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From Mines to Roads:

A Phased, Risk-based Approach for ML/ARD Assessment for Linear Projects

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Agenda

- **Phased Approach**
- **Risk-based Approach**
- **Screening Tool**
 - **Objectives**
 - **Hypothetical Example**
- **Detailed Investigation**
- **Effects Assessment**
- **Lessons Learned**
- **Conclusion**



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Phased Approach

- **Conceptual Design:**
 - Alignment determined *early*
 - From 30 to 300+ km long
- **Preliminary Design:**
 - Cut & fill balanced
 - Preliminary risk ratings
- **Detailed Design:**
 - Quarries every few km, identified *late*
 - Focus detailed investigation on sections with higher risk
 - Lead into water quality predictions





Risk-Based Approach

- ML/ARD can be a “deleterious substance” as per *Fisheries Act*
- E.g. Pennask Creek (2002)
- Consider
 - **Stressor**
 - Geochemistry
 - **Pathway**
 - Hydrology
 - **Receptors**
 - Toxicology



- **Precedent: Sea-to-Sky Highway Upgrade (2004)**

**SEA TO SKY HIGHWAY
AND ACID ROCK DRAINAGE:
A MODELLING APPROACH TO
ASSESSMENT OF POTENTIAL
ENVIRONMENTAL EFFECTS**

...Results of the **ARD/ML** testing were coupled with the results of a **hydrologic analysis** to predict metal loading to streams. The predicted stream concentrations were assessed in the context of sensitive **aquatic organisms** known to occur in the drainages...

Mallen, N.D. & C.S. Ross, 2004





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Screening Tool - Objectives

- Timely input to conceptual, preliminary design
- Facilitate avoidance, minimize risk
- Focus subsequent effort on higher risk areas

GEOCHEMISTRY

HYDROLOGY

TOXICOLOGY





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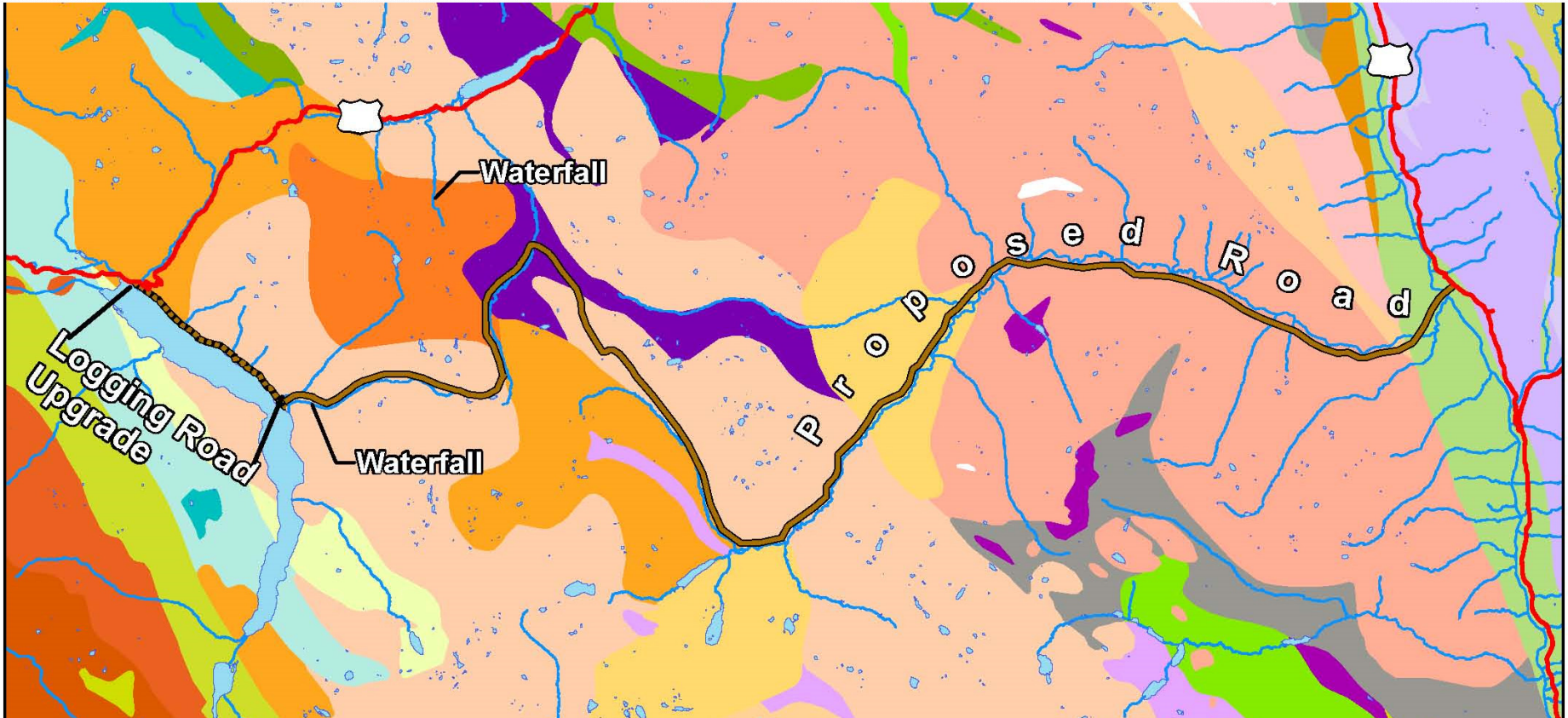
Hypothetical Example





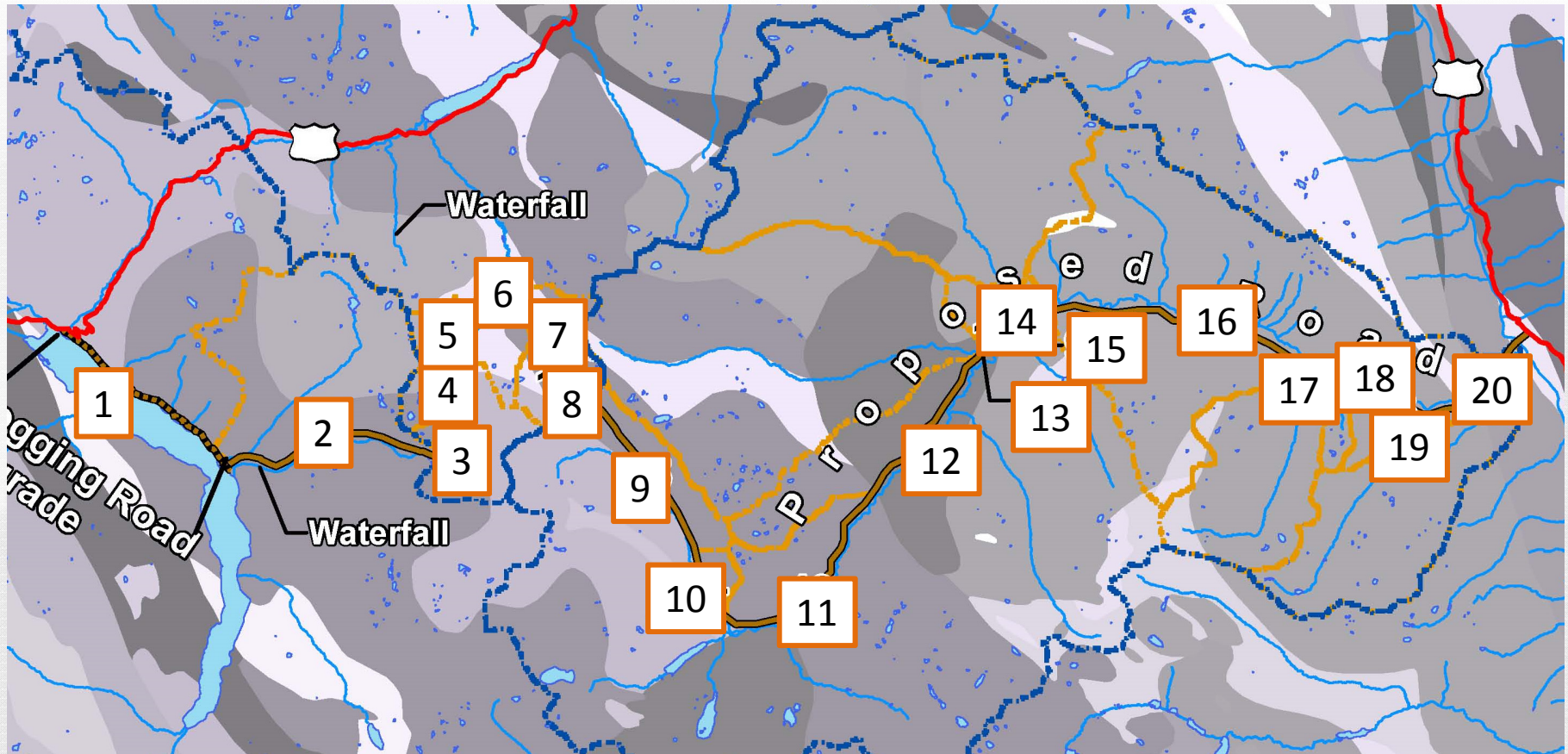
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Hypothetical Example





Hypothetical Example



Stressor Rating x Pathway Rating x Receiver Rating = Risk Rating



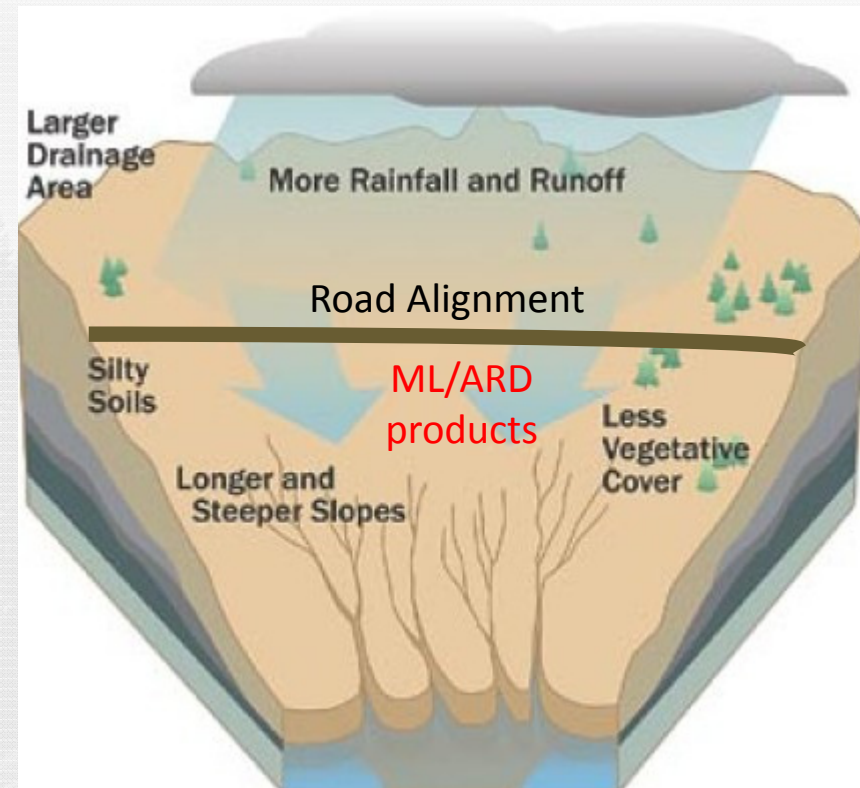
Stressor (ML/ARD)

- **Objective:**
 - Approximate ML/ARD potential of disturbed rock
- **Based on:**
 - Published mapping
 - Initial ABA results from chip samples
- **Rating:**
 - Initial rating based on general characteristics of geologic unit (i.e. alluvium - low risk, marine shale – high risk)
 - Subsequent sampling used to update assessment with site-specific criteria set based on S content, NPR and paste pH
 - 0 – no risk1 - low.....2 - moderate.....3 – high risk



Pathway (Hydrology)

- Objective:
 - Approximate contact flow and receiver low flow
- Based on:
 - Ratio rock cut volume : up-gradient catchment
- Rating:
 - Order-of-magnitude estimate (m³:ha)
 - 0 – 100 = 3
 - 101 – 1,000 = 2
 - 1,001 – 10,000 = 1

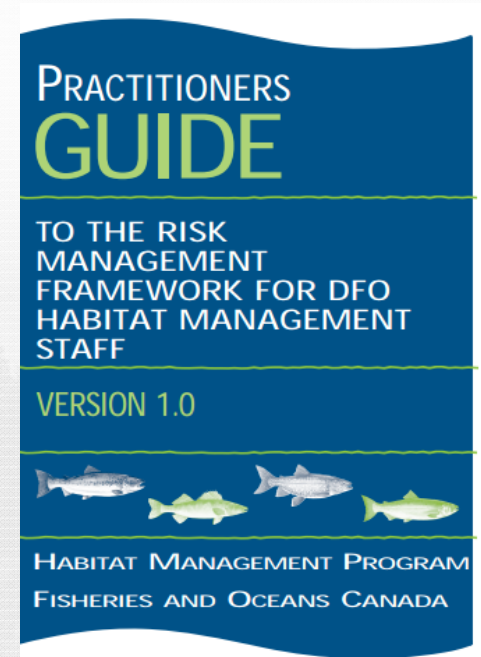




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Receiver (Biota)

- **Objective:**
 - Estimate sensitivity of aquatic organisms to changes in water quality
- **Based on:**
 - Stream size, fish accessibility, species presence
- **Rating:**
 - **Small stream, only periphyton, benthics – low abundance / diversity = 1**
 - **Moderate stream, only “coarse” fish – moderate abundance / diversity = 2**
 - **River, Commercial, recreational fishery = 3**





Hypothetical Example

Road Section	Stressor (0-3)	Pathway (1-3)	Receptor (1-3)	Total (0-27)
ONE	0	3	3	0
TWO	3	1	1	3
THREE	2	2	1	4
...				
NINE	3	3	3	27
TEN	2	2	3	12
...				



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Detailed Investigation

- **Confirm / refine geochemical risk through additional static tests**
- **Confirm / refine information on drainage network and aquatic ecology**
- **Provide input on construction methodology to avoid, minimize impacts**





Effects Assessment

- Determine “source terms”, using SFE, kinetic test results (field bins, humidity cells)
- Estimate “contact” water relative to low flows in receiving environment
- Identify receptors and toxic effect thresholds - fish, benthic invertebrates, primary producers





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Lessons Learned

- Challenging to provide guidance early enough
- Communication with design team is critical
- The screening tool is useful in 3 ways:
 - Identify high risk areas early
 - Helps to communicate risk
 - Facilitates transition to detailed assessment
- If avoidance fails
 - Mitigation options limited, costly



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Conclusion

- **Screening Tool has benefits**
 - **Facilitates early input**
 - **Avoid, minimize impacts**
 - **Saves time and money**
 - **Facilitates communication**
 - **Gradually builds knowledge base**
 - **Facilitates transition into, and focuses, detailed investigation and effects assessment**



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Questions?

