Speaking for Wildlife

Presentation to the

Select Committee of the Yukon Legislature Regarding the Risks and Benefits of Hydraulic Fracturing

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WILDLIFE CONSERVATION SOCIETY CANADA

What is WCS Canada?

- Charitable, non-profit organization
- Registered in Canada
- Parent organization in NY; 60+ countries internationally
- Working in Yukon since 2004

Mission: *WCS saves wildlife and wild places worldwide through science, conservation action, education, and inspiring people to value nature.*

What is Risk (and Benefit)?

PROBABILITY of an Outcome

X

COST (REWARD) of that Outcome

- Subject of science
- Many factors
- Often lack precise answers

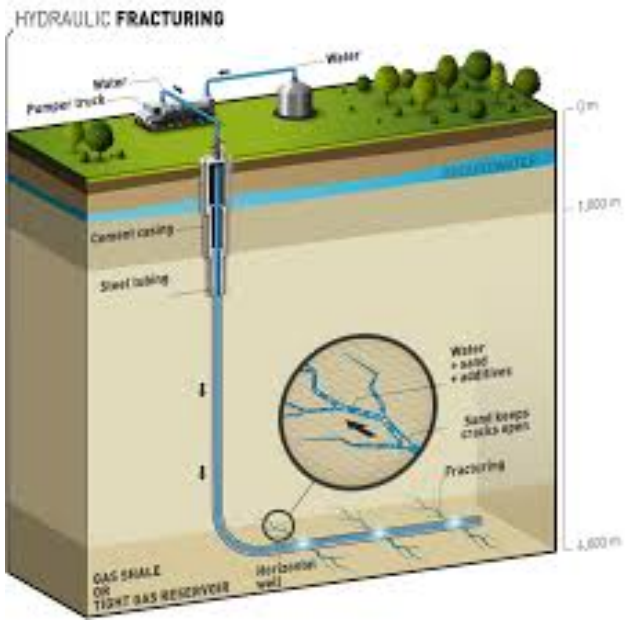
- Partly science
- Tangibles vs Intangibles
- Values

POTENTIAL MECHANISMS of RISK & BENEFIT TO WILDLIFE

- WATER USE
- WATER POLLUTION & CONTAMINANTS
- AIR POLLUTION
- INFRASTRUCTURE

WATER USE - Amounts

SITUATION



- Fracking fluid is 90 - 95% water
- Each well uses 2,000 to 80,000 m^3 water
- Most comparisons are made with other uses of water:
  - 20,000 m^3 = Golf course for 28 days
  - Much larger % used in irrigation or domestic situations

WATER USE - Amounts

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ISSUE (Risk)

Comparisons are misleading:

- In most uses, water recycles
- Fracking results in net loss:
  - 10 – 60 % stays underground
  - Remainder is "flow-back"
  - Flow-back is polluted so requires dilution / treatment to be re-used
  - Much flow-back is disposed of "permanently" in deep wells
- Fracking removes water from the Earth's water cycle
- Comparison of rates of use should be with **what is available**

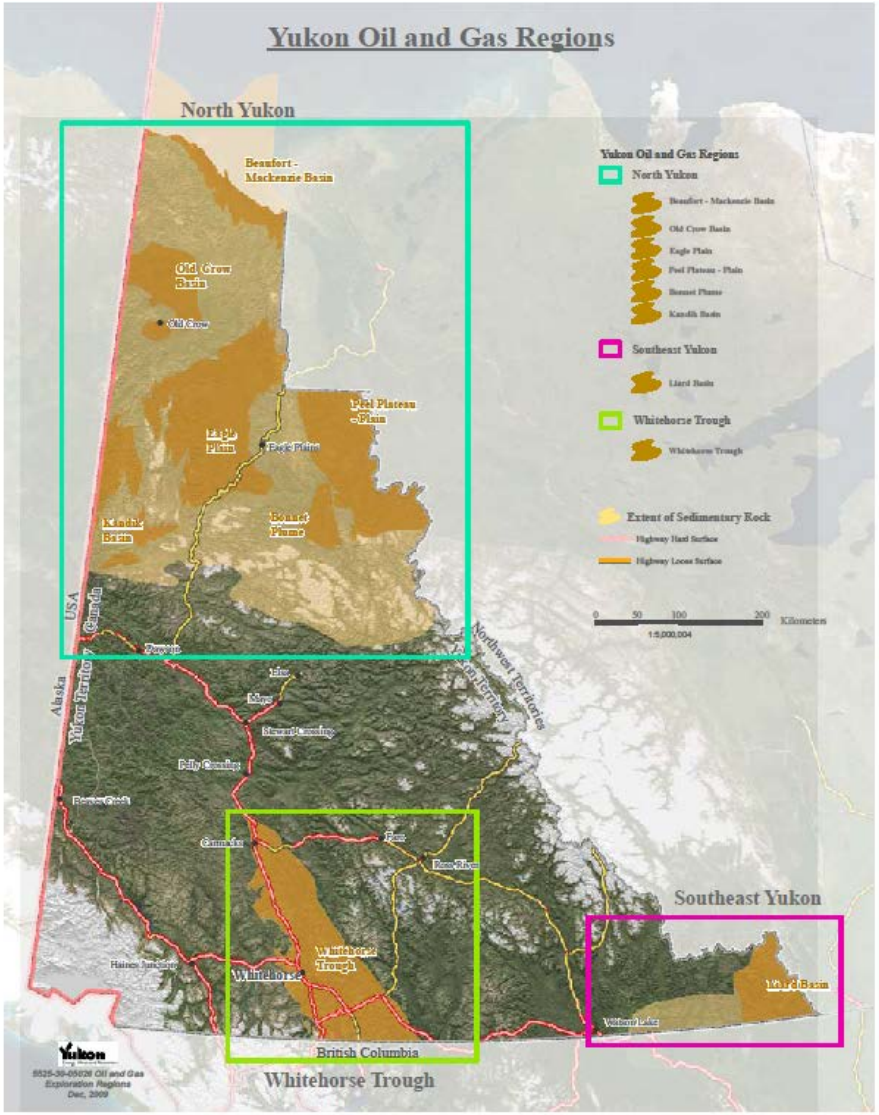
WATER USE - Sources

- What is available?

SITUATION

- Water comes from:
  - Surface waters
  - Sub-surface aquifers
  - Recycling

- Yukon sources:
  - Liard – streams
  - Whitehorse Trough – lakes
  - Eagle Plains / Kandik - streams

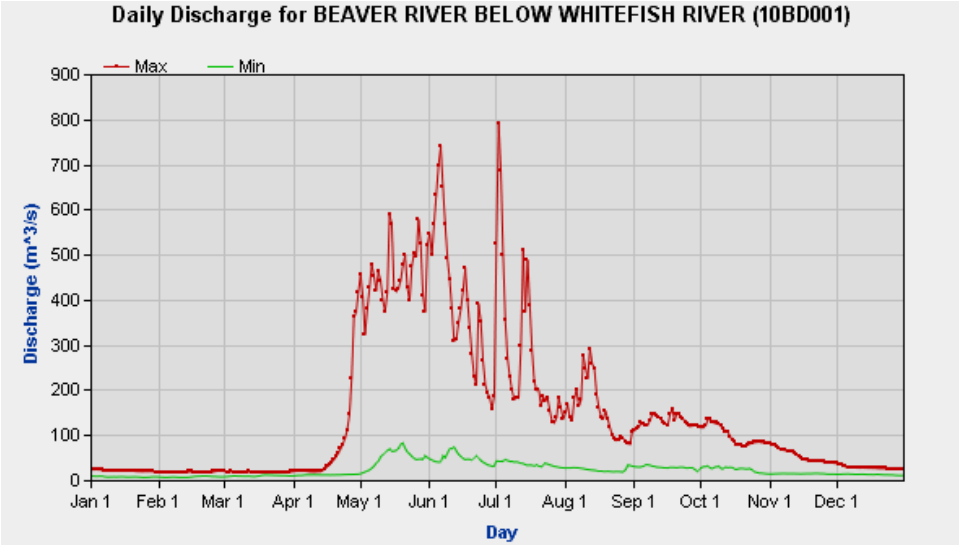


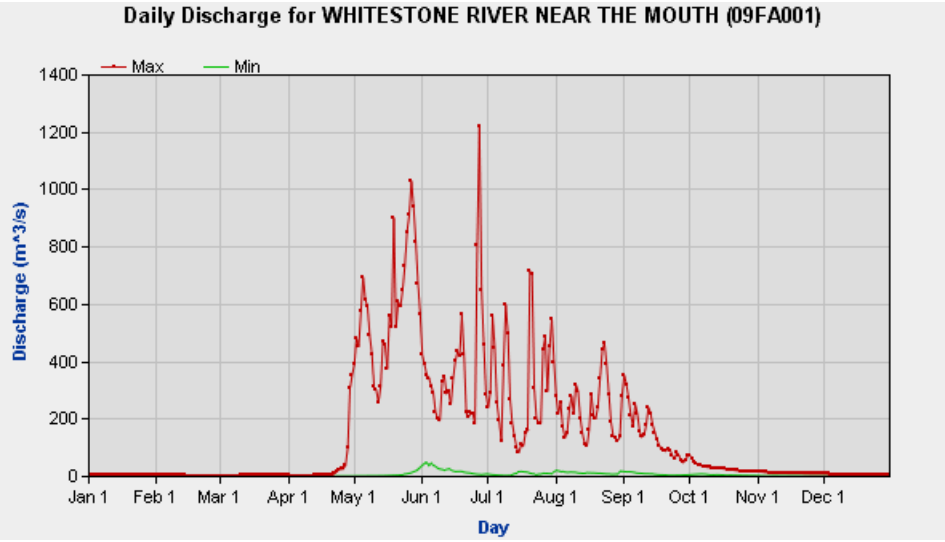
WATER USE - Sources

MEDIUM-SIZED RIVERS

- Liard Basin:
  - Beaver R. (7,280 km^2)
- Eagle Plains Basin:
  - Whitestone R. (6,730 km^2)

- Flow Regimes:
  - Summer: Fairly substantial
  - Winter: c. 20 m^3 / s
  - To feed a well at 40,000 m^3 :
    - 100 % flow for 33 mins (0.5h)
    - 5% flow for 667 mins (11 h)
    - 1% flow for 3333 mins (55.5 h)





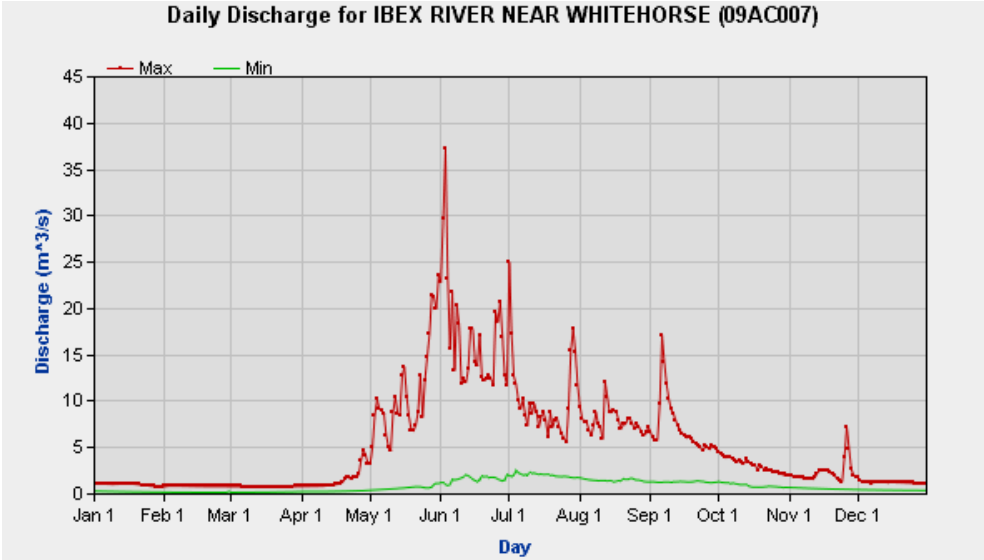
Data from Water Survey of Canada: http://www.wsc.ec.gc.ca/staflo/index_e.cfm?cname=main_e.cfm

WATER USE - Sources

SMALL – SIZED STREAMS

- Ibex River (648 km^2)

- Flow regime:
  - Summer : Less than medium-sized rivers in winter
  - Winter: c. 1 m^3 / sec
  - Pumper truck (500 gallon/min = 0.04 m^3 / s) takes a substantial proportion (4%) of total flow



ISSUE (Risk)

Winter water removal could seriously harm aquatic habitats

- Loss of overwintering pools and riffles for invertebrates (fish food)
- Reduction in size of overwintering pools for fish

Water Station, Fort Nelson R
Google Earth

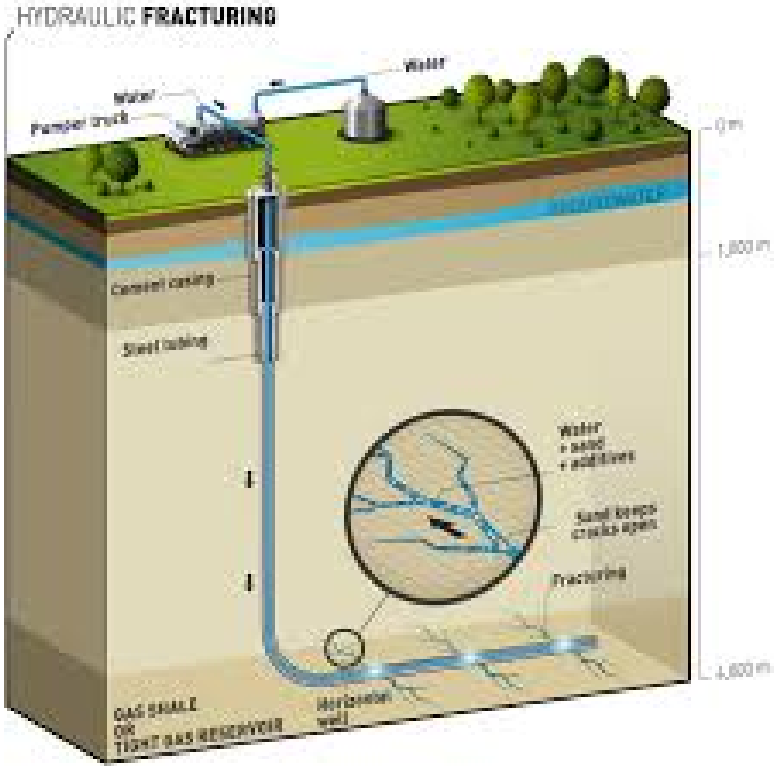
WATER POLLUTION

SITUATION

Fracking fluid is:

- 90 - 95% water
- 6 - 9% sand
- 0.5 – 2% chemicals

One well takes large volume of chemicals - e.g. 400 m^3 (87,000 gallons)



Problem is with Chemicals:

1. Often unreported (proprietary)
2. Some injected chemicals are toxic
3. Reactions happen underground
4. Flow-back of 10 to 50% of volume injected (this is toxic)

WATER POLLUTION

Chemicals include:

- Clay stablizers (salts - KCl)
- Friction reducers (polyacrymamide gels; hydrocarbons)
- Viscosity enhancers (guar gum)
- pH adjusters (acids)
- Biocides (glutaraldehyde)
- Surfactants (hydrocarbons, alcohols)
- Gel breakers (sulphates, salts)

- 750 chemicals; 29 toxic or carcinogenic

Chemicals mobilized underground can include:

- Heavy metals
- Radioactive elements
- Hydrocarbons
- Salts

ISSUE (Risk)

- Leakage of injected and/or mobilized toxics into aquifers and surface waters
  - Through well casing
  - From fractured rocks
- Spills of flow-back on surface (Reserve Pits)

WATER POLLUTION

How Big is this Risk ?

- Most thorough discussion in 2014 report by *The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction. Council of Canadian Academies. (Image opposite)*

- Pathways for contamination are real, may be underestimated, could last up to 10 years.

- Probabilities cannot be accurately quantified because of big lack of knowledge in:
  - Baseline hydrogeology
  - Behaviour of chemical additives
  - Assimilation capacity of groundwater
  - Linkages between ground and surface waters
  - No long term monitoring

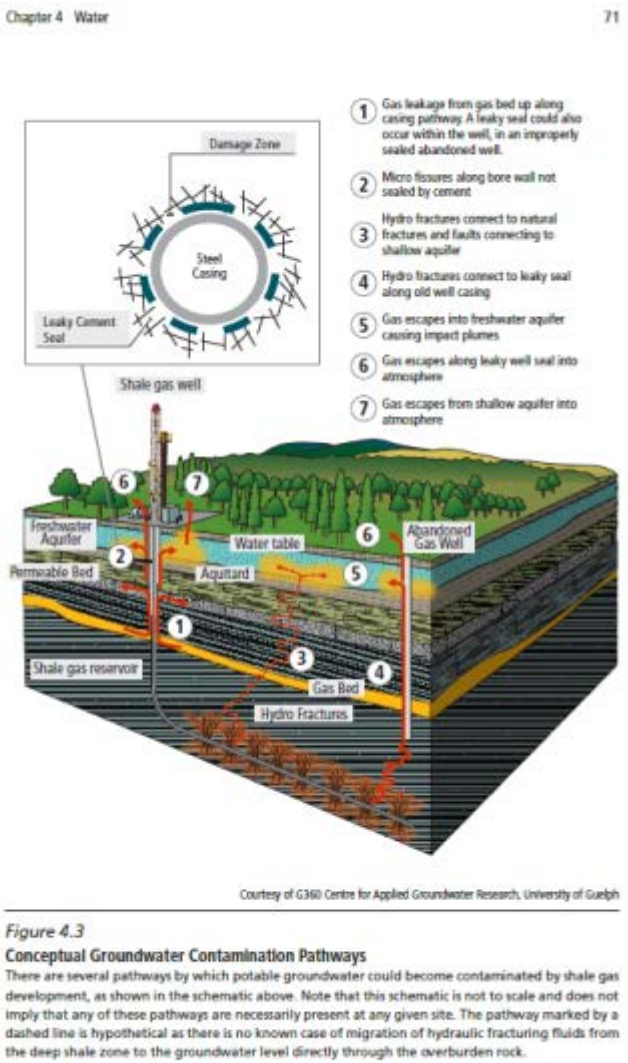


Figure 4.3

Conceptual Groundwater Contamination Pathways

There are several pathways by which potable groundwater could become contaminated by shale gas development, as shown in the schematic above. Note that this schematic is not to scale and does not imply that any of these pathways are necessarily present at any given site. The pathway marked by a dashed line is hypothetical as there is no known case of migration of hydraulic fracturing fluids from the deep shale zone to the groundwater level directly through the overburden rock.

WATER POLLUTION

Risk of flow to surface is likely quite high in Yukon:

- Mountain geology with numerous faults & tilted beds
- Many perched water tables draining down slope
- Numerous seeps, springs and resurgences bringing ground water to surface


Haunka Lake


Squan Lake

WATER POLLUTION

The Risk is to WILDLIFE HEALTH = FOOD SECURITY

EVIDENCE:

- No control-treatment experiments
- Accidents have been revealing:
    1. Fish & Invertebrates: Fracking fluid spill
        - Killed invertebrates
        - Heavy metal uptake by fish
        - Gill lesions associated with toxic levels of heavy metals & acidic water
    2. Waterfowl: Using wastewater ponds:
        - Deaths
    3. Cattle: On pasture with fluid spill compared to no spill:
        - Increased sudden death, lack of reproduction, stillbirths.

- Analogous to Human health issues:
    1. Increased methane in domestic water wells
    2. Reduced birth weights and child developmental performance

AIR POLLUTION

SITUATION

- Sources of gases / particulates:
  - Well venting & flaring
  - Leaks (well-head; pipes; compressors)
  - Fluid evaporation (flow-back; reserve pits)
- Risks:
  - Volatile organics (xylene, benzene) – carcinogens;
  - NO_x and SO_x - respiratory issues;
  - H_2S - brain damage; reduced reproduction
  - Radioactives (radon) - carcinogen
  - Combinations leading to Ozone – respiratory issues

ISSUE (Risk)

- Wildlife health = Food security
- Most evidence from domestic livestock
- Mortality risk
- Relatively limited in space and time
- Greater risk in mountains?

INFRASTRUCTURE

Hydraulic Fracturing

- "Unconventional" oil and gas ***extraction***

BUT

- Relies on "conventional" means of finding and transporting equipment, oil and gas (seismic, roads, drill pads, pipelines, compressors)
- Often more intensive footprint than "conventional".

THEREFORE

- Issues regarding "conventional" infrastructure apply

INFRASTRUCTURE

SITUATION

Infrastructure is:

- Geographic & physical layout of all structures
- Noise from structures and activity

Infrastructure has an influence by:

- Converting habitat types (loss or gain)
- Changing habitat quality
- Influencing movements
- Influencing mortality
- Changing interactions among species (e.g., predators & prey) cumulatively

Komie Camp, Horn R basin

INFRASTRUCTURE

HABITAT CONVERSION:

- Mature forest to open habitats
  - Seismic, road, well pad, camp, power line, pipeline, sand quarry
- Species losing:
  - Caribou
  - Bears (in part)
  - Forest birds (grouse, passerines)
- Species gaining:
  - Moose & deer & bears (in part)
  - Arctic ground squirrel; woodchuck
  - Voles
  - Some birds (sparrows)
  - Invasive plants

REDUCED HABITAT QUALITY

- Noise & activity force animals away (Caribou, songbirds)
  - Previously good forest habitat now relatively unoccupied
  - "Footprint effect" is much more extensive than area converted
- Sediment / pollutant runoff into water bodies increases
  - Decreased fish survival


Kotaneelee Rd, Google Earth

INFRASTRUCTURE

DISRUPTED MOVEMENTS

- Above-ground pipelines
  - Absolute barrier (big game)
  - Crossing structures ?
- High grade roads / pipeline corridors
  - Partial barrier - some animals avoid noise / activity (depends on traffic volume and consistency):
    - Adult female wolverine
  - Break wetland connectivity
    - Changes to water flow
    - Reduced fish habitat / passage

INCREASED MORTALITY

- Public access hunting
  - Loss of unhunted landscapes
  - Net reduction in game regionally
- Road kill
  - Gas field roads
  - Feeder roads
    - Alaska Hwy: Supply trucks (One well could use 1.5 million kg sand)


Horn R basin, GoogleEarth

INFRASTRUCTURE

CUMULATIVE CHANGES

- Key issue is the cumulative direct and indirect effects of changes
- Largely unstudied, except for caribou predator-prey dynamics
- Well studied in boreal caribou

Beaton R. BC Boreal caribou

DISTURBANCES
(linear features + young forest (fire and cutting))

↓

REMOVE CARIBOU HABITAT but INCREASE MOOSE / DEER HABITAT

↓

WOLVES INCREASE
(prey density / ease of hunting)

↓

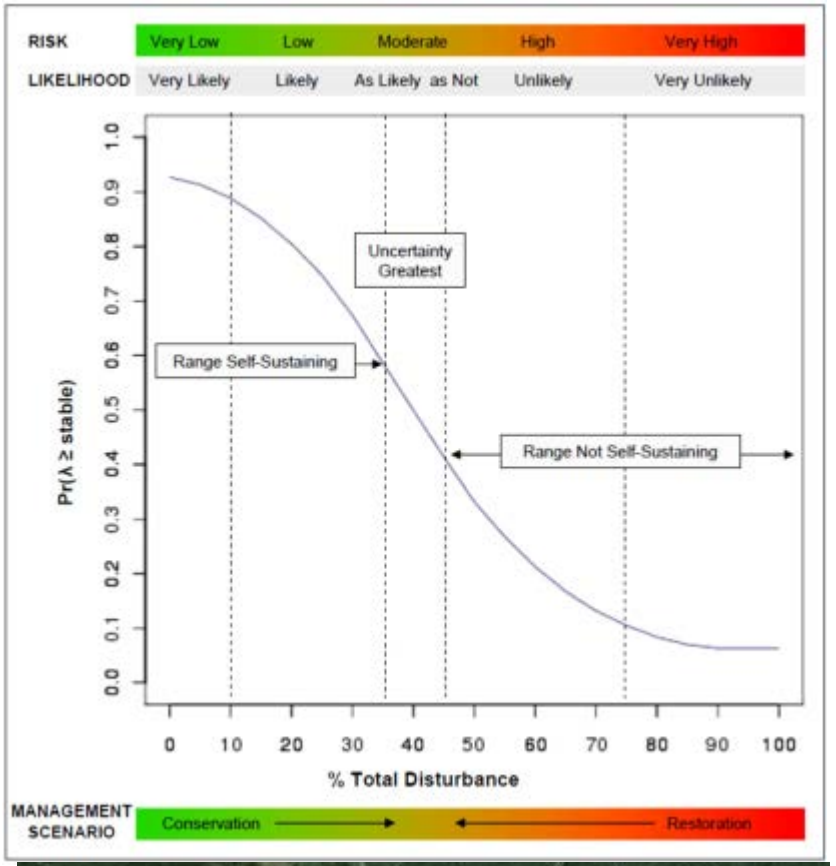
CARIBOU DECLINE

INFRASTRUCTURE

Boreal Caribou Disturbance Threshold Model

(from: Environment Canada. 2011. “Scientific assessment to inform the identification of critical habitat for woodland caribou, boreal population”.)

- Cumulative disturbance is unsustainable above c. 35% of the land base
- Unfortunately, this model cannot be transferred directly to Northern Mountain Caribou or Barren-ground Caribou (i.e. Yukon)
- Basic principles will still apply:
  - When moose are abundant, caribou will be heavily predated
  - The same disturbances (corridors, fires, cutting) will affect mountain caribou
  - Disturbance thresholds for sustaining caribou probably exist , but are likely different for mountain and barren-ground caribou



INFRASTRUCTURE

ISSUES (Risks)

- Disturbance footprint is widely dispersed
  - Limited refuges in space
  - No refuges in time
- Disturbance footprint will last many decades
  - Linear features have long life
  - Recovery options limited
- Cumulative impacts, direct and indirect, of the various changes will be large
- Probabilities and magnitudes of adverse outcomes un-quantified for Yukon

SUMMARY

ISSUE	RISK	MITIGATION
Water Use	Loss of fish habitat	Regulate withdrawals
Water Pollution	Dangerous chemicals	Industry reveals constituents
	Aquifer pollution	*None available*
	Surface spill / reserve pit	Closed containment / Berms
Infrastructure	Habitat conversion	Overlap new developments with existing disturbances
		Do not combine timber harvest with oil and gas development
	Runoff – stream sedimentation	Well pads / camps away from water bodies
	Seismic lines enhance wolf kill rates	Heli-assisted seismic mandatory; Barriers on lines; Reclamation scheduled
	Big game population declines	No public access to industrial roads

SUMMARY

RISK is:

PROBABILITY of an Outcome **x** COST (REWARD) of that Outcome

- Many potentially negative outcomes for wildlife (some positive)
- Science has quantified only a few probabilities
- Uncertainty abounds

- Food security a dominant cost
- Few costs quantified
- Some costs less tangible (loss of some species; poor health for some individuals; water pollution)
- Evaluating costs is value-laden exercise

SUMMARY

How to react to:

Uncertainty in outcomes

- Act with caution
  - Learn more before acting
  - Model scenarios
  - Leave diverse possible routes
  - Mitigate in advance
- Use capacities other than science
  - Common sense / expert knowledge
- Act experimentally
  - Yukon as a control (no oil and gas development) to compare to impacted regions (ne BC)
  - Control (no development) and treatment (development) regions within Yukon gas fields.
  - Monitor and measure.

"The burden of proof should not be on the public to show impacts, but on industry to verify that their claims of performance are accurate and reliable over the relevant scales in space and time."

Council of Canadian Academies. 2014. Environmental Impacts of Shale Gas Extraction in Canada. Ottawa (ON); The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction. Council of Canadian Academies. Page 96.

SUMMARY

How to react to:

Uncertainty in costs; conflicting values

- Act with caution
  - Learn more before acting
  - Model alternatives
- Ascribe value to intangibles
- Apply ethical analysis
  - What are the values?
  - What is a suitable time frame?
  - What are the trade-offs?