Performance of a Sediment Retention Pond Receiving Chemical Treatment

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Outline

- Background
- Study overview
- Location and methods
- Results
- Performance of chemical treatment
- Summary

Background

- Increasing use of flocculants in the last decade
  - Liquid Polyaluminium Chloride (PAC)
- ALPURT B1 trials 1998-1999 (ARC TP 227)
  - 62-99 % reduction in suspended solids concentrations in treated ponds
  - Compared to 4-12% in untreated ponds
  - Only 1-2 samples per event
  - Didn't quantify loads or variations between and during events

Study Overview

Objectives:

- **Efficiency of PAC treatment in terms of total sediment mass load removed**
- **Variations in effectiveness during events of differing rainfall characteristics**

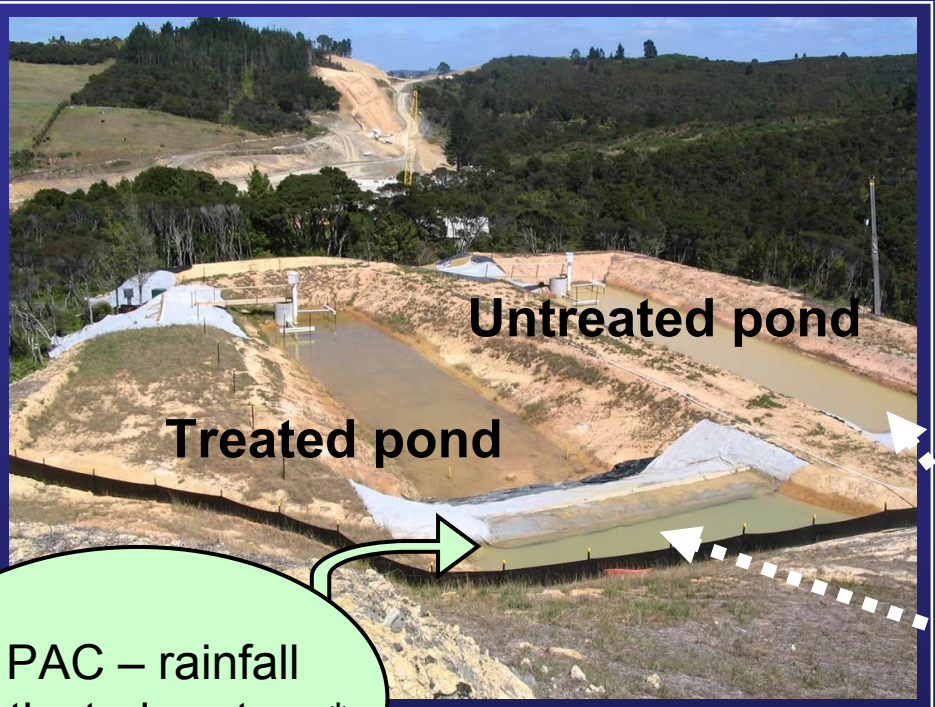
Key aspects:

- **paired study pond system with a shared catchment**
- **continuous monitoring of pond hydrology**
- **Storm event water sampling and analysis for Total Suspended Concentration (TSS)**

Study Location – ALPURT B2 Motorway

- Ecologically sensitive (RAP 21)
- Steep topography
- > 3 million m^3 earthworks
- PAC required by consents

Study Ponds



PAC – rainfall activated system *

*as per TP90 (BCHF, 2003)

Flow splitter

- Weir + water level recorder
- Auto-sampler
- Rain gauge

Catchment runoff, via cut off drain

Study Pond Outlets

Emergency spillway

- Weir + water level recorder

Outlets

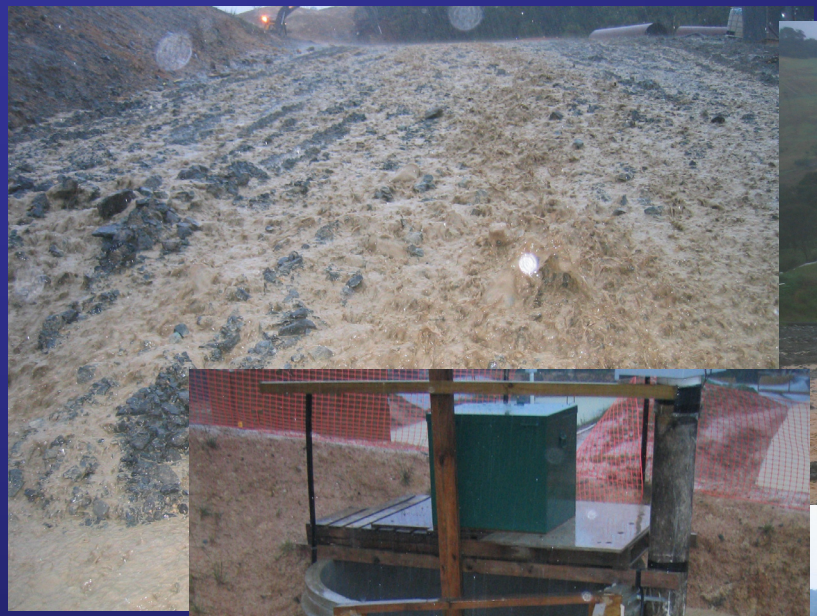
- Weir + water level recorder
- Auto-samplers

PAC dosing of untreated pond outflows to comply with consent

Sampling Event Characteristics

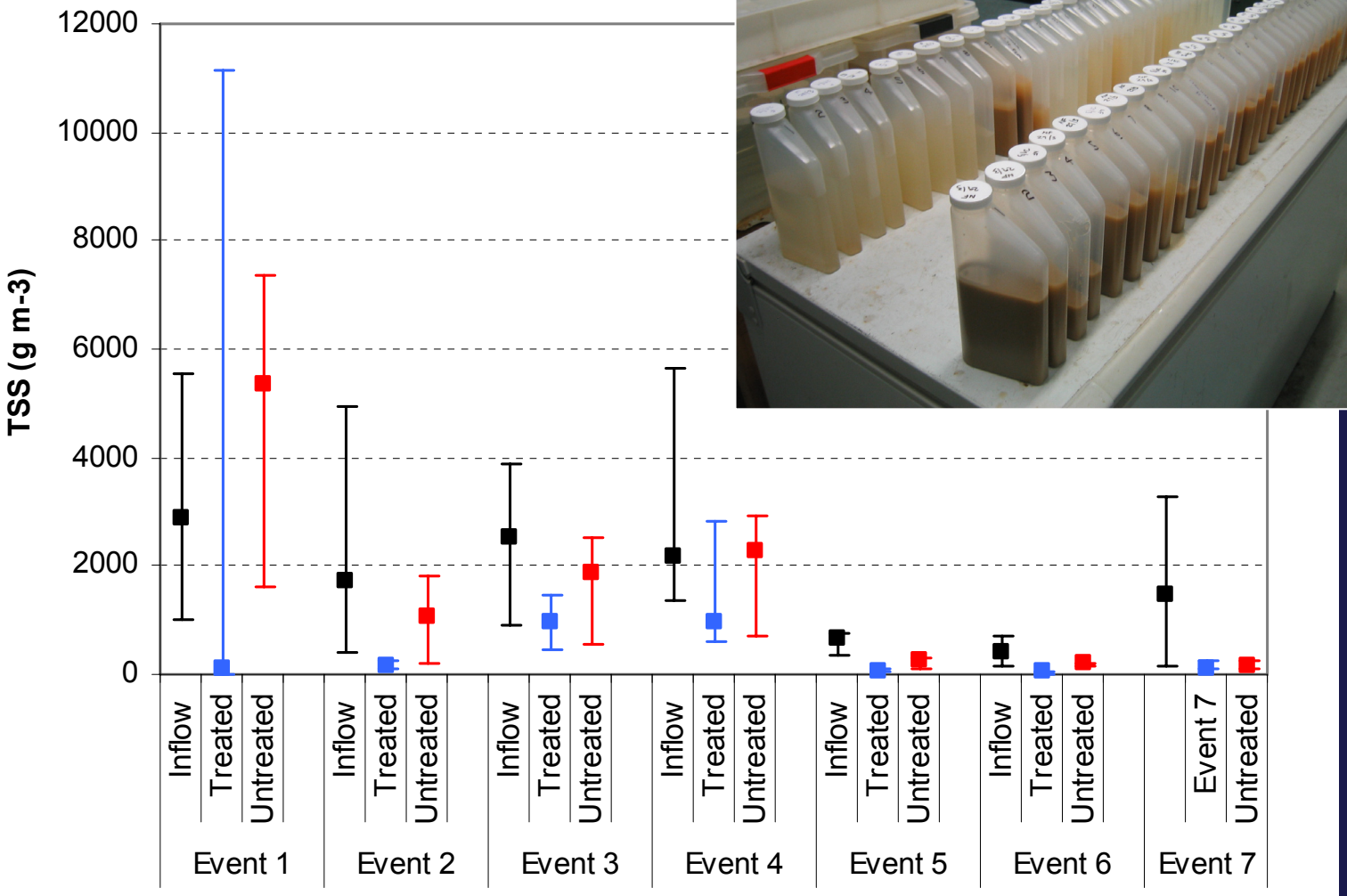
	Dates	Rainfall Depth (mm)	Rainfall Duration (hours)	Inflow volume (m^3)	Peak inflow (l/sec)
1	28-30 Mar 2007	195	42	>2032	>100
2	29-30 Jun 2007	41	21	703	25
3	29 Jul 2007	48	8.5	1019	91
4	16-17 Aug 2007	68	16.5	1528	275
5	6 Nov 2007	18.5	12	183	7
6	9 Dec 2007	10.5	21.5	123	6
7	18-19 Dec 2007	28	15	177	51

28-30 March 2007

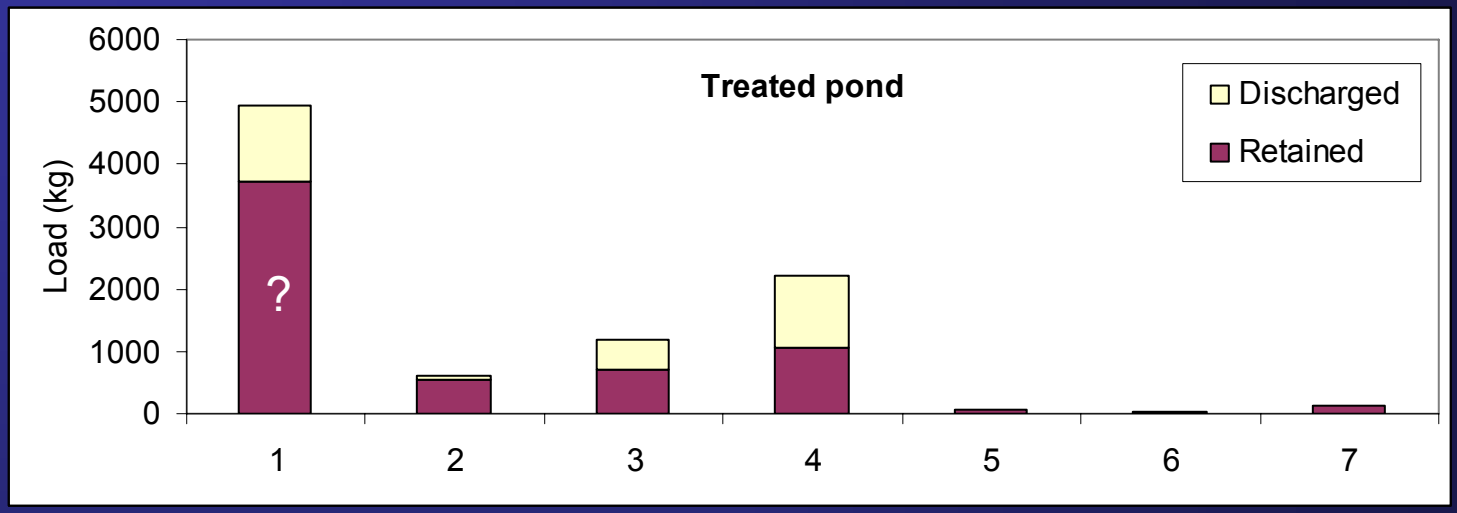


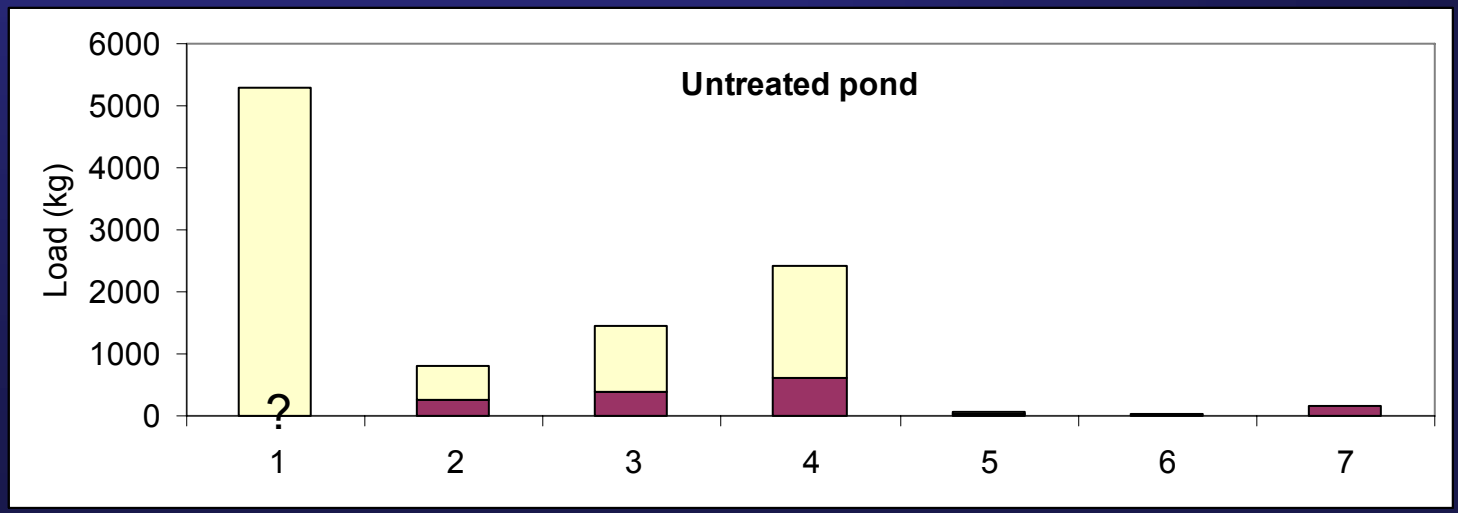
- 195 mm in 43 hours
- 1 in 13 year 24 hour event
- Water level recorder float and auto-sampler intake buried
- Emergency spillway did not operate

Results – TSS concentrations

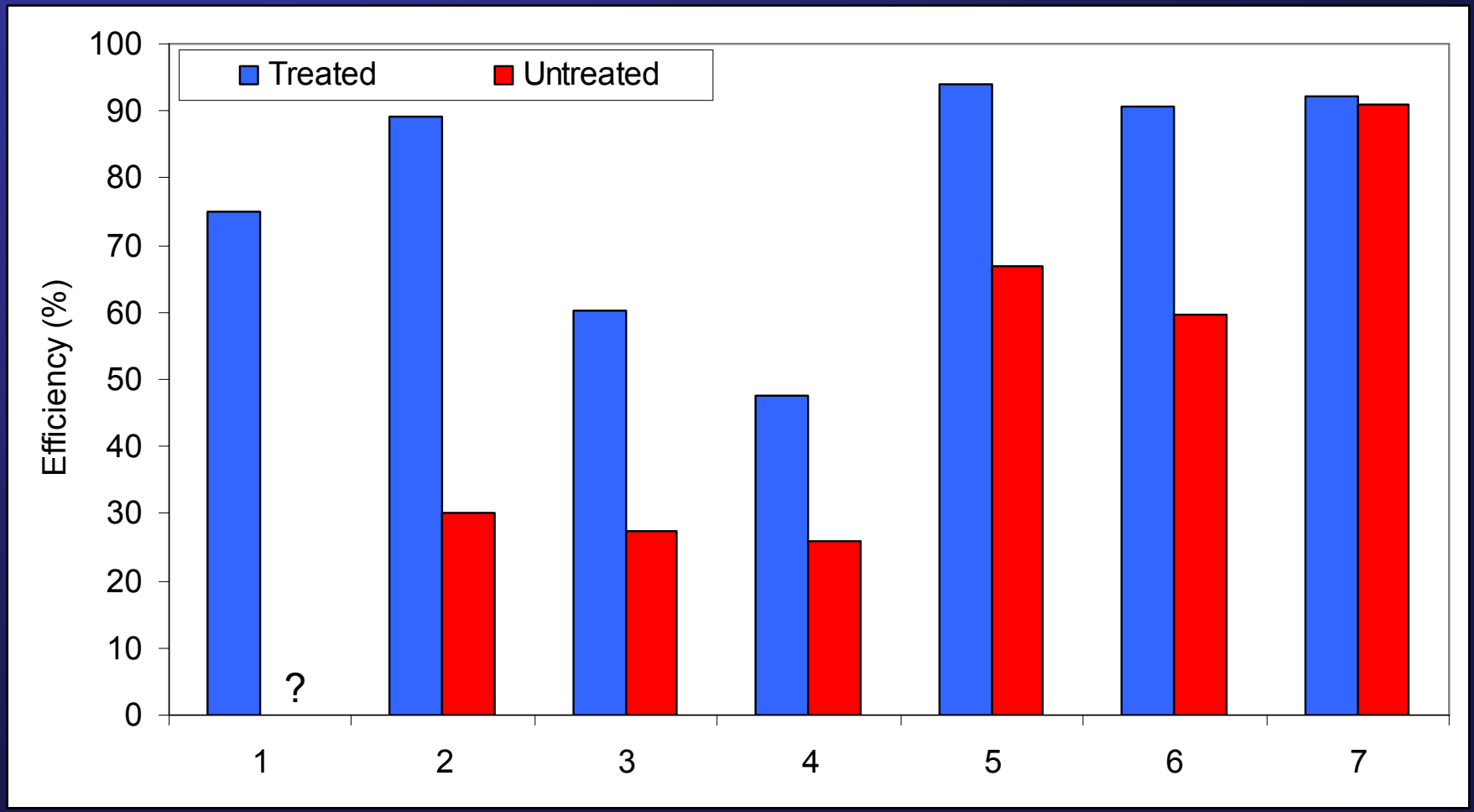


Results – Sediment Loads





Results – Efficiency



Performance of PAC Treatment

- PAC treatment was effective
  - TSS concentrations in treated pond up to 2 orders of magnitude lower than in untreated pond
  - Total load discharged from untreated pond was 3 times that from treated pond (approx 9 and 3 tonnes respectively)
  - Efficiency of treated pond ≥ 68 % compared to ~ 30% untreated pond
- Effectiveness varied between and during events

Variations – 'larger' events

- Events 1 to 4 (41 – 195 mm)
- Untreated pond performance poor (≤ 30%)
  - High influent TSS concentrations
  - Limited residence time
- Large relative improvement due to treatment (48 to 89 % efficiency)
  - PAC promotes settling that would otherwise be limited
- Substantially greater mass load retained in the treated pond over these 4 events
  - 8.7 tonnes discharged from untreated pond
  - 2.9 tonnes discharged from treated pond
  - 4 tonnes less from untreated pond during Event 1

Event 1

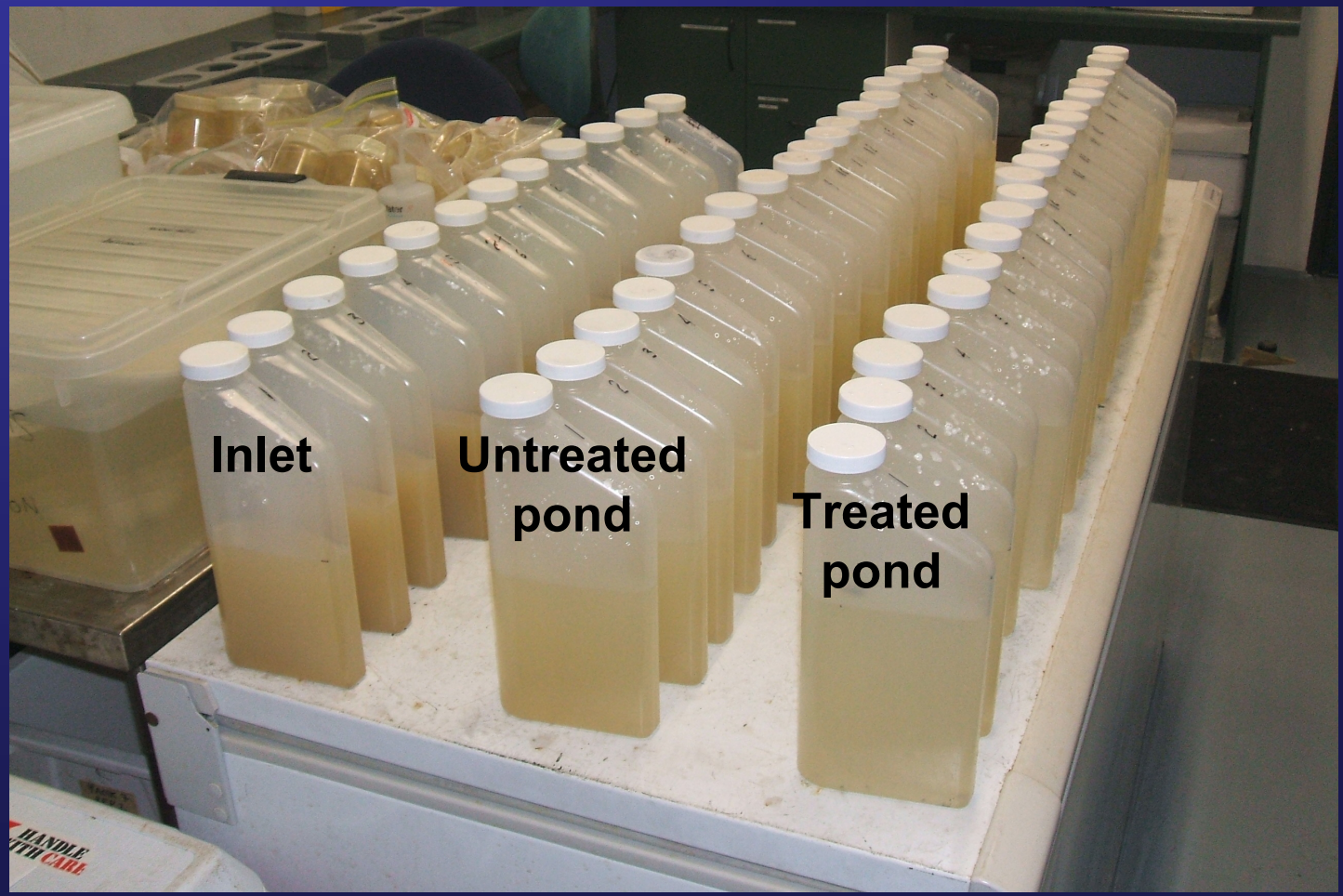
Treated pond

Untreated pond

Variations – ‘smaller’ events

- Events 5 to 7 (10.5 – 28 mm)
- Untreated pond performance good (67 to 91%)
  - Low influent TSS concentrations
  - Longer residence time
- Small relative improvement due to treatment (91 to 94 % efficiency)
- Only a small contribution to the total mass load retained
  - Only 3 % of load retained in treated pond

Event 5



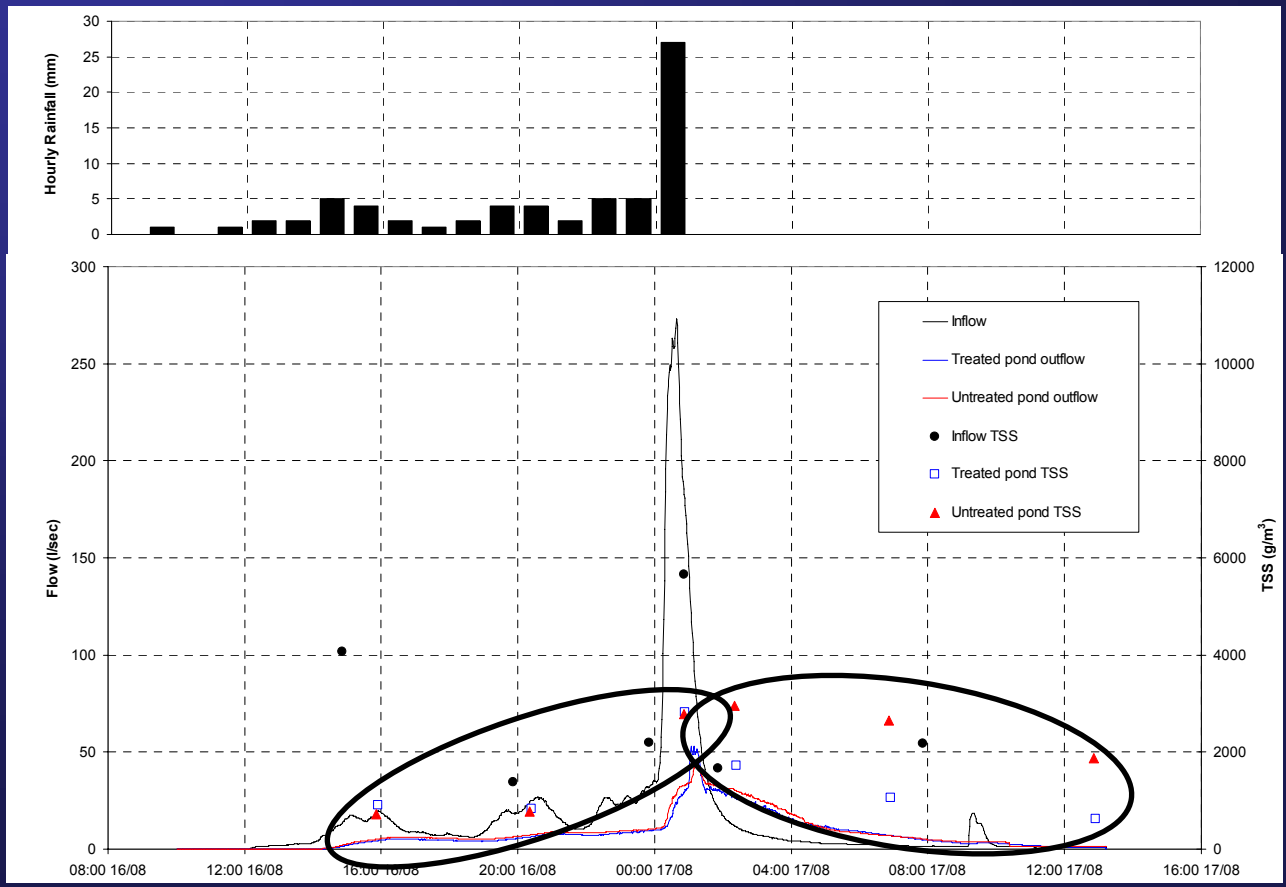
Other observations

Use of PAC during closed season:

- greater frequency of discharges and large events during winter
- but sites are closed – what are the benefits of continued PAC treatment ?
- untreated pond discharged 3.4 tonnes sediment during 3 winter storms, compared to 1.7 tonne from treated pond
- Continued treatment during winter was an important factor in the overall improvements due to PAC treatment

Other observations

Initial under-performance of PAC treatment

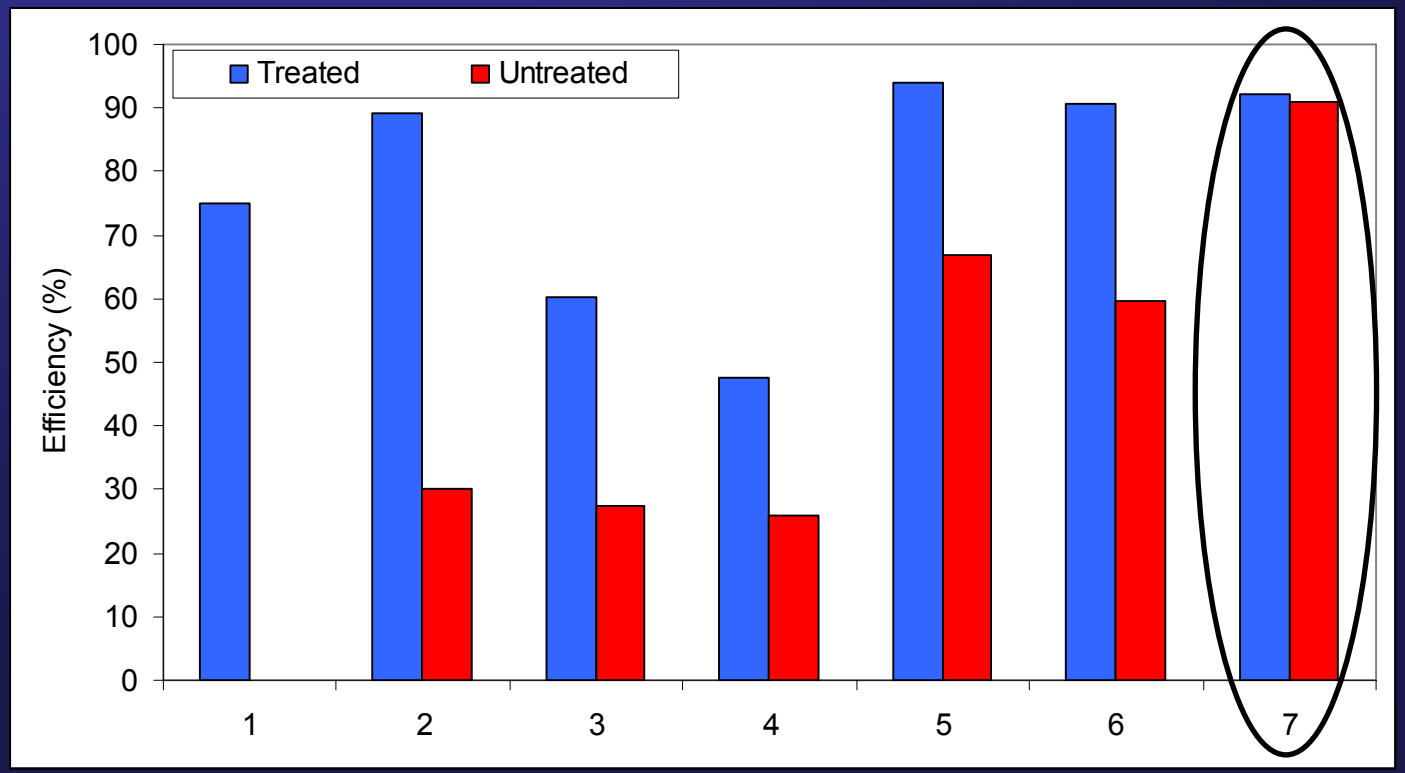


- delay in delivery of PAC ?
- Initial delivery at low rate ?

Other observations

Dosing system operation / management

- Event 1 - PAC dosing ran out ?
- Event 7 - Evidence of leakage to untreated pond ?



Summary

- Objective – effectiveness and variations in performance of PAC treatment
- paired study pond system with identical catchments at ALPURT B2
- Sampling during 7 storm events, summer and winter
- PAC treatment was effective – the total load discharged from untreated pond was 3 times that from treated pond
- Effectiveness varies between and during events
  - Both ponds performed well during small events, but only a small proportion of the total load was retained during these events
  - The relative improvement due to PAC treatment was more marked during large events with substantially more sediment discharged from the untreated pond during these events
- PAC treatment didn't always perform well
- PAC treatment during winter was an important factor in it's overall performance

Acknowledgments:

Auckland Regional Council
Northern Gateway Alliance

For further information see:

Moores, J. and Pattinson, P. 2008. Performance of a Sediment Retention Pond Receiving Chemical Treatment. NIWA Client report AKL-2008-019 prepared for Auckland Regional Council. 75p.

References:

Auckland Regional Council (2004) The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff : Trials, Methodology and Design (draft). Auckland Regional Council Technical Publication 227.

Beca Carter Hollings and Ferner Ltd. (2003) TP 90 Flocculation Guidelines (draft). Report to Auckland Regional Council.