood Hazard Area
- 1 in 20 yr Flood Limit, including 0.6m freeboard
- 1 in 200 yr Flood Limit, including 0.6m freeboard (FCL)
- 1 in 200 yr Basement Restriction Area



CITY OF  
PRINCE GEORGE

# Nechako River Basin







15.12.2007 14:36





16.12.2007 14:23





20 12 2008





24 12 2008





15.12.2007 14:37

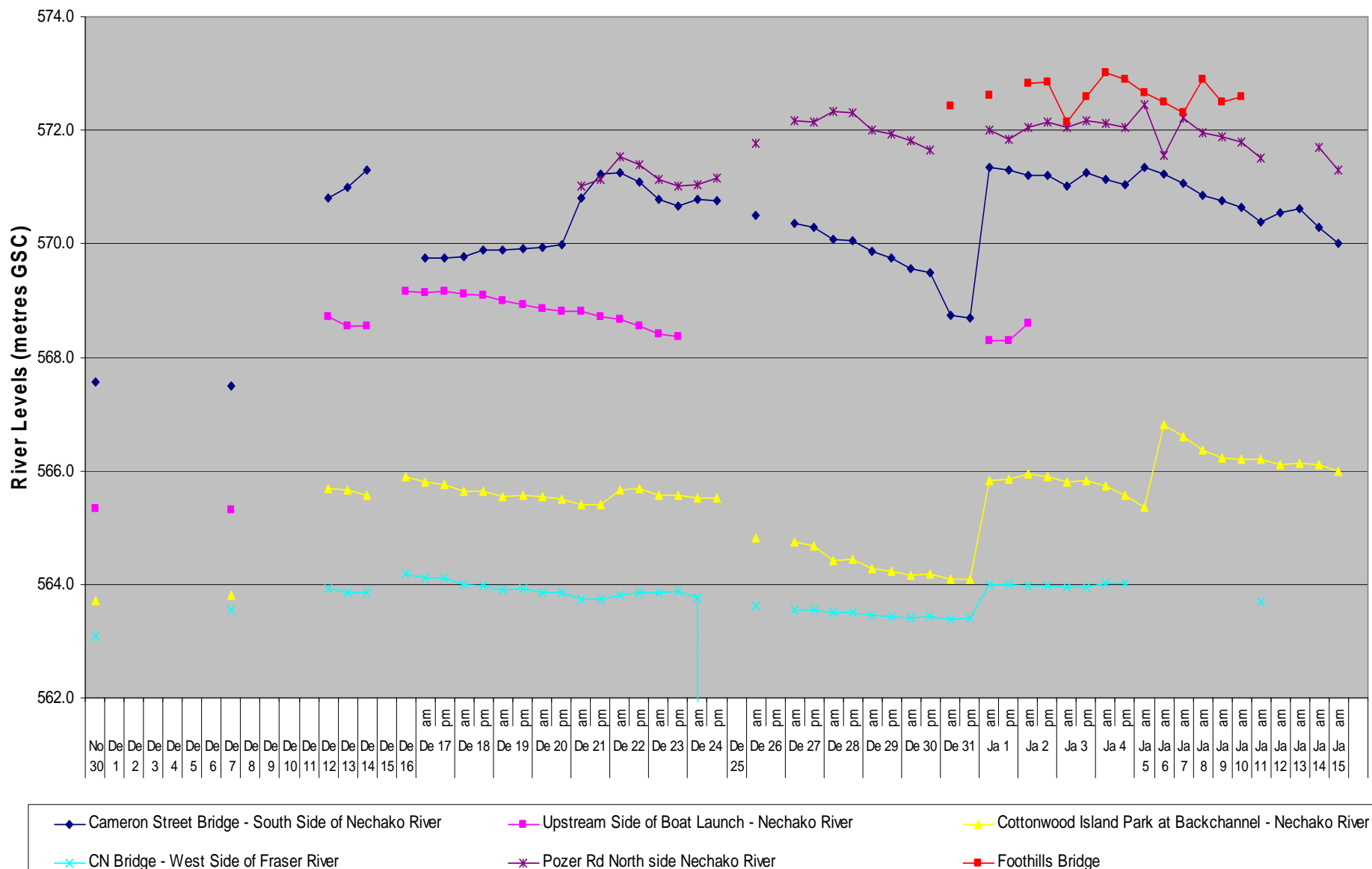




16.12.2007 14:24



## 2007-2008 Nechako River Ice Jam - Water Levels





# Climate Impacts – Stormwater

1. How does more precipitation impact storm return periods?
2. Will more precipitation + warmer temperatures mean more extremes (longer dry spells, heat waves and higher intensity storms )?
3. Will freeze-thaw cycles in winter increase rain events ice storms in winter?
4. Will groundwater base levels increase or decrease?

# Runoff – Winter Thaws







# Climate Impacts – Storm Water

- Completion of two watershed drainage plans in 2011 – sensitivity analysis to be conducted
- Work to proceed in 2011 to assess impact of 3 to 10% increases in annual precipitation.
  - new rainfall intensity curves
  - storm sewer flow monitoring
  - stream monitoring
- Currently using design minimum pipe sizes to 1 in 10 year storm return period (up from 1 in 5 year) for minor systems, 1 in 100 year for major systems



# Implementing Climate Change Adaptation – Stepping Forward

- Official Community Plan Update
- City's participation in the Regional Adaptation Collaboration (RAC) project – comprehensive case study:
  - Completion date March 2012
  - Implementation of City's climate change adaptation strategy
  - Integration of climate change adaptation into City policy (*myPG*, Official Community Plan)
  - Develop partnerships (e.g. transportation stakeholders)
  - Investigate impacts on storm water/drainage, slope stability, erosion, etc.
- Natural Areas Eco-systems Mapping

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