SUMMARY FOR POLICY MAKERS

Climate Change Engineering Vulnerability Assessment

Coquihalla Highway (B.C. Highway 5)
March 2010

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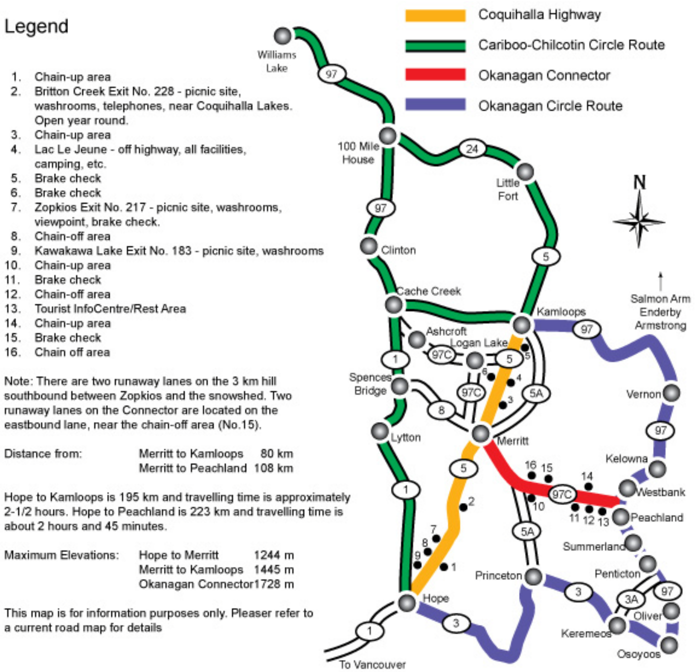
Purpose

- Identify those components of the Merritt South Road Section of the Coquihalla Highway that are at risk of failure, damage and/or deterioration from extreme climatic events or significant changes to baseline climate design values.
- The assessment was carried out using the PIEVC Engineering Protocol, Version 9, April 2009

The Coquihalla Highway

- The Hope to Merritt section of the Coquihalla Highway, Hwy 5, in British Columbia was constructed between 1982 and 1986 through mountainous terrain bordered by the Fraser Delta to the West and the Cascade Mountain Range to the East.



Study Scope and Timing

- Assessment evaluated a 44.83km in length of highway
  - From the Nicolum River Bridge, North End at .90km, to the start of Dry Gulch Bridge at 45.73km in LKI Segment 2000.
- Project was completed over the period November 1, 2009 through March 31, 2010.
  - Contemplated climate change effects through the year 2050.

Climate Parameters Selected

Climate Parameters and Infrastructure Indicators Selected for the Risk Assessment

#	Climate Parameter	Infrastructure Indicator
1	High Temperature	Number of Days with max. temp. exceeding 30° C
2	Low Temperature	Days with min. temp. below -24° C
3	Temperature Variability	Daily temperature variation of more than 24° C
4	Freeze / Thaw	17 or more days where max. temp. > 0° C and min. temp.<0° C
5	Frost Penetration	Assessed through empirical analysis of forecast climate conditions.
6	Frost	47 or more days where min. temp. <0° C
7	Extreme Rainfall Intensity Over One Day	Determined empirically. PCIC used > 76mm over 24hrs.
8	Magnitude of Severe Storm Driven Peak Flows	Determined empirically. PCIC used directional wind speed, temperature and precipitation all > median values.
9	Frequency of Severe Storm Driven Peak Flow Events	Determined empirically. PCIC used directional wind speed, temperature and precipitation all > median values for three consecutive days in autumn.
10	Rain on Snow	10 or more days where rain falls on snow
11	Freezing Rain	1 or more days with rain that falls as liquid and freezes on contact
12	Snow Storm / Blizzard	8 or more days with blowing snow
13	Snow (Frequency)	Days with snowfall >10 cm
14	Snow Accumulation	5 or more days with a snow depth >20 cm
15	High Wind / Downburst	Wind speed > 80.5 km/hr
16	Visibility due to Fog	Decrease in stopping sight distance < 245 m

Infrastructure Components

List reviewed and finalized for risk assessment workshop in early March 2010

Infrastructure Components

#	Infrastructure
1	Surface - Asphalt
2	Pavement Marking
3	Shoulders (Including Gravel)
4	Barriers
5	Curb
6	Luminaires
7	Poles
8	Signage - Side Mounted - Over 3.2 m2
9	Signage - Overhead Guide Signs
10	Overhead Changeable Message Signs
11	Ditches
12	Embankments/Cuts (Constructed)
13	Hillsides (Natural)
14	Engineered Stabilization Works
15	Avalanche (Inc Protective Works)
16	Debris Torrents (Inc Protective Works)
17	Structures that Cross Streams
18	Structures that Cross Roads
19	River Training Works (Rip Rap)
20	MSE Walls
21	Pavement Structure above Sub-Grade
22	Catch Basins
23	Median and Roadway Drainage Appliances
24	Sub-Drains
25	Third party utilities
26	Culverts < 3m
27	Culverts ≥ 3m
28	Asphalt Spillway and Associated Piping/Culvert
	Environmental Features
29	In stream habitat works
30	Off channel habitat works
31	Wild life fence system
32	Wild life crossing structures
33	Vegetation management
34	Invasive Plants & Pests
	Miscellaneous
35	Administration/Personnel & Engineering
36	Winter Maintenance
37	Ancillary buildings and utilities and yards.
38	Communication
39	Emergency Response
40	Maintenance (Markings, Crack Sealing)

PCIC Projections for the Region

- Warming with;
  - Increasing hot extremes;
  - Decreasing periods of hard frost;
- Reduction in the range of temperatures; and
- An increase in periods of heavy precipitation;
  - Requiring more detailed empirical downscaling to resolve.

Risk Rankings

- Three Categories
  - Low or No material Risk
  - Medium Risk
  - High Risk
- Evaluated:
  - 435 low/no material risk
  - 111 medium risk
  - 14 high risk

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High Risk Items

- 14 High Risk Items
- All related to extreme rainfall and Pineapple Express events
  - Risk was further characterized through additional engineering analysis
- Team recommended additional studies to characterize:
  - These climatic events; and
  - Response of the highway infrastructure to them

Conclusion

Based on this risk assessment, the Coquihalla Highway is generally resilient to climate change with the exception of drainage infrastructure response to Pineapple Express events

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Recommendations 1

1. Investigate design of reserve capacity for increased local extreme rainfall
2. Incorporate required upgrading of infrastructure component into part of regular design and maintenance program
3. Further investigate potential frequency and magnitude of local extreme rainfall events
4. Monitor and document infrastructure component responses and issues to extreme climate events
5. Investigate if infrastructure failure models include climate as variable

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Recommendations 2

6. Continue to investigate relevant climate parameter data
   - Use of downscale analysis of Regional Climate Model data
   - Matching of modeling data to local IDF data
   - Develop systematic measurement basis for analysis
7. Pursue better definition through more advance downscaling work
   - Frequency of rain on snow events
   - Frequency on freezing rain events
   - Snow accumulation
8. Further investigation and evaluation of high wind/downburst issues
9. Further investigation and evaluation of visibility (fog) issues

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Recommendations 3

10. With better definition of current visibility issues, assess the impact of climate change on this matter

11. Establish central repositories for technical, engineering, design, operation, maintenance and climatic data necessary to conducting climate change vulnerability assessments for each highway segment contemplated for future vulnerability assessment studies.

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