



RPIC Federal Contaminated Sites National Workshop



Environmental Site Investigation and Human Health and Ecological Risk Assessment of Legacy DDT Contamination at Prince Albert National Park, Saskatchewan

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Background



- Located in the centre of Saskatchewan.
- Established in 1927 – size: 3,875 km².
- Park open all year; winter population <100, summer population >5,000, average of 200,000 visitors/year.
- Park centre is Waskesiu townsite.
- Not a recognized municipality; PCA leases the land and Park Superintendent is responsible for the administration and management.





Project Objective



- To assess the risk associated with legacy DDT contamination at Prince Alberta National Park (PANP).
 - Collected soil, sediment and water samples in May/June, 2008 and July, 2009 for an environmental site investigation.
 - Collected biota samples (*i.e.*, plants and animals) in September, 2008 and July, 2009 for a human health and ecological risk assessment (HHERA).





Sampling Strategy



- Initial May/June, 2008 site visit:
 - Judgmental sampling approach based on probability of historical spraying (**conservative bias**):
 - Adjacent to existing roads during time of spraying
 - Avoided recently landscaped or re-developed areas
 - Factored in activity types and witness accounts
- September, 2008 site visit:
 - Targeted biota sampling based on results of May/June, 2008 program.
- July, 2009 site visit:
 - Primarily to collect garden produce samples; an identified data gap based on preliminary assessment of September, 2008 results.



Sampling Summary



- A total of 745 samples (*large number*), including:

- Soil (326)
- Sediment (139)
- Water (14)
- Biota



- Garden vegetables (carrots, chives, lettuce, radish, rhubarb) (17)
- Mice (45)
- Opportunistic muscle tissue samples (bear, deer, elk, grouse, marten, pelican, wolf) (16)
- Leeches (9)
- Vegetation (grass, rosehips, willow) (70)
- Worms (5)
- Yellow perch (juveniles) (4)

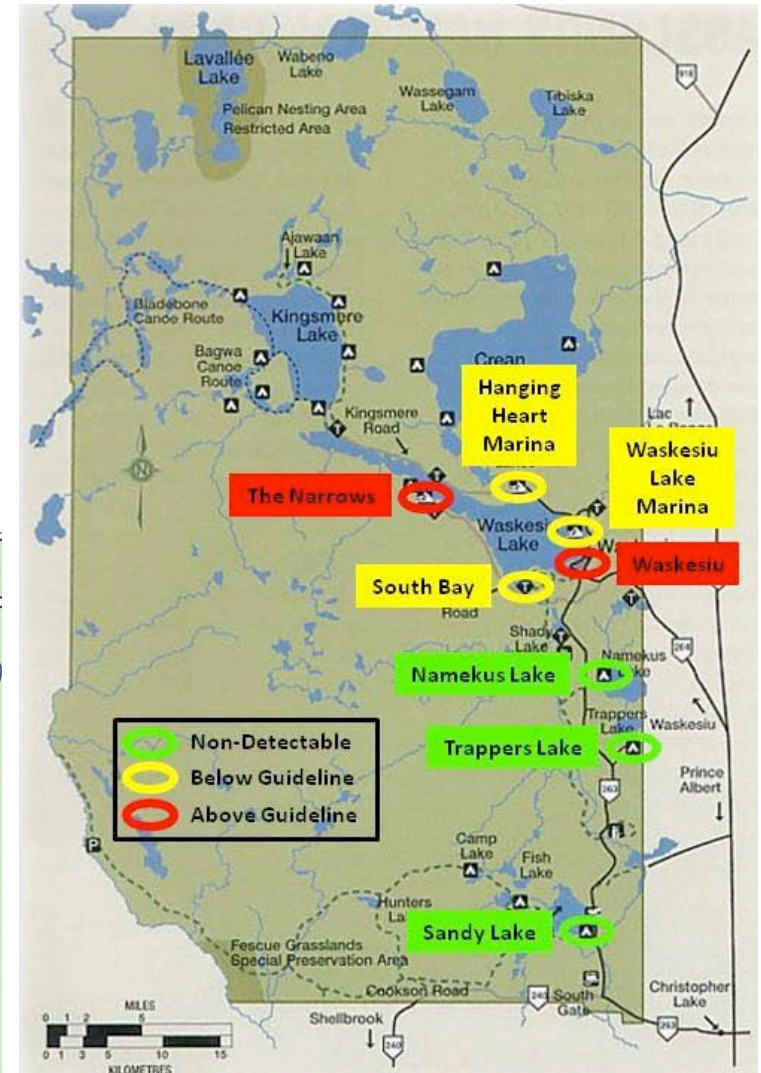
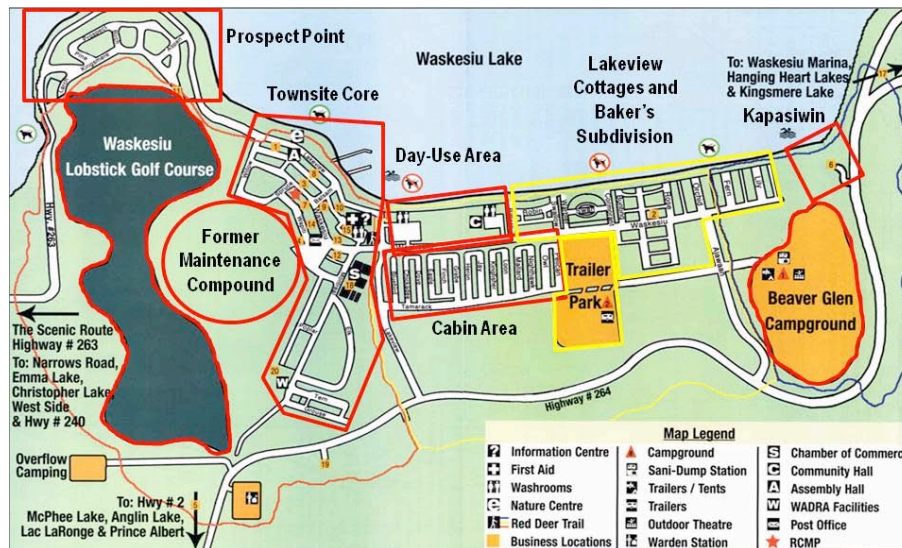
Composite samples



Site Investigation Results



- Results compared to CCME CSQG residential/parkland (0.7 ppm).
- Waskesiu (9% samples > CSQG; range: <0.001 to 56 ppm).
- The Narrows (39% samples > CSQG; range: <0.001 to 36 ppm).
- Carried forward into the risk assessment.





HHRA Receptor Groups



Receptors
(humans)

- Permanent residents (with and without garden produce)
- Seasonal residents (with and without garden produce)
- Golf course maintenance workers.
- Front country/backcountry visitors.
- All ages - infants, toddlers, children, teenagers and adults



DDT Exposure Pathways



Exposure Pathways

- Inadvertent soil ingestion
- Soil-skin contact
- Water ingestion
- Water-skin contact
- Food consumption
- Particulate or vapour inhalation





PQRA Results



- Preliminary quantitative risk assessment (PQRA) results after 2008 field program highlighted the need to collect garden produce in 2009.

Scenario	Hazard Quotient	Cancer Risk
Permanent/seasonal resident (consumes garden produce)	Red	Red
Permanent/seasonal resident (does not consume garden produce)	Green	Green
Golf course maintenance worker	Green	Green
Front country / backcountry visitor	Green	Green

 HQ less than 0.2 or Cancer Risk less than 1-in-100,000
 HQ greater than 0.2 or Cancer Risk greater than 1-in-100,000



SSRA Changes



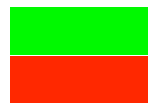
- Site-specific risk assessment (SSRA):
 - Updated PQRA with measured concentrations in garden produce, wild game and local edibles.
 - Used most conservative literature values for fish concentrations (Evans *et al.*, 2007).
 - Adjusted local food intake to 140 days per year based on growing season.
 - Increased consumption of wild game items to 20% of daily intake.



SSRA Results



Exposure Scenario	HQ	ILCR
Permanent residents (garden produce)		
Permanent residents (no garden produce)		
Seasonal residents (garden produce)		
Seasonal residents (no garden produce)		
Golf course maintenance workers		
Front country/backcountry visitors		



HQ less than 0.2 or Cancer Risk less than 1-in-100,000

HQ greater than 0.2 or Cancer Risk greater than 1-in-100,000

No unacceptable risk to any human receptor



ERA Receptor Identification



**Receptors
(*ecological*)**

- Receptors selected with help of PCA and stakeholder groups, based on:
 - Presence
 - Importance
 - Susceptibility
 - Trophic level
- Receptors selected:
 - American mink
 - American robin
 - Barred owl
 - Deer mouse
 - Mallard duck
 - Northern leopard frog
 - Red fox
 - White pelican
 - White-tailed deer



DDT Exposure Pathways



Exposure Pathways

- Inadvertent soil ingestion
- Inadvertent sediment ingestion
- Water ingestion
- Food consumption



ERA Details



- Exposure point concentration (EPC) values used:
 - Soil EPC: UCL95 for both areas evaluated
 - Sediment EPC: max. value
 - Water EPC: not calculated (no values above detection)
 - Vegetation EPC: UCL95 garden produce value (**conservative** - all other vegetation samples were below detection)
 - Food EPC: max. value used for earthworm, mouse, leech, opportunistic game species (grouse) and fish (Evans et al., 2007)



ERA Details (cont'd)





- Receptor characteristics – ***conservative***.
 - Garden produce, fruit ingestion, receptor characteristics (size, home range, etc.), etc.
- TRVs based on the No Observed Adverse Effects Level (NOAEL) – ***conservative***.
 - Two TRVs were found in the literature for avian receptors; the less conservative one was selected, but it was more recent and carried greater statistical power.



ERA Results



Receptor	HQ Waskesiu	HQ Narrows
American mink		
American robin		
Barred owl		
Deer mouse		
Mallard duck		
Red fox		
White pelican		
White-tailed deer		

 HQ less than 1
 HQ greater than 1

No unacceptable risk to any ecological receptor



Conclusions



- Despite length of time since last spraying event, DDT is still present at significant concentrations within the Park – an assessment needed to be made.
- Overall, the DDT concentrations pose no risk to humans or the ecological receptors studied in this report.
- Importance of the SSRA vs. the PQRA.
- This was an in-depth study and the first of its kind for a residential setting.
- Can provide insight into conditions of other Parks that have had a similar DDT-spraying program.

A photograph of a sunset over a body of water. The sun is low on the horizon, partially obscured by a dark pier structure. The sky is filled with soft, orange and yellow clouds. The water is calm, reflecting the colors of the sunset. A small buoy is visible in the distance.

Questions?