

Grounding Electrodes



A Field Trial Comparison

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5 implementations:



- ▶ Single ground rod
- ▶ Single ground rod, embedded in cement
- ▶ 50 ft trench, #2AWG with 6 rods
- ▶ 50 ft trench, 4/0 counterpoise wire
- ▶ 50 ft trench, 4/0, embedded in cement

Experiment Setup

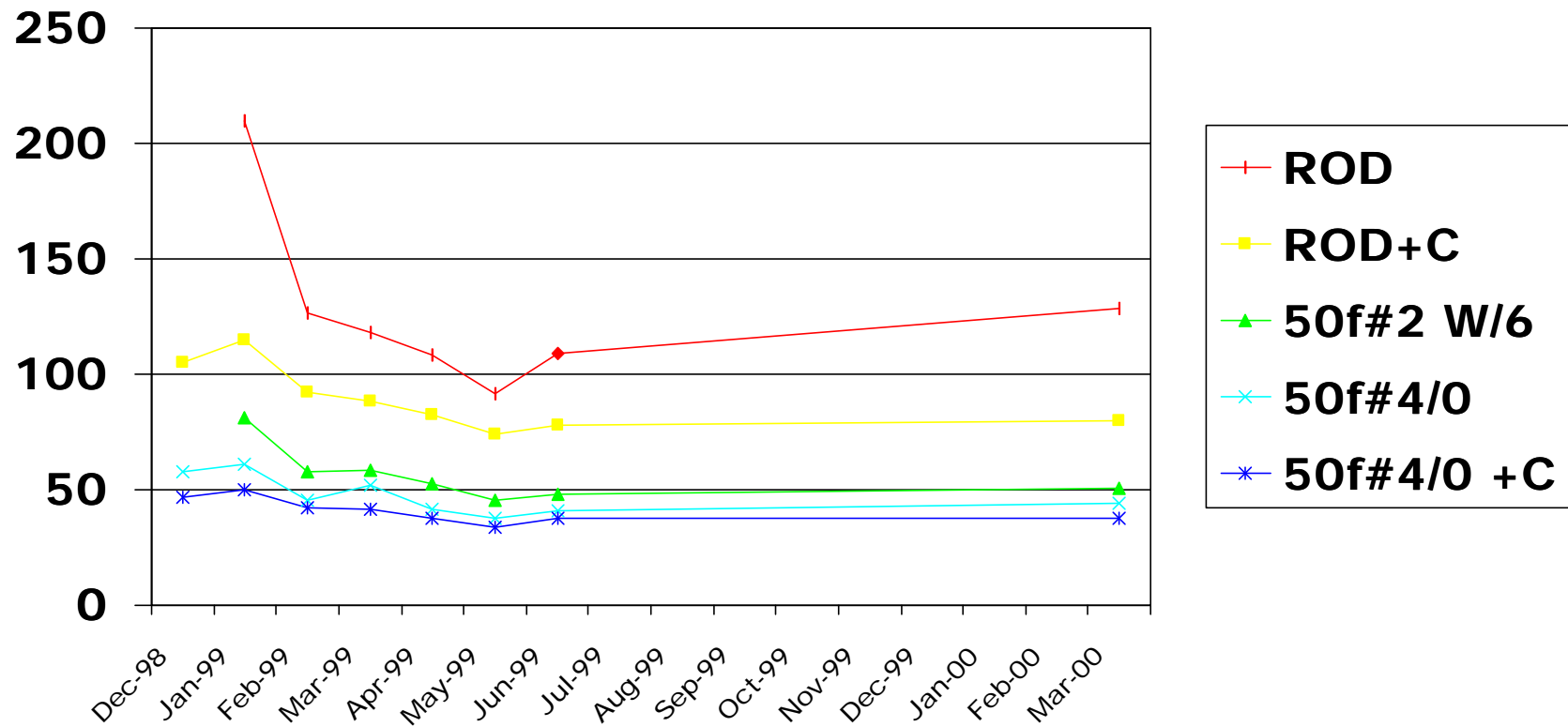
- Test site: Chester, NJ
- 4 point resistivity measurements:

5 ft	10 ft	20 ft	Ave
29.8	22.0	19.1	23.6
31.4	24.7	20.6	25.6
29.0	25.5	23.4	26.0

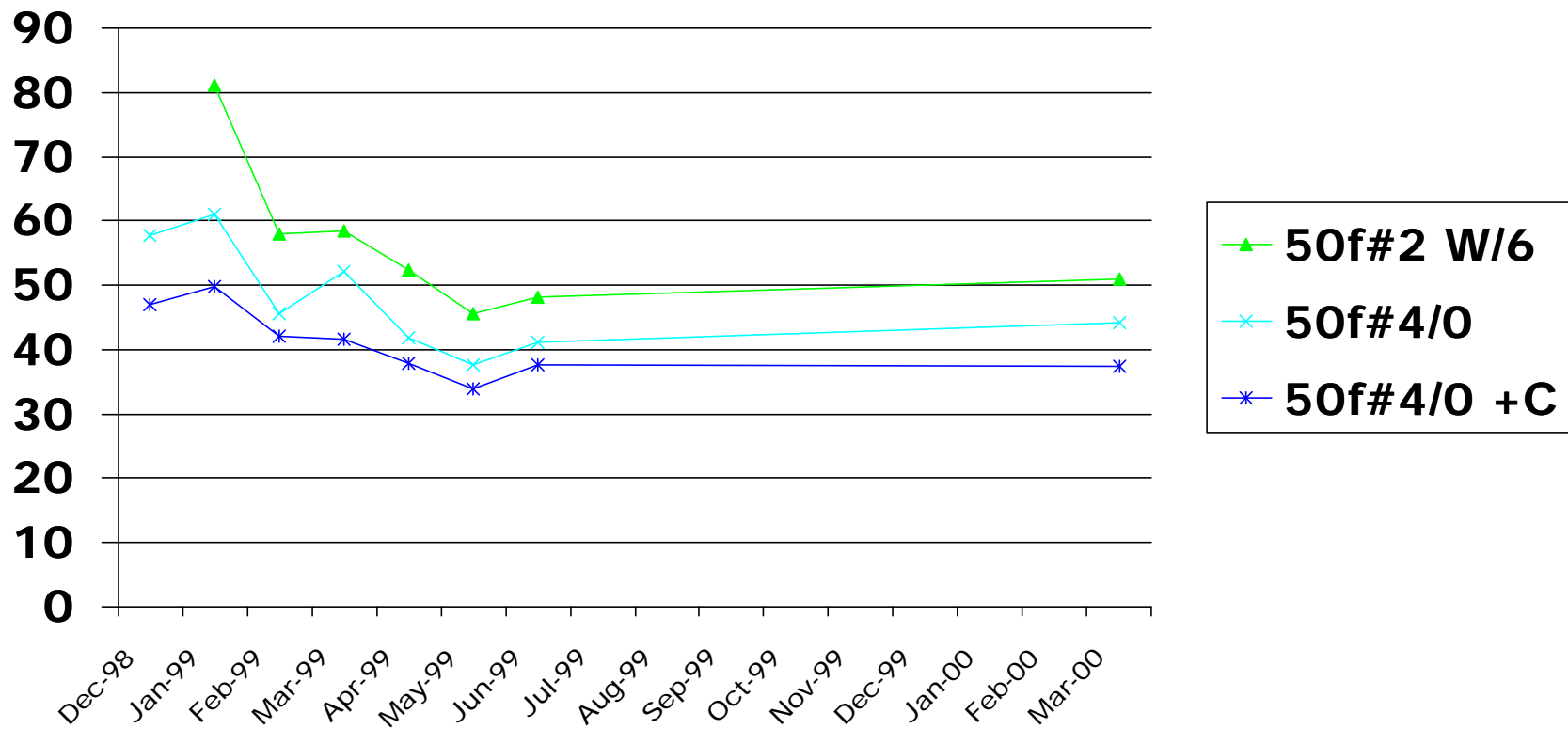
Resistance Readings

Date	1/99	3/99	4/99	6/99	3/00
1 rod	210	118	108.5	109.4	128.7
1 rod w/cement	115	88.4	82.7	77.8	79.6
50 ft #2 w/ 6 rods	81.1	58.4	52.3	48.2	50.9
50 ft #4/0	61	52.1	41.8	41.2	44.1
50 ft #4/0 w/ cement	49.9	41.6	37.9	37.6	37.5

Resistance Over time



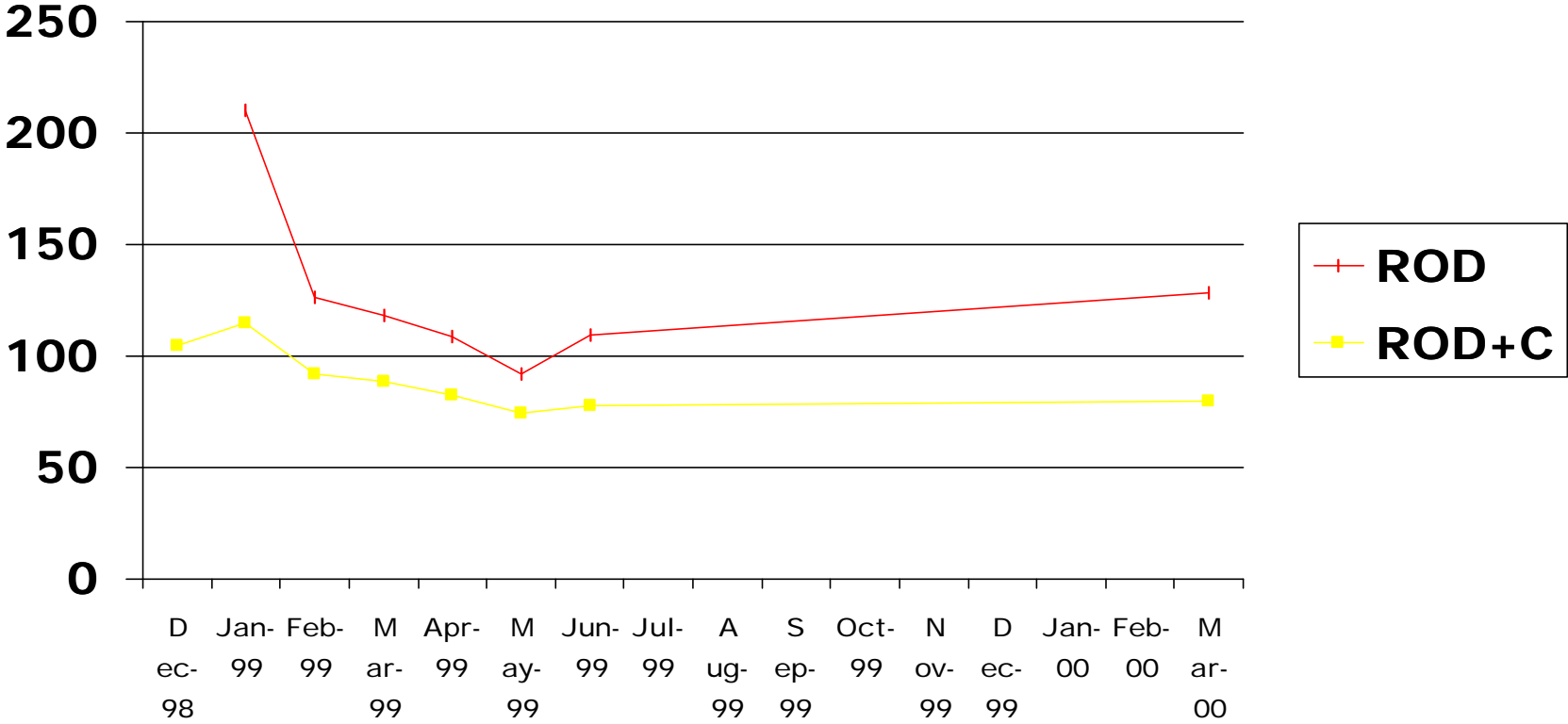
Horizontal Rods



Comparison: Horizontal

- Bare 4/0 was in lower resistance soil than embedded 4/0 (19.1Ω vs 23.4Ω)
- Bare 4/0: 44.1Ω Embedded 4/0: 37.5Ω
- Adjust for soil: $37.5 * (19.1/23.4) = 30.6 \Omega$
- Improvement: $30.6/44.1 = 69\%$
- Resistance reduced by 31%
- Trend is better with cement

Vertical Rods



Comparison: vertical rods



- ▶ Accurate soil resistance readings not taken, but rods are near each other near trench 2 ($R=25.6 \Omega$)
- ▶ 16" auger used for cement rod
- ▶ $79.6 \Omega / 128.7 = 62\%$
- ▶ 38% reduction in resistance
- ▶ Resistance trend over time improved