Manaaki Whenua
Landcare Research

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo

CRL Energy Ltd

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

Objective 2 Ecological Impacts

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1. Aims of objective 2
2. Approach
3. Introduction to mine drainage issues
4. Summary of West Coast work
5. Preliminary Southland work
6. A look forward

Objective Statement

to characterise the impacts on aquatic ecosystems based on potential risks to water quality identified in obj 1, and to determine the sequence of events by which streams recover

Specifically;

a) Identify threshold ranges of water quality which should support functioning stream communities
b) Characterise stream communities in mined streams
c) Test the recovery of streams post-remediation (obj 3)

Healthy stream ecosystems

Dissolved organic matter (DOM)

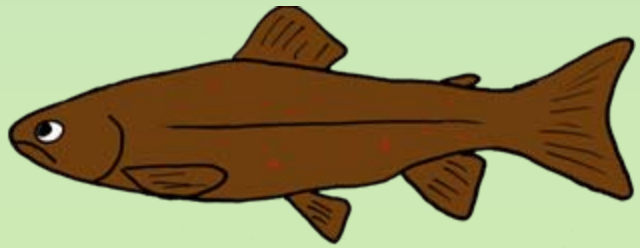
Algae (periphyton)

Bacteria & fungi

Stream invertebrates

Bryophytes & Macrophytes

Fish & crayfish



Mine impacted stream ecosystems

Dissolved organic matter (DOM)

Algae (periphyton)

Bacteria & fungi

Stream invertebrates

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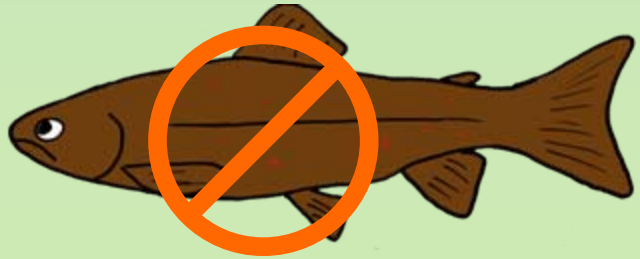
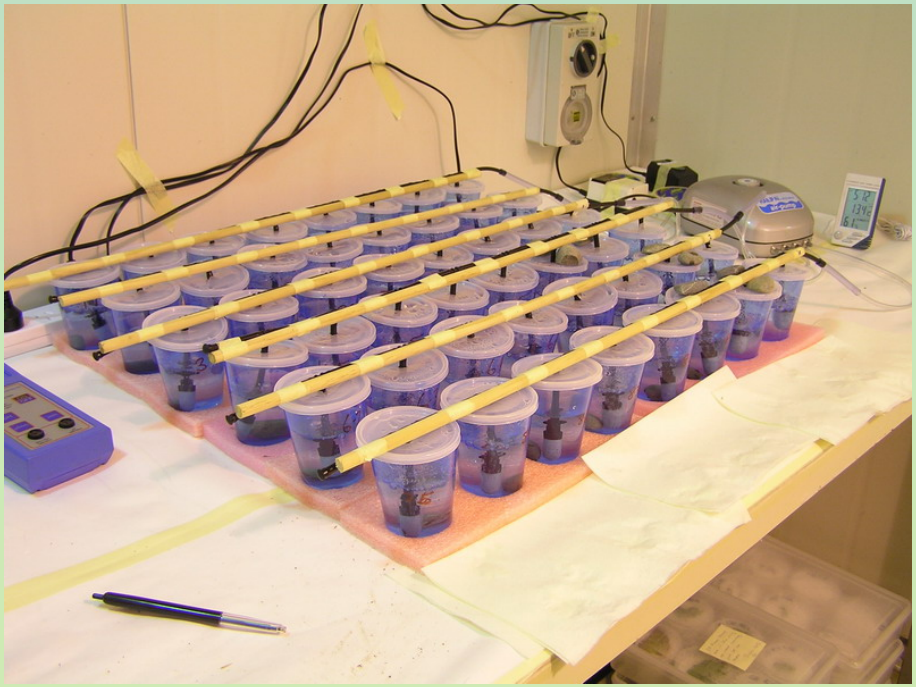


Stream invertebrate community

Approach

- Ecological field studies
  - Algae
  - Benthic invertebrates
  - Fish
- Ecotoxicological tests
  - Benthic invertebrates



Summary of West Coast work

Ecological field studies

✓54 field sites surveyed, ranging from highly AMD impacted to “natural” reference condition

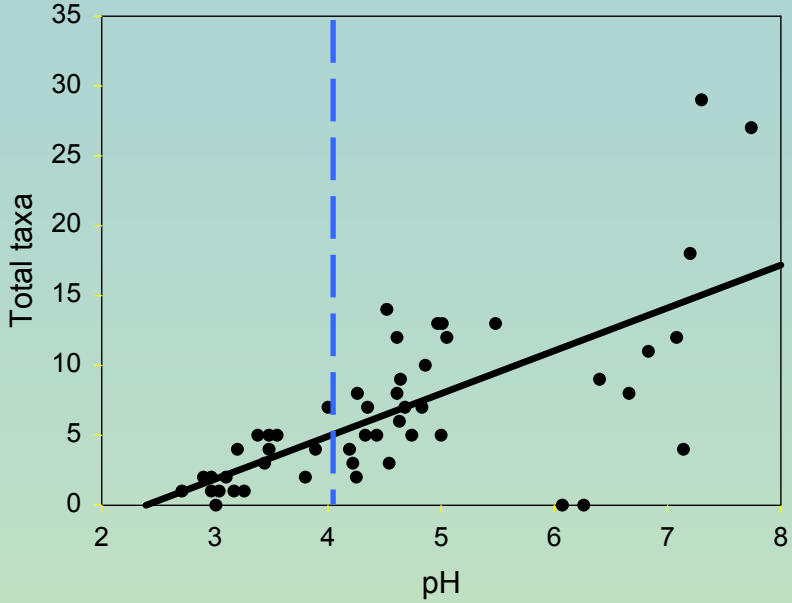
✓ Water chemistry (pH, conductivity, Fe, Al, Ni, As), physical habitat and benthic invertebrates

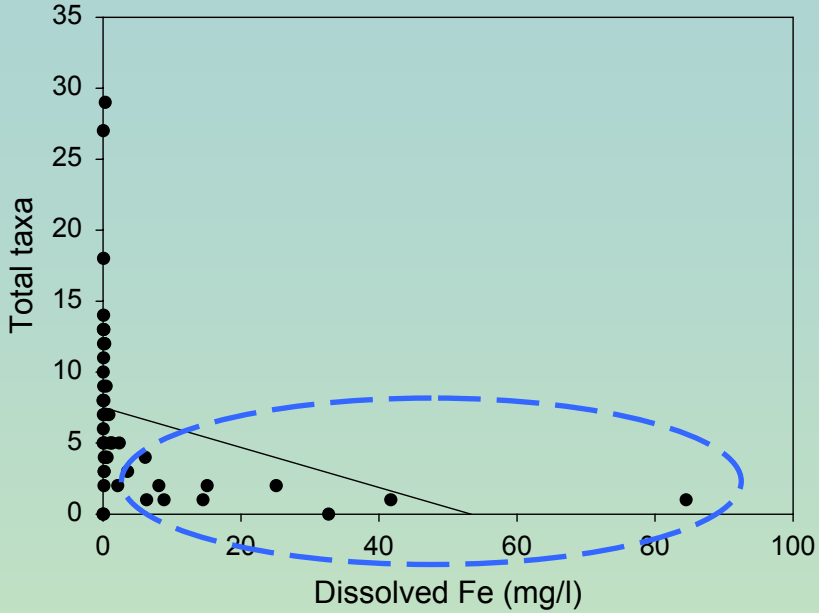
✓Additional MSc student working on algae

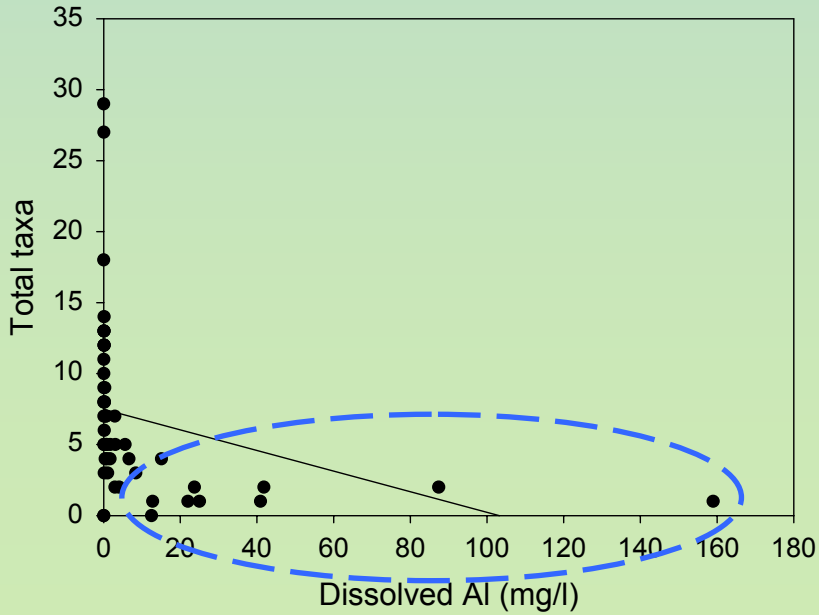
✓Additional fish survey

✓ Data added to obj 1 geological database

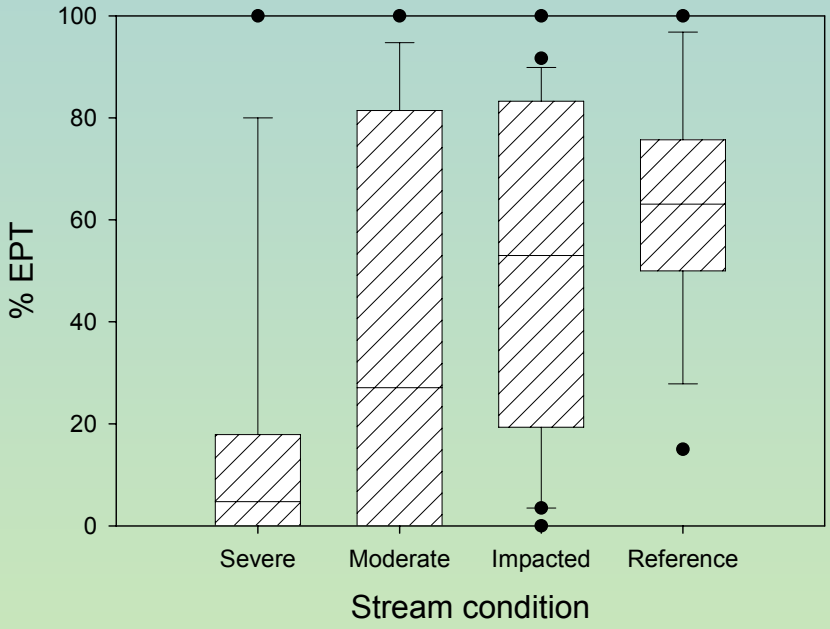
Benthic invertebrates v water chemistry

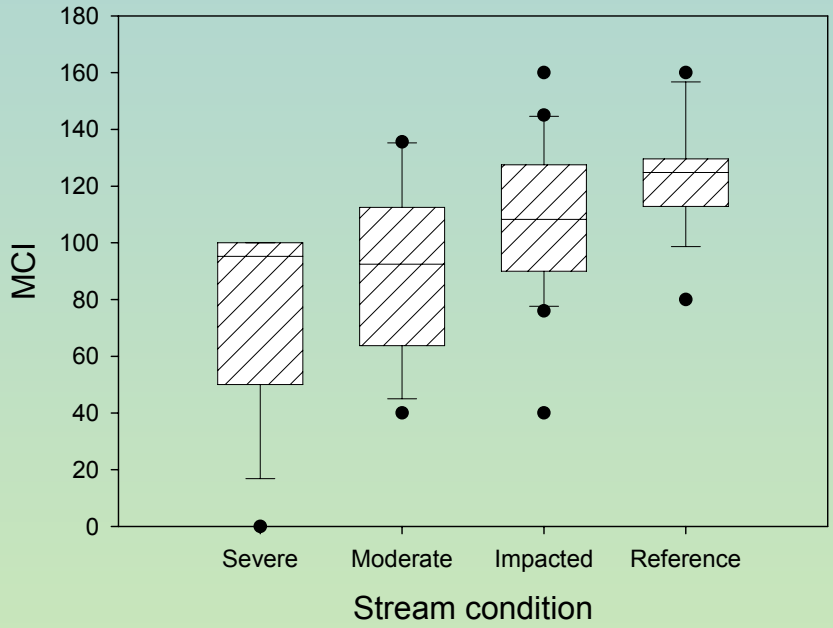






Other biotic indices



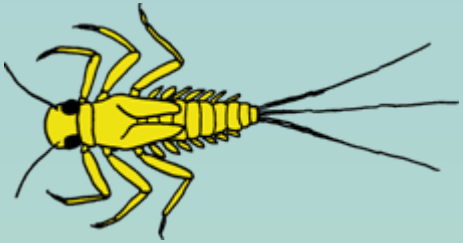


Field studies summary

✓Even the most highly degraded may have invertebrates

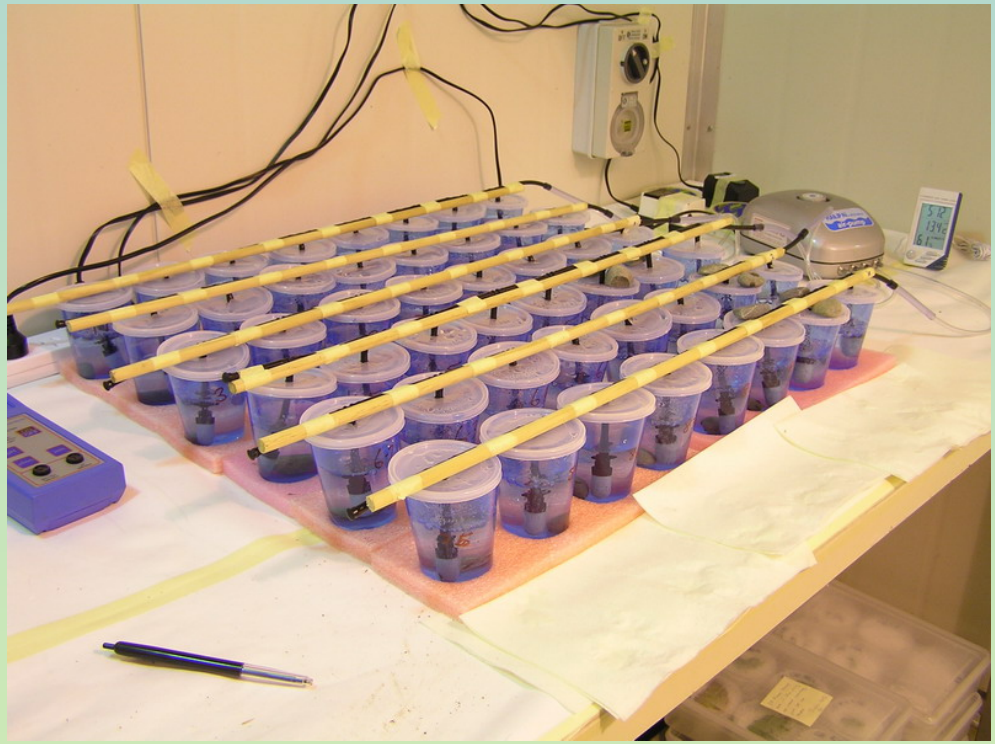
✓ Taxonomic richness depleted <4 pH, dissolved Al >1mg/l, dissolved Fe >1 mg/l

✓ Some taxa e.g. chironomids, stoneflies and beetles can survive in poor water chemistry contrary to accepted indices

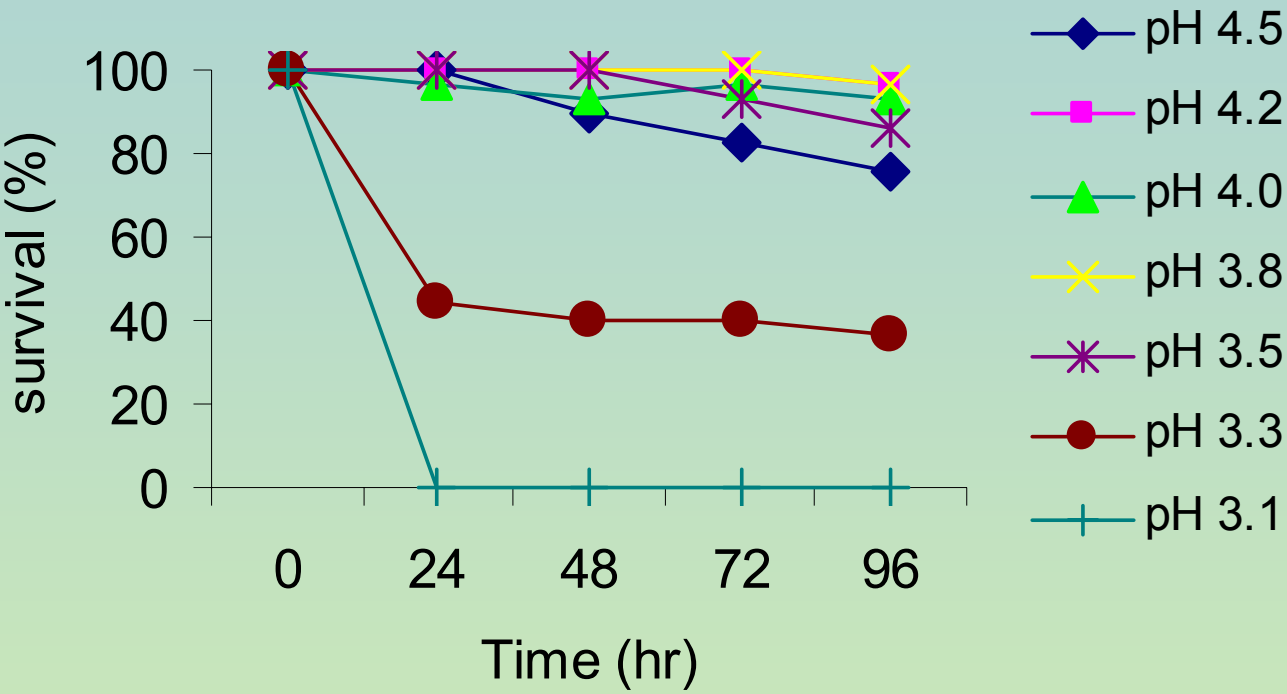


Ecotoxicology test

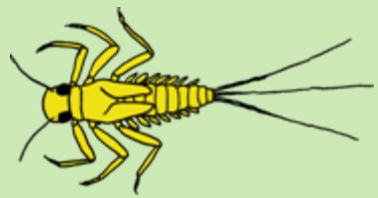
- Aquatic invertebrates
- Standardised temp, day/night
- Treatments replicated
- 5 organisms/ replicate
- Short-term test (96 hr)
- 24 hr survival checks



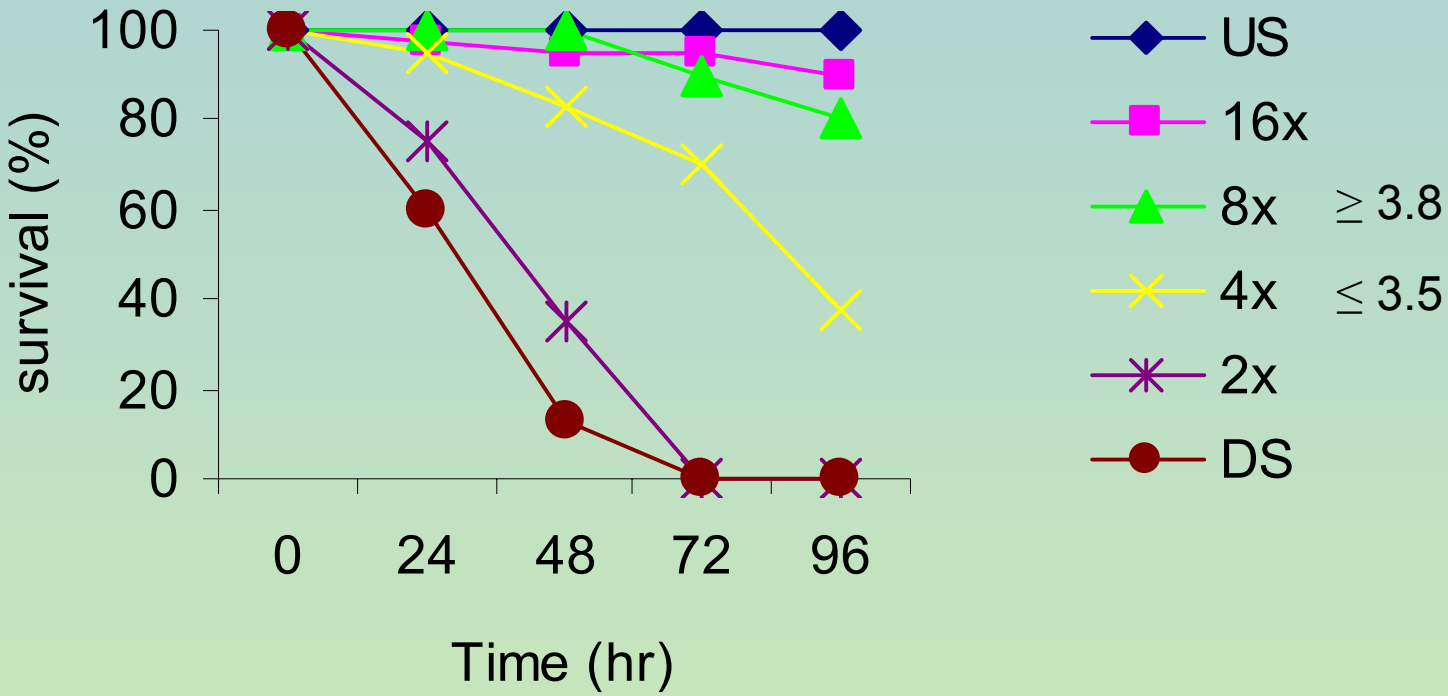
pH toxicity



- In <u>uncontaminated</u> water, West Coast mayflies survived in pH ≥ 3.5
- What happens in Acid Mine Drainage (AMD) water?

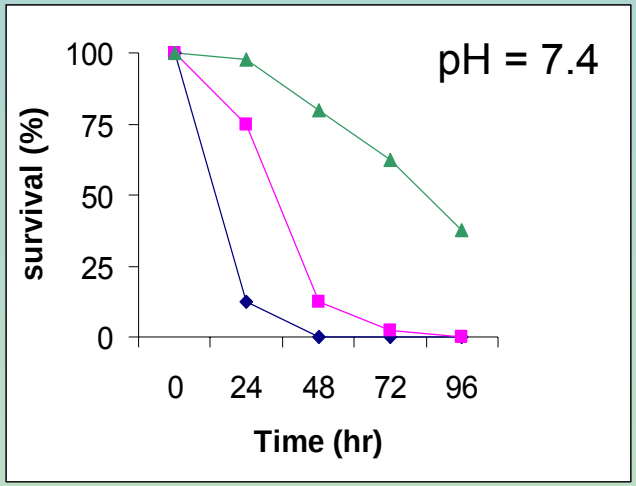


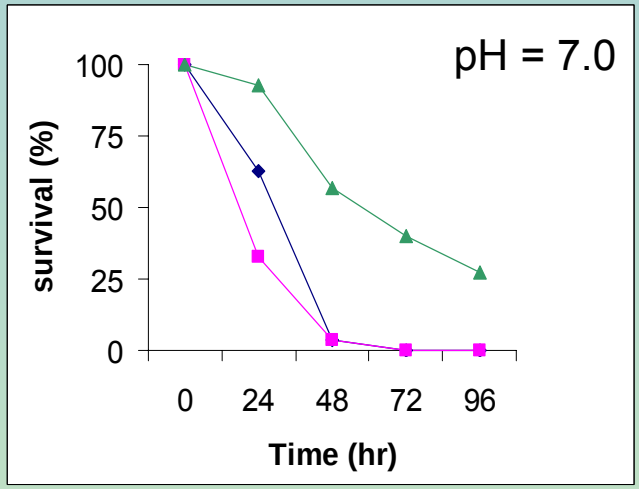
Toxicity in AMD water

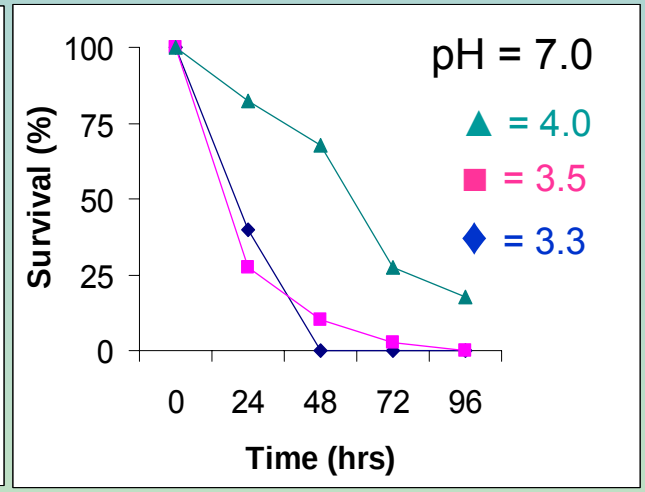


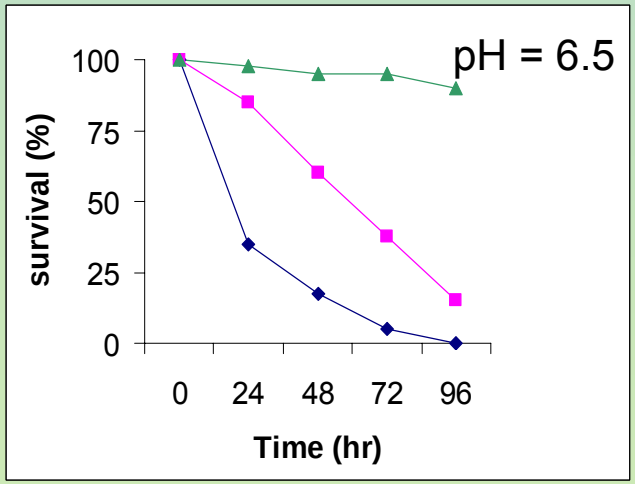
- Mayflies survive in AMD when pH ≥ 3.8
- Toxicity of AMD is ameliorated when pH is modified up to the natural pH of the stream

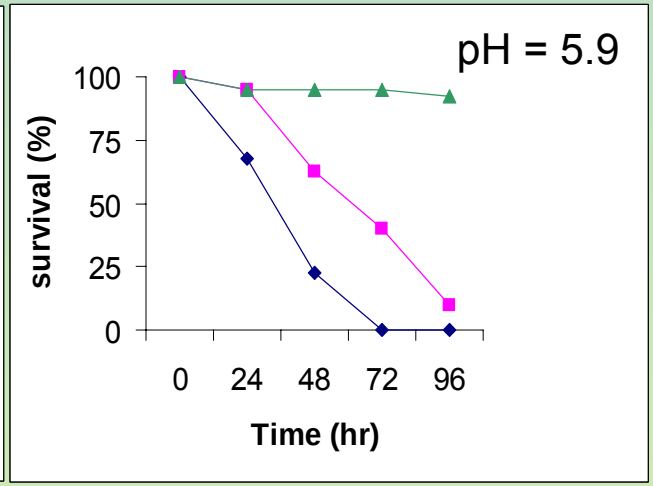
Mayflies sourced from different streams

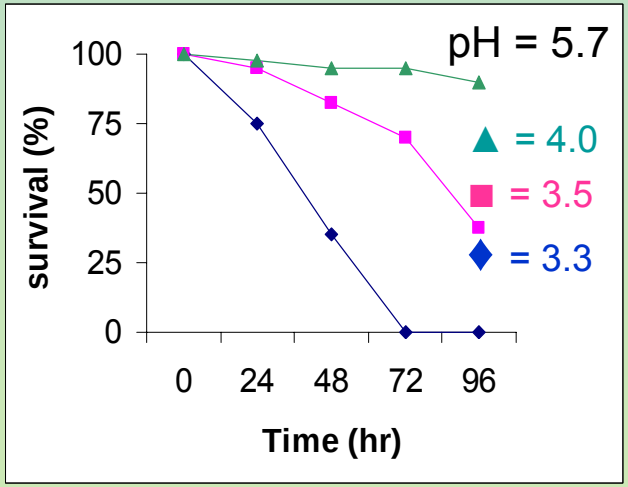












❑ Mayfly tolerance to AMD depends on the pH of their home stream

Indicative pH thresholds of mayfly tolerance to AMD

Level of impact	**pH**
Low	> 4.0
Moderate	3.5 – 4.0
High	≤ 3.5

Preliminary Southland work

- Small scale benthic invertebrate survey of current mining operations;
  - Some localised AMD e.g. Belle-Brook alluvial gold
  - Possibility turbidity issue
  - Confounding issue agricultural landscape
- Numerous pit lakes (various ages)

A look forward

- Collation of existing benthic invertebrate
  - Environment Southland (SOE, Consent)
  - Theses, Academic publications
  - National databases; NIWA, Canterbury Museum (caddisfly & mayflies)
  - Others; DoC, F&G, Liquid Fuels Trust Board data

  Little focus site specific data on mining sites ?

- Extensive benthic survey focused on potential & current mining sites

- Ecotoxicological tests on Southland species for tolerances to AMD and turbidity (?)

- Ecology of pit lakes

- Assess validity of West Coast water quality thresholds