R.V. Anderson Associates Limited
environment · infrastructure

PIEVC CVIIP

Greater Grand Sudbury

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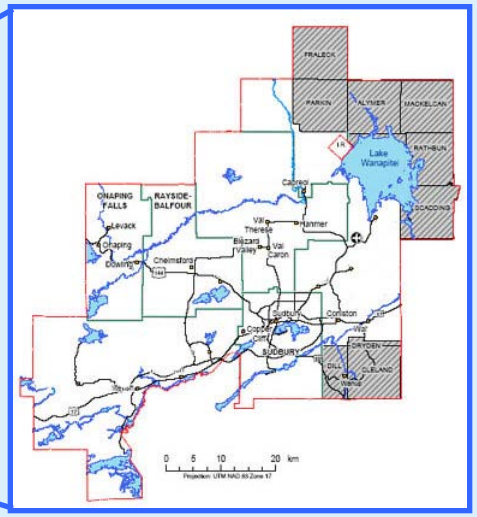
March 13, 2008

Sudbury Roads and Associated Structures Vulnerability Assessment Phase II – Pilot Study

Project Definition – Greater Sudbury, Ont.



- 340 km NW of Toronto, 425 km west of Ottawa
- population ~160 000
- on Canadian Shield
- 3,627 km^2
- 330 Lakes within city boundaries
- main industry is mining (nickel/copper ore)

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Project Definition – Infrastructure of Interest

- Surface – Gravel
- Surface – LCB
- Surface – Asphalt
- Curb
- Sidewalk
- Traffic Signals
- Street Lighting
- Utility Poles
- Boulevards & Shoulders
- Ditches
- Interlock Pavers
- Catch Basins
- Culverts
- Maintenance Holes
- Bikepaths
- Embankments/Cuts
- Bridge/Structures
- Municipal Signage
- Road Sub-Base
- Storm Sewer Systems
- Collection Systems
- Underground Utilities
- Administration/Personnel
- Maintenance (Markings, Crack Sealing)
- Winter Maintenance
- Record Keeping

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Project Definition – Team and Timeframe

Study Team:

- City of Greater Sudbury
- Dennis Consultants (RVA Sudbury)
- Hydro-Com Technologies (RVA Fredericton)

- Lifecycle of pavement to be 30 years
- Lifecycle of “buried structures” 50 - 100 years

- Three tri-decadal horizons:
  - 2011-2040 (2020)
  - 2041-2070 (2050)
  - 2071-2100 (2080)

Climate Analysis

Rainfall:

"more rainfall with more frequent and more intense storms"

- ↑ 6 hour freq for 5, 10 and 20 mm events
- ↑ 1 day freq for 5, 10 and 20 mm events
- ↑ Avg. max for 1, 2, and 5 day periods
- ↑ Avg. total annual
- ↑ Daily intensity

Snowfall:

"less snow with less small storms but more big storms"

- ↑ 1 day freq events ≥ 20 mm SWE
- ↓ 1 day freq events ≥ 5 mm and ≥ 10 mm SWE
- ↓ Avg. total annual
- ↑ Daily intensity
- ↑ Rain on snow events

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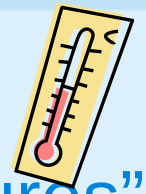
Climate Analysis

Temperatures:



"rising temperatures"

- Monthly average maximum
- Monthly average minimum
- Annual maximum
- Annual minimum

Wind:

no trends identified

Freeze-Thaw:

decreasing frequency

Ice Accretion:

no data available

Groundwater table:

no data available

Infrastructure Data

- No drainage infrastructure or culvert data.
- Insufficient infrastructure age info.
- Good information on road types and lengths.
- Some information on road maintenance costs.

Conclusions

- Increased frequency of high intensity rain events ***will*** affect:
  - Washouts and damage of gravel road surfaces.
  - Surcharging/flooding of drainage systems.
- Rising temperatures ***may*** affect softening/rutting of asphalt road surfaces.
- Ice accretion ***could*** affect all infrastructure of interest (functionality and O&M).

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Conclusions

- **Probable** *major* vulnerabilities exist for:
  - Drainage infrastructure
    - Rainfall (surcharging and/or flooding)
      - All performance responses
  - Retrofit and change design standards

  - Gravel surfaced roads
    - Rainfall (washouts and damage)
      - Functionality, O&M and environmental
  - Retrofit and change construction standards

Conclusions

- *Minor* vulnerabilities exist for:
  - Asphalt surfaced roads
    - Higher max. temperatures (softening & rutting)
      - Durability and O&M
  - Modify mix design for new roads
  - Embankments/cuts
    - Higher groundwater tables (slope stability)
      - Structural integrity
  - Perform sensitivity analyses

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Conclusions

- **Possible** vulnerabilities exist for:
  - All infrastructure of interest
    - More ice, more often ????
      - All performance responses but especially functionality and O&M
  - Additional study of changes in climate
  - Risk & criticality assessment
  - Changes in winter maintenance of roads and sidewalks

Recommendations

- Develop hydraulic inventory database.
- Develop stormwater management plan.
- Assess impacts of environmental and functionality effects on gravel surfaced roads .
- Perform infrastructure risk assessment for ice accretion/ice storms.
- Change asphalt mix to accommodate higher temperatures.
- Evaluate slope stability of large and “high risk” embankments/cuts.

Cross-Cutting Issues

- Major vulnerabilities due to:
  - Increase in frequency of high intensity rain events (drainage and flooding).
  - Potentially increased incidence and intensity of ice accretion/ice storms (structural stability, functionality and O&M).
- Minor vulnerabilities due to:
  - Increased max. temperatures (material durability).
  - Rise in groundwater (slope stability).