



Site-Specific Plant Ecotoxicity of Residual Petroleum Hydrocarbons Fraction 3 in Subarctic Soils

Amy Gainer, Ph.D., P.Ag.

S. Bordenave (Advisian), A. Glatiotis (Advisian), E. Haack (Ecometrix), L. Eastcott (Imperial Oil Limited)

Advisian
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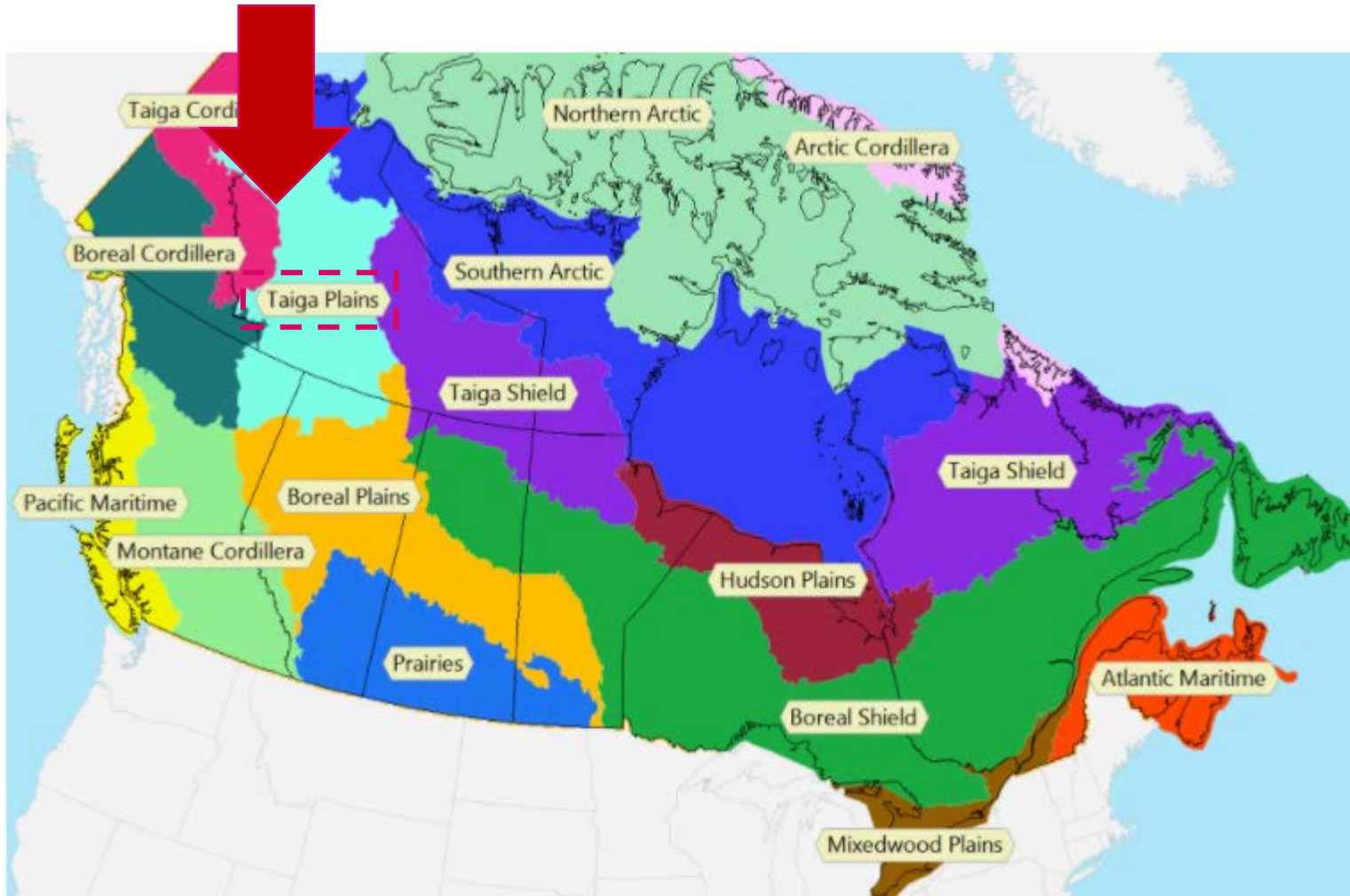
Ecometrix



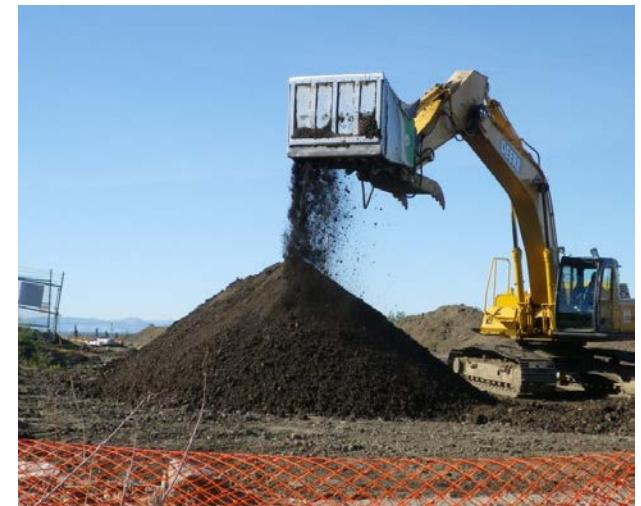
Northern Challenges

- Remediation success limited by numerous factors including:
 - Climate
 - Remoteness
 - Lack of waste disposal facilities
- Often bioremediation approaches used for hydrocarbons

Project Background



- Taiga Plains Eco Zone of NWT
- Bioremediation of petroleum hydrocarbon contaminated soils using on-site biocells
 - ~5 years treatment
- F2 degradation success



Project Challenges

- Residual F3 degradation became limited overtime
 - Still exceeding generic CCME guidelines
- Treatability range 2500 to 5000 mg/kg F3
 - Industrial Guidelines = 2500/1700 mg/kg
 - Residential/Parkland Guidelines = 1300/300 mg/kg
- Eco soil contact generic guidelines issues
 - Earthworms
 - Agronomic species
 - Minimal weathering



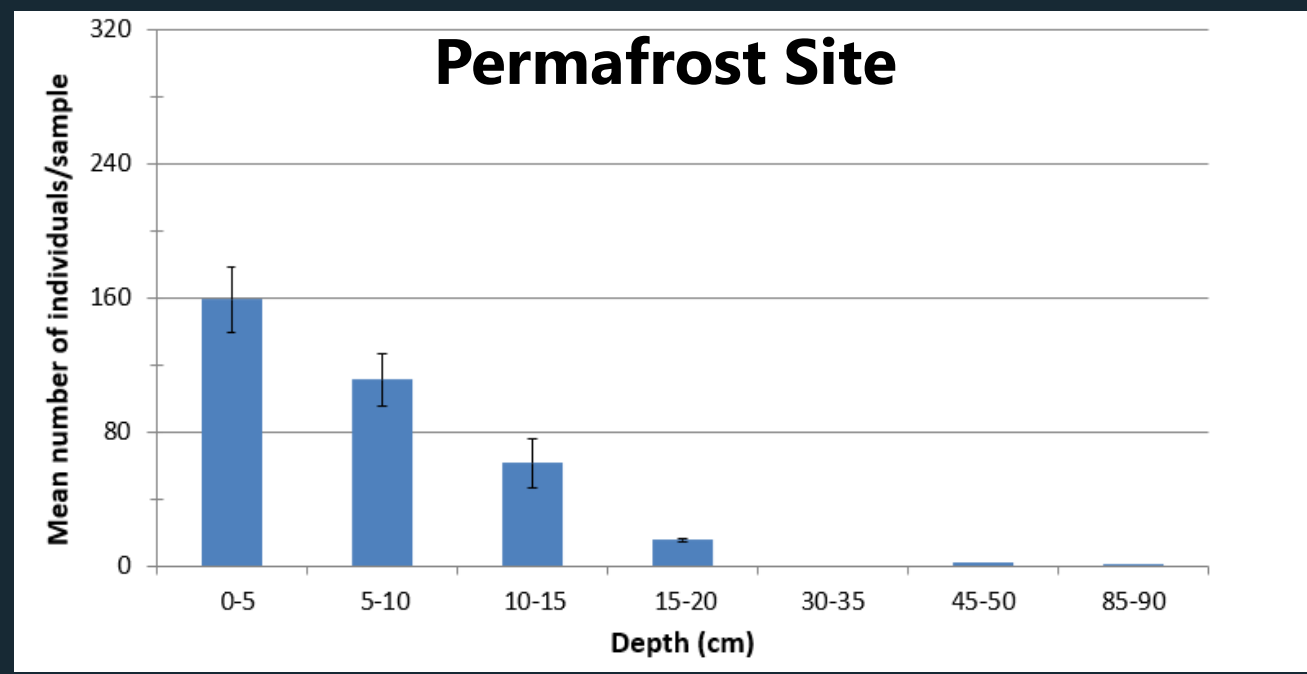
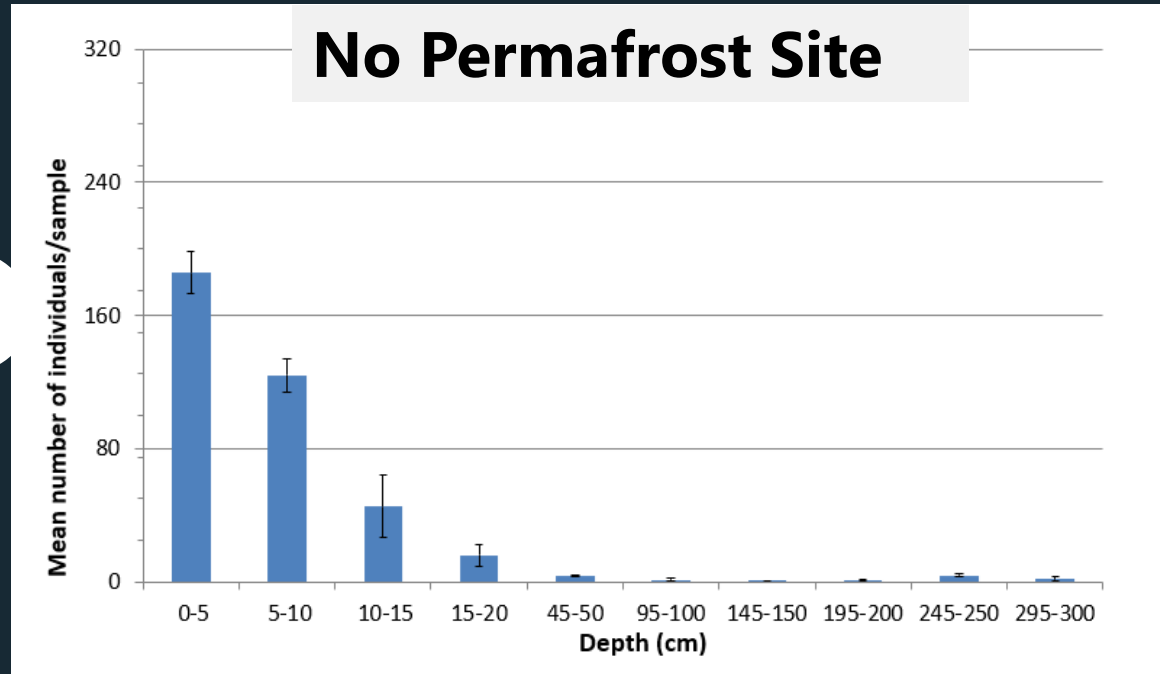


Project Objective

- Developing site-specific remediation guidelines for PHC F3 for the eco-contact pathway that are protective of native plants and invertebrates found in Taiga Plains eco-zone.
- Test using climatic conditions reflective of Taiga Plains

Collaborative research project with industry partner, consultants, academia, Saskatchewan Research Council and Environment Canada and Climate Change

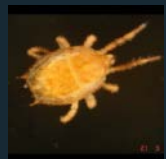
Project History - Soil Fauna Survey



Majority in top 20 cm
Low populations identified 0.5 to 3 m

Majority in top 20 cm
Low populations identified 0.3 to 0.9 m

40 species identified – 18 Collembola and 22 Mite

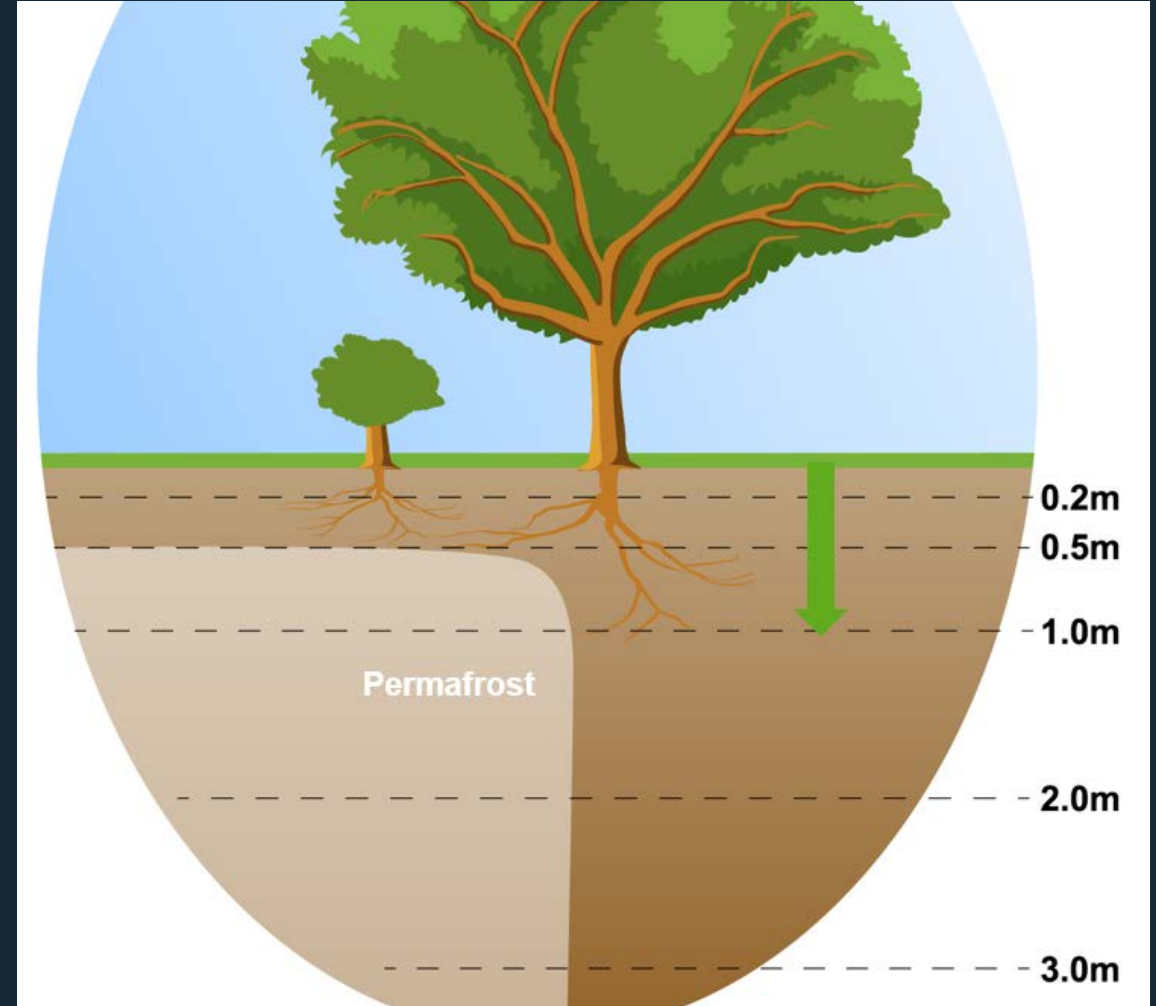


Project History – Rooting Depth Field Survey



Permafrost = 0.3 to 0.5 m

Non-permafrost = 0.7 to 1.0 m



1 m depth for ecological soil contact is appropriate

Project History – Plant Selection

# of Species	Comment
140	Taiga Plains Literature/Site survey
39	Suitable for eco-tox tests
15	Seed acquisition from Taiga Plains
10	Met test validation criteria under northern climate conditions
6	Tested in reference and F3 contaminated soils

Project History – Plant Selection

Plant	# of test soils
Yarrow	4
Black spruce	4
Bebb's willow	1
Green alder	1
Slender wheatgrass	1
Balsam poplar	1



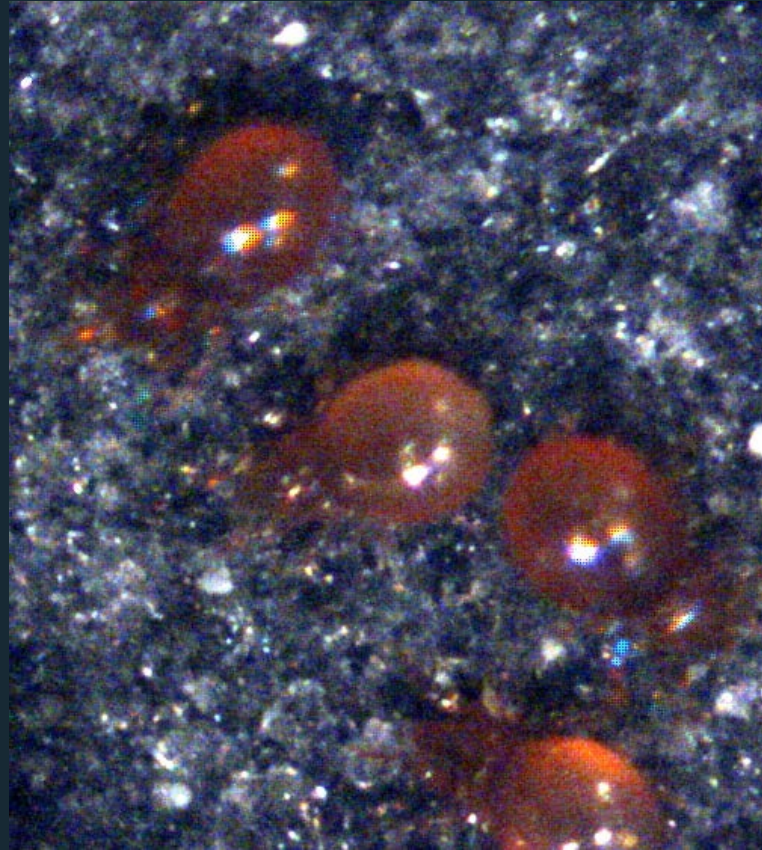
Plant Toxicity Testing Results

Plant	No Observed Effects Concentration (mg/kg F3)
Yarrow	1600-5950
Black spruce	1600-5950
Bebb's willow	1600
Green alder	1600
Slender wheatgrass	1600
Balsam poplar	1600

- No toxic effects to plants observed between uncontaminated background locations and contaminated samples
 - at times higher growth in F3 contaminated soils
- Coarse/Fine F3 guidelines for parkland land use 300/1300 mg/kg

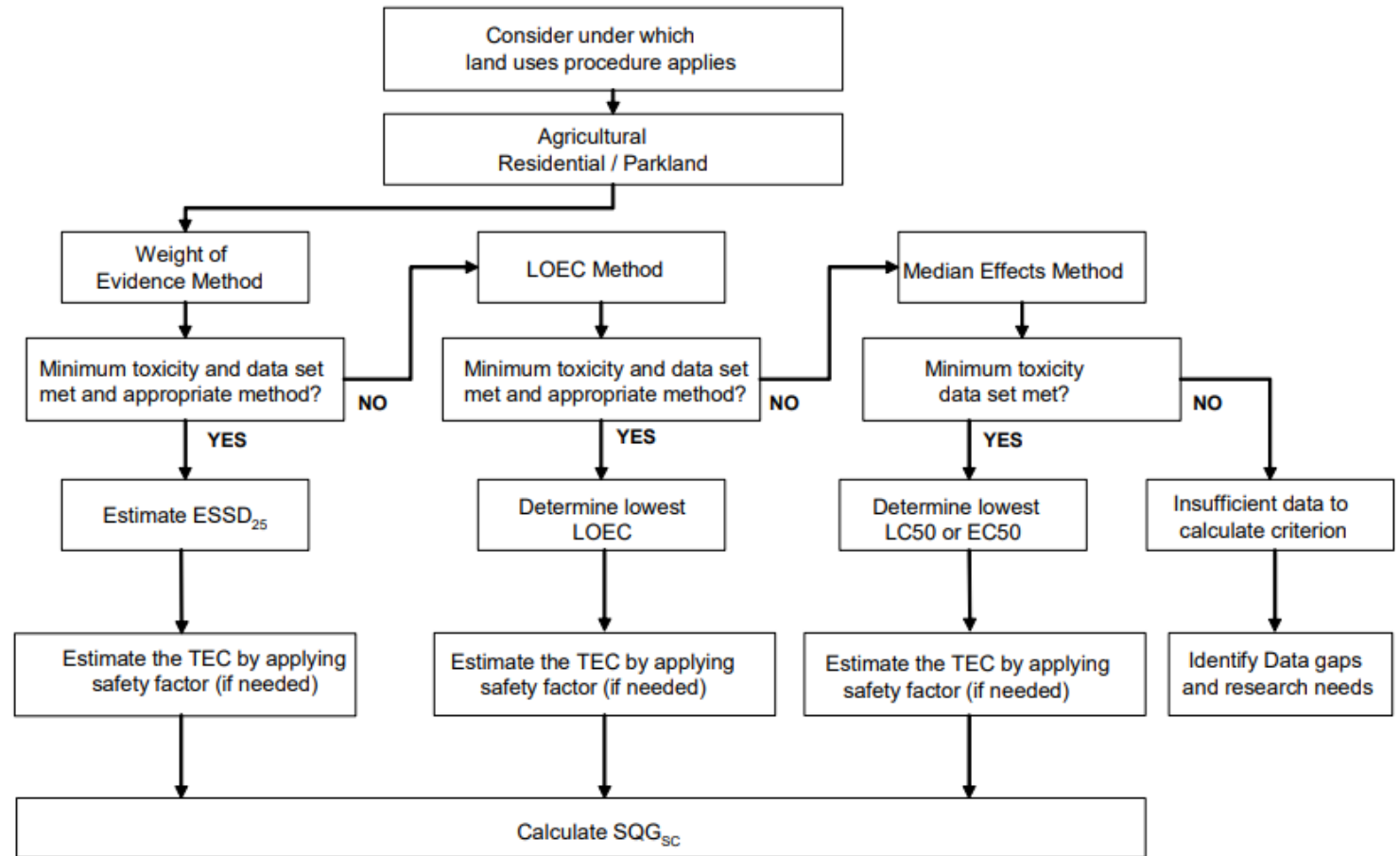
Future Directions

- Soil Invertebrate toxicity tests with Collembola and Mites



Future Directions

- Determine a site-specific guideline using NOECs that is not overly conservative



Where: ESSD₂₅ = Estimated Species Sensitivity Distribution – 25th Percentile, TEC = Threshold Effects Concentration, LOEC = Lowest Observed Effect Concentration, LC₅₀ = Median Effective Concentration.

Figure 10: Procedure for Deriving Soil Quality Guidelines for Soil Contact for Agricultural and Residential/Parkland Land Use

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Previous contributors



amy.gainer@advisian.com