No Easy Answer.

Spatial Decision-Making Under Uncertainty for Emergency Preparedness.

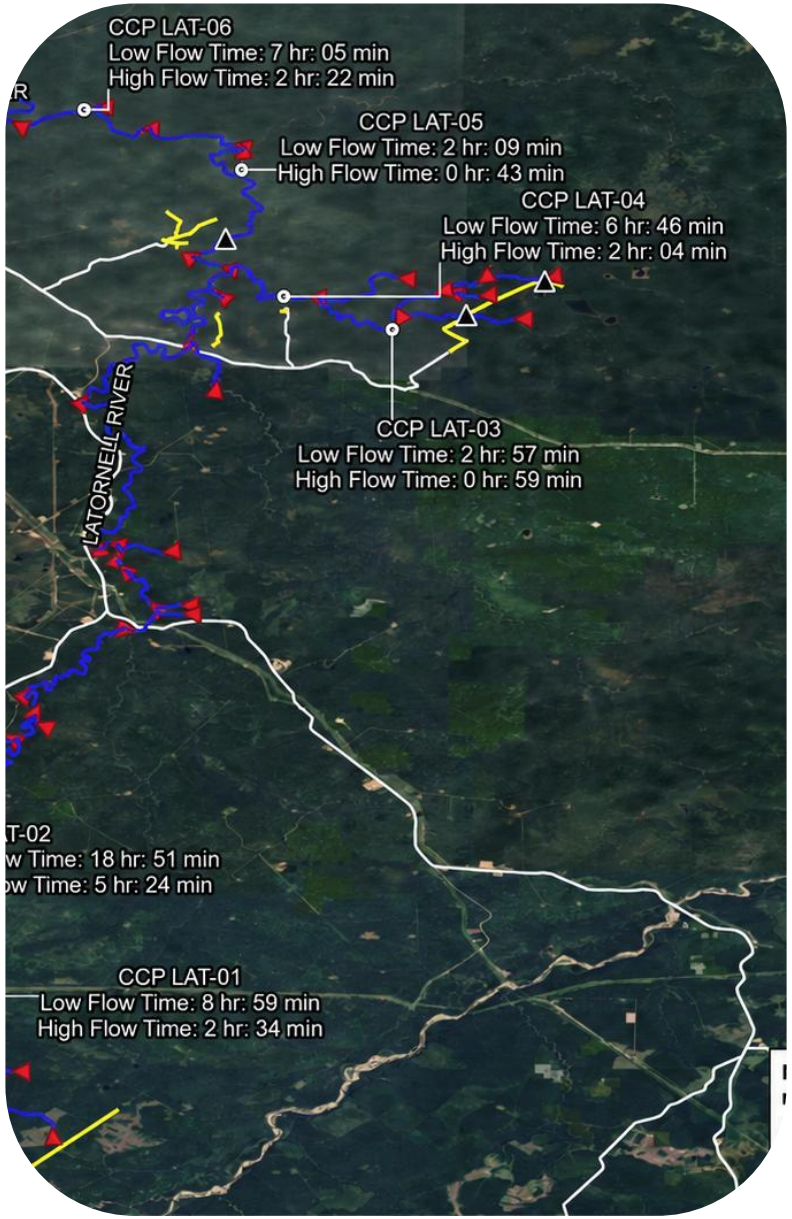


Matthew Meadows & Kale Haupt

ambipar

The question(s) that started it all

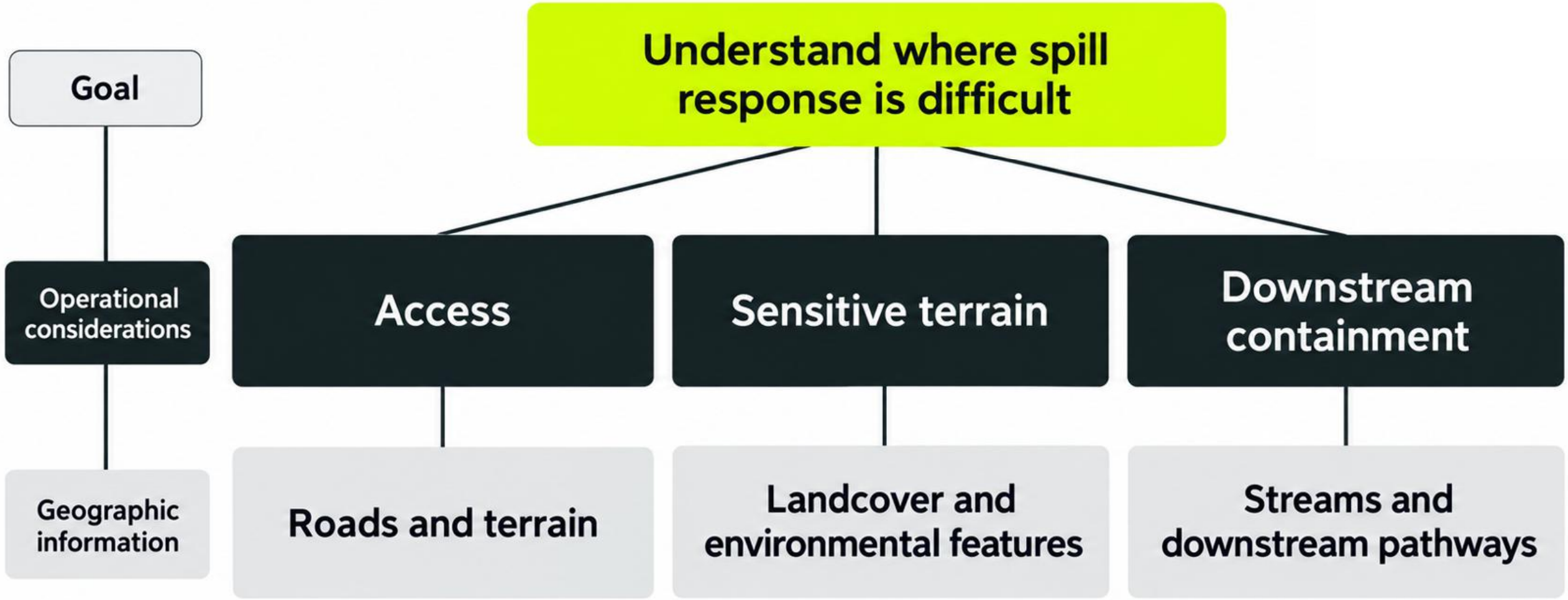
Across a large and diverse pipeline network, where should we focus spill response planning, and how do we justify that decision?



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What makes a spill response difficult?

Criteria are the basis.



Challenges in Spill Response

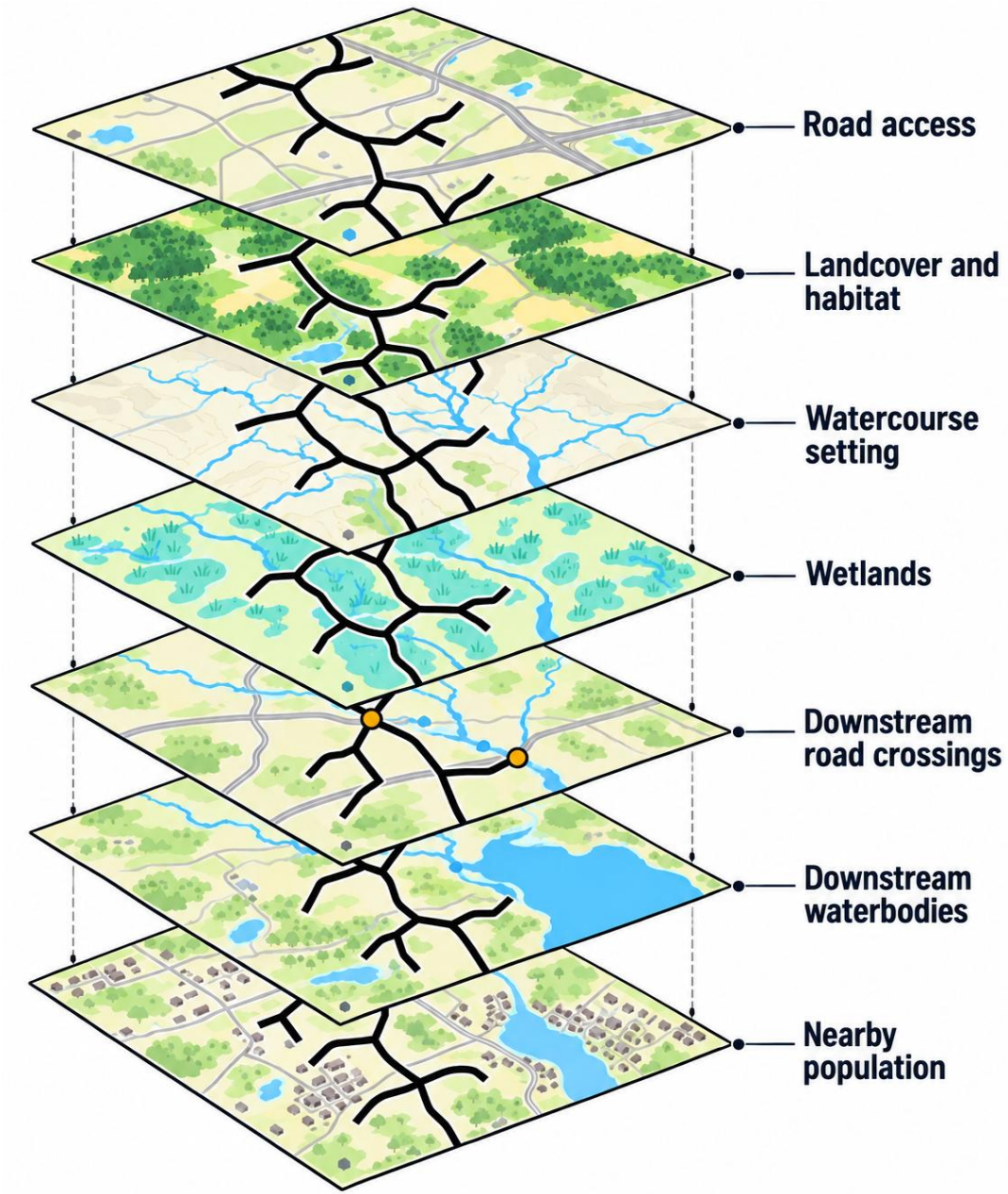








Data to Geographic Context



Analysis & Evaluation

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We measure distance—but what counts as close or far?

Expert knowledge to define what conditions lead to more difficult response scenarios

Example Measures	Operational Outcome
Landcover and wetlands	What conditions could complicate containment and cleanup?
Downstream distances and crossings	Where could product initially travel, and what containment opportunities exist downstream?





What is Pipeline Vulnerability?

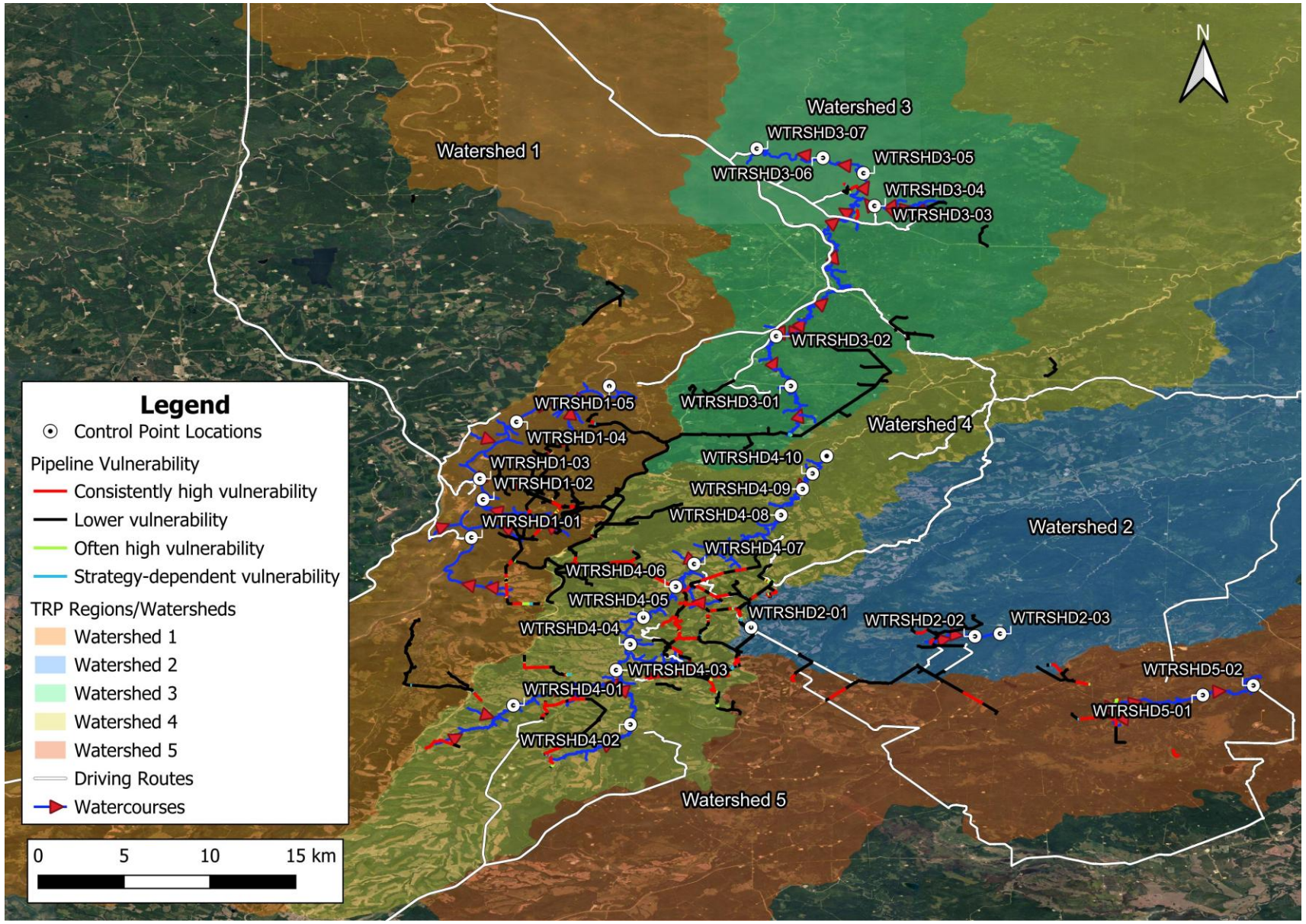
- **It’s a numerical value representing spill response difficulty**



- **Expressed through classes ranging from low to very high vulnerability for planning purposes**



Project Showcase



2,700 km²

In AB. Foothills

5

Distinct Watersheds

1007

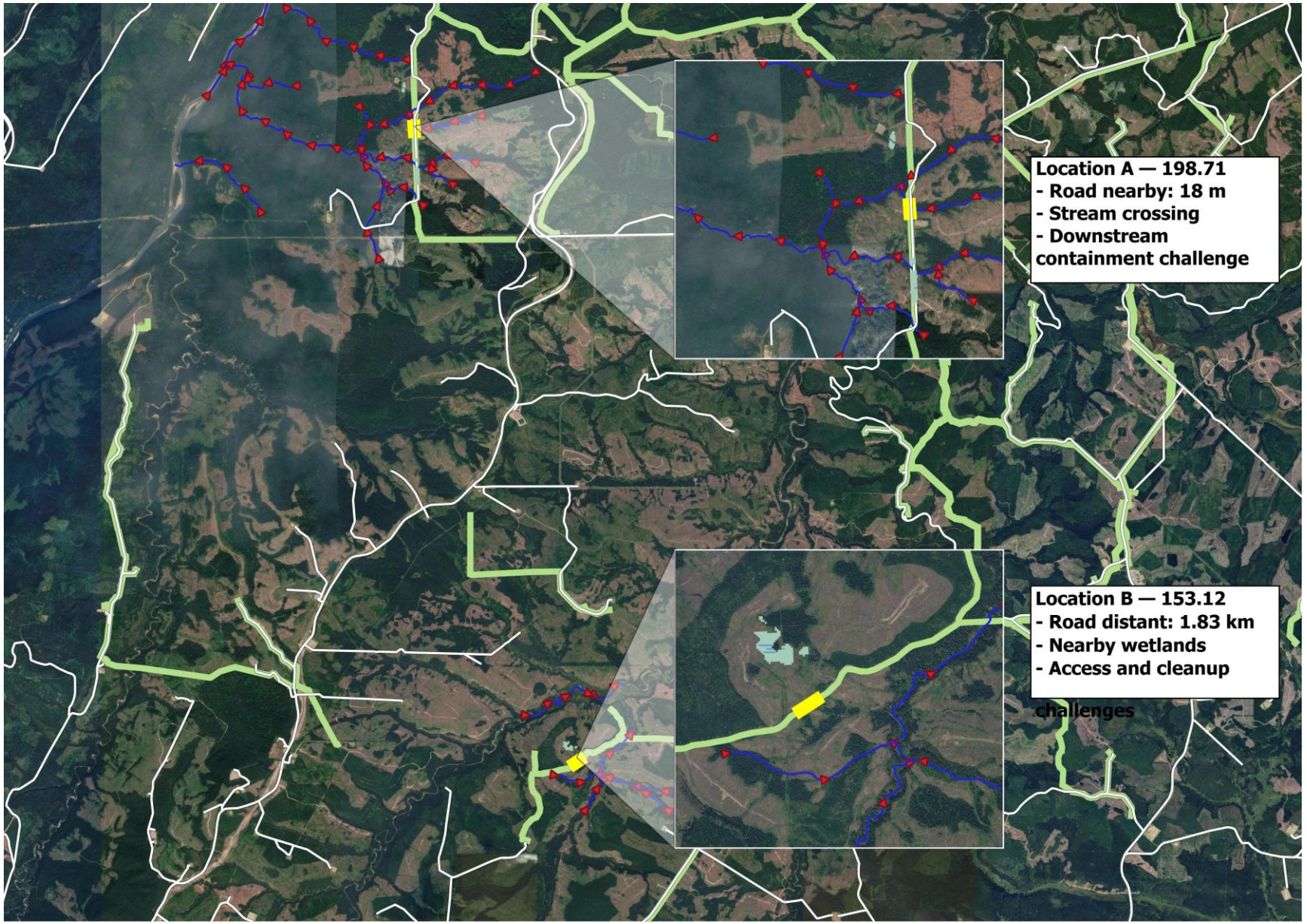
consistently high vulnerability pipeline segments

28

control points

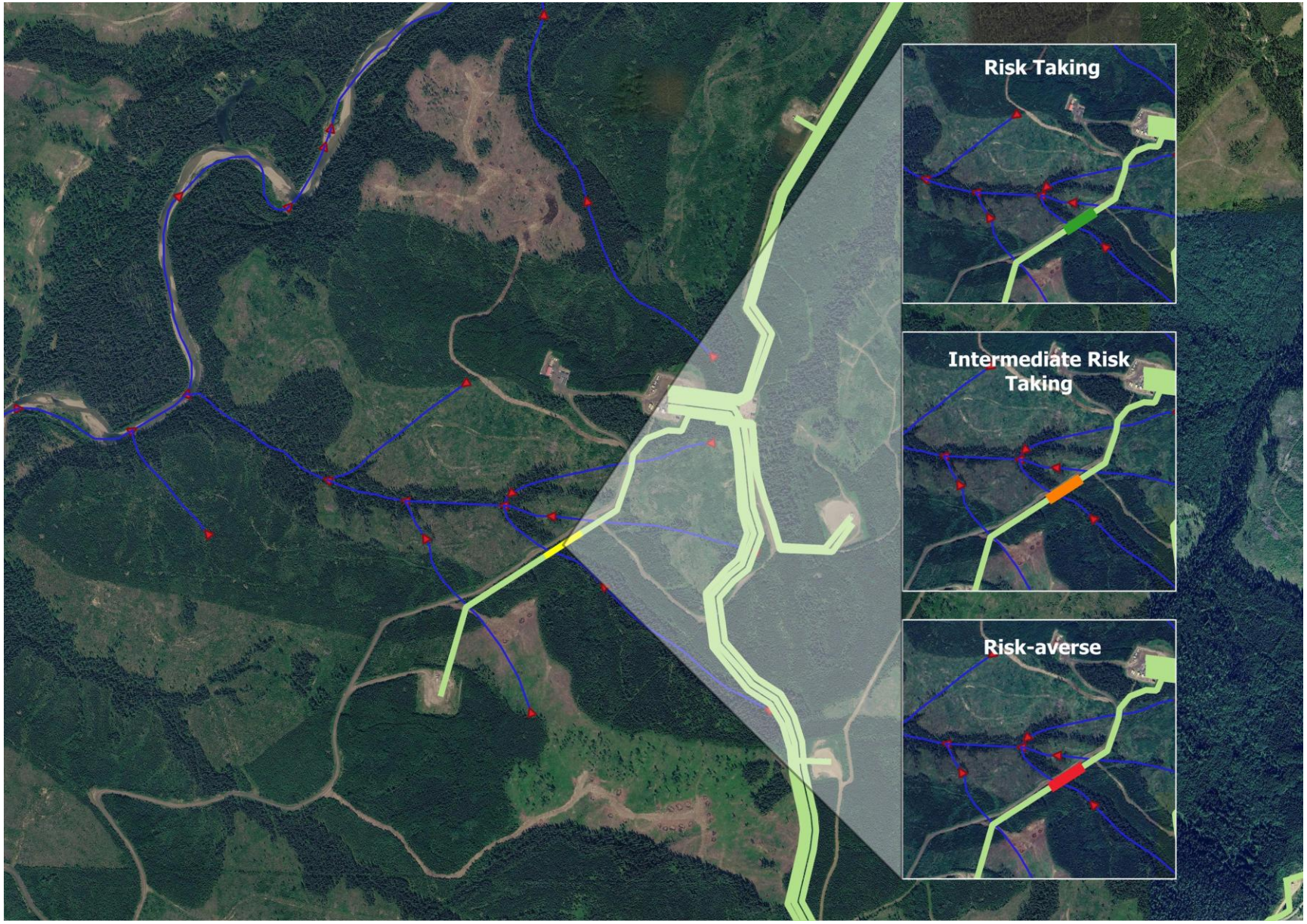
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Competing Conditions



- **Different challenges**
- **Expert driven**
- **Tradeoff?**

Different Planning Attitudes



- **Different attitudes**
- **Different vulnerability**
- **Site Specific**

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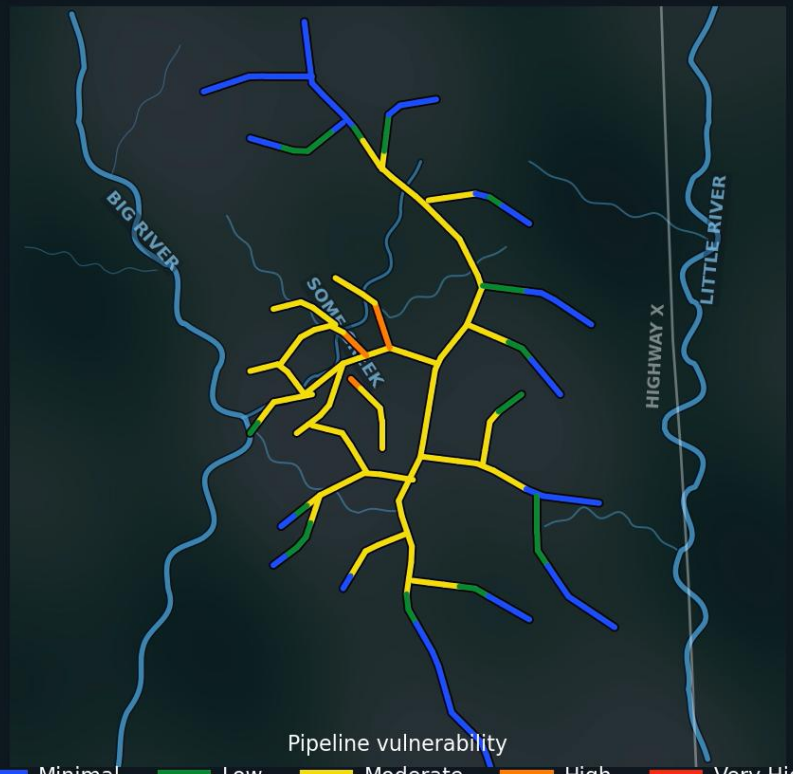
Testing Modelling Assumptions

The model runs 10,000 planning scenarios across the pipeline network.

MONTE CARLO RUN 1 / 10,000

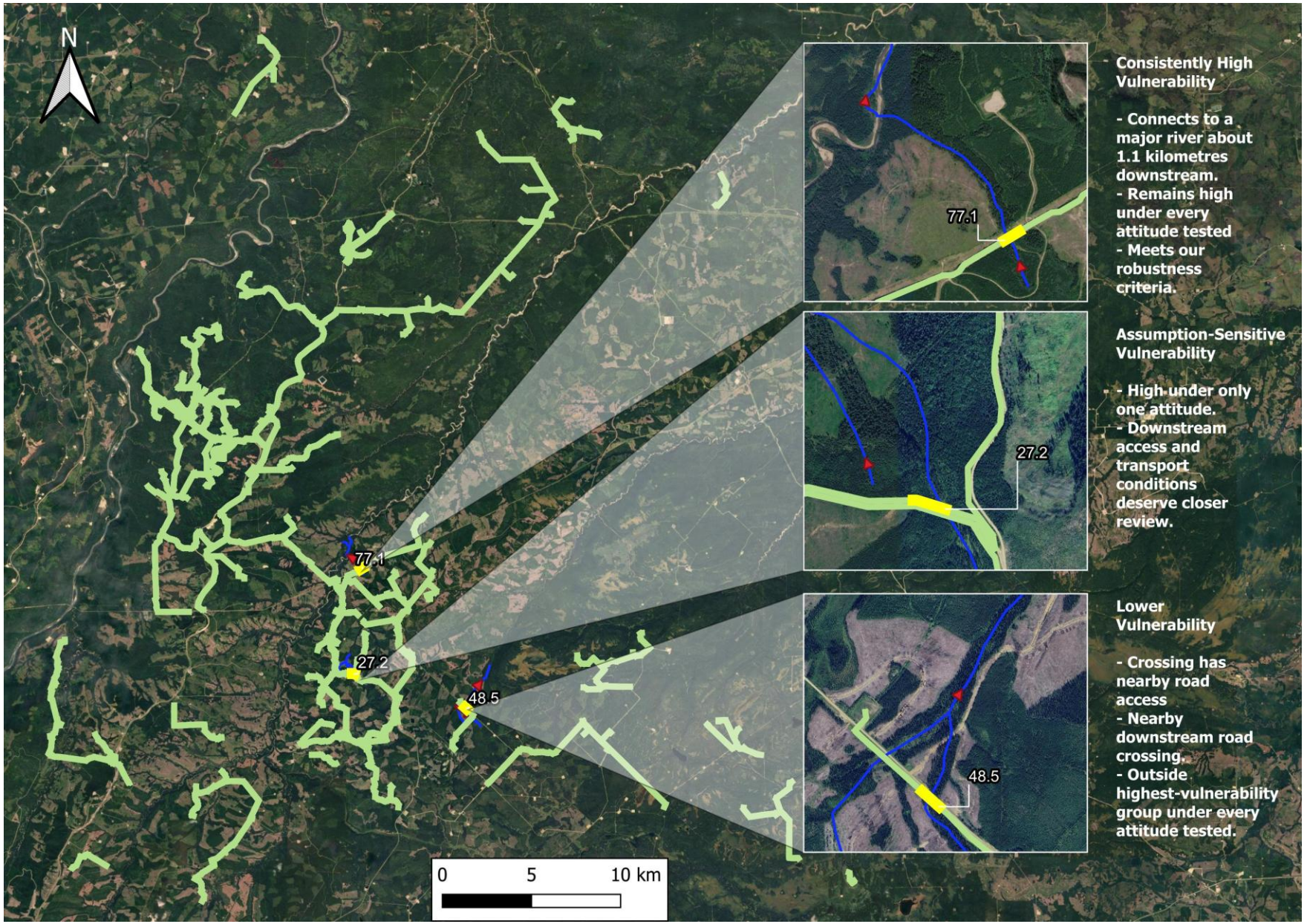
CRITERION IMPORTANCE Varied across each run
PLANNING ATTITUDE Risk-averse

209
PIPELINE SEGMENTS



TESTING THE FULL PIPELINE NETWORK

Which locations remain high across every planning approach?



- **What stands out**
- **What changes**
- **Where to plan**

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Downstream Network Analysis

The robustness result becomes the starting point for downstream control-point planning.

ROBUSTNESS RESULT

Based on all 10,000 Monte Carlo runs
the white overlay shows segments that remained high
in at least 80% of runs.

13
ROBUST SEGMENTS

209
PIPELINE SEGMENTS



ROBUST VULNERABILITY SEGMENTS


QUESTIONS?
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There is no planet B. Take care of planet