Impact of Sludge Towards Stabilization of the Fire Road Mine

M. Coleman[1], K.D.Phinney[2]+

+

[1] NB Power
[2] Consulting Chemist./Chemical Engineer

Mine Location

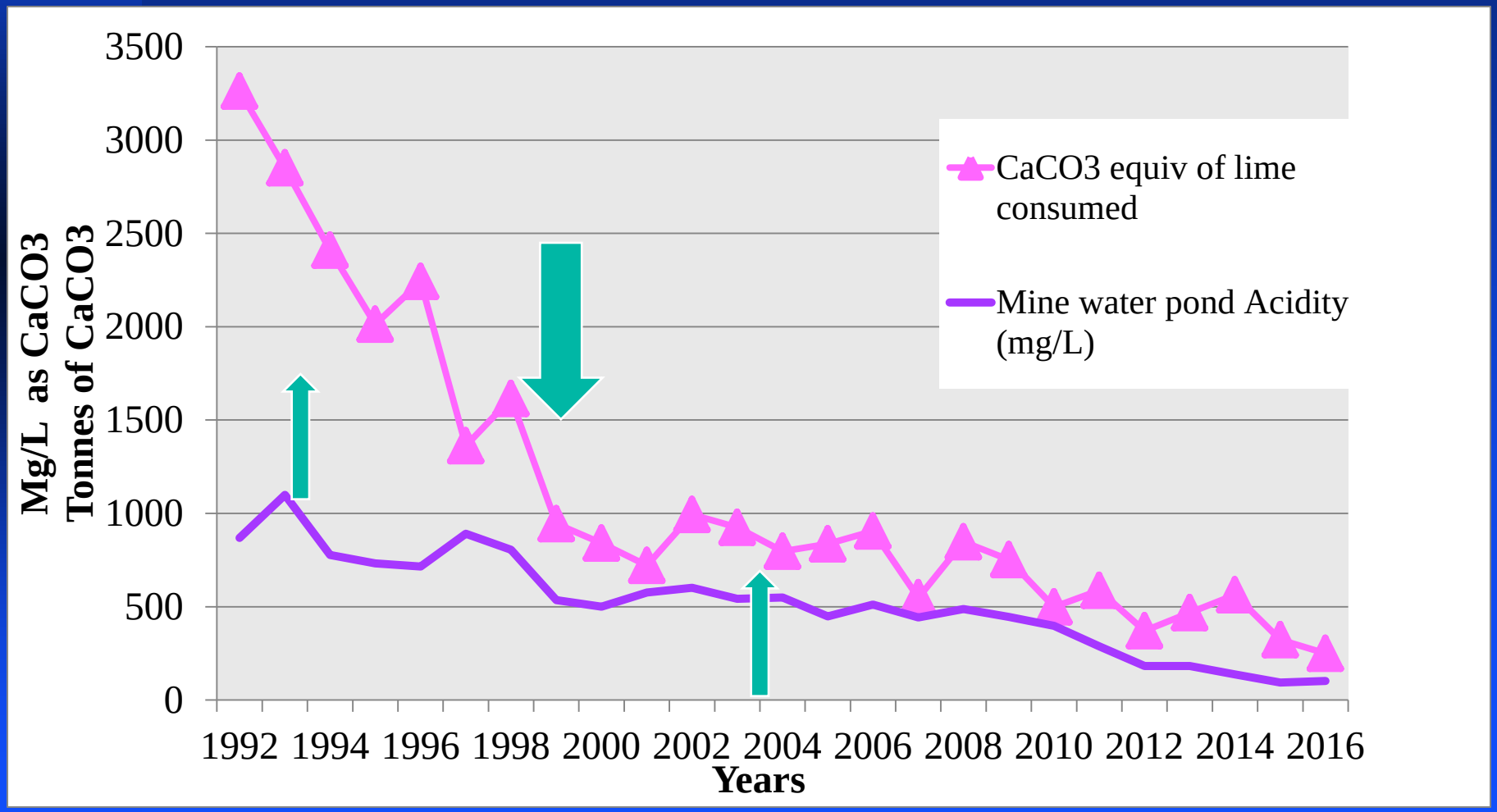
Background

- Mined 1982-1985;
  - 250 acre site (100 ha).
- AMD since mid-80's.
  - Waste rock contoured
- Hydrated lime treatment
  - 4 one -acre sludge ponds/yr
- Long term solution-sludge disposal into waste rock

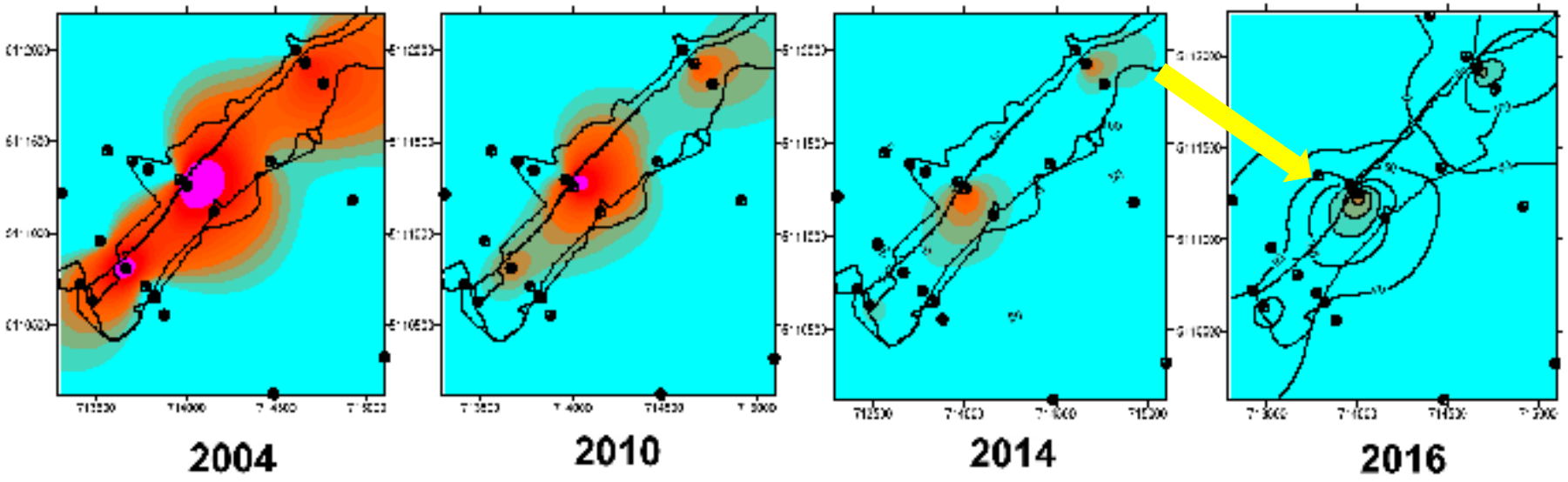
Initial Dredging Rationale

- Disposing of lime neutralization sludge into acid generating rock could provide several benefits including:
  - utilization of the excess alkalinity
  - final disposal area for sludge
  - minimize additional land disturbance
  - decrease personal liability
  - reduce accessibility of oxygen into the waste rock.

Equivalent Lime Consumption and Mine Water Pond Acidity



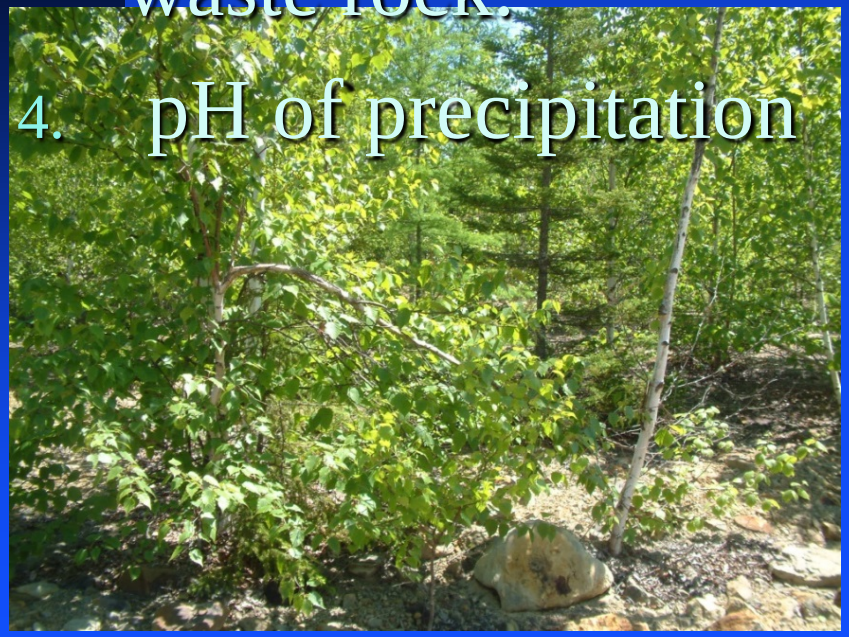
Decreasing Acidity in Mine Water from Monitoring Wells



Acidity Scale (mg/l)
Pink >1000
Orange 200-1000
Gray 150-200
Green <150

Factors That May be Impacting the Change in Acid Generation

1. Waste rock weathering.
2. Vegetation coverage increasing.
3. Putting the sludge back onto the waste rock.
4. pH of precipitation



- 26,000 m^3 sludge, late fall 2014

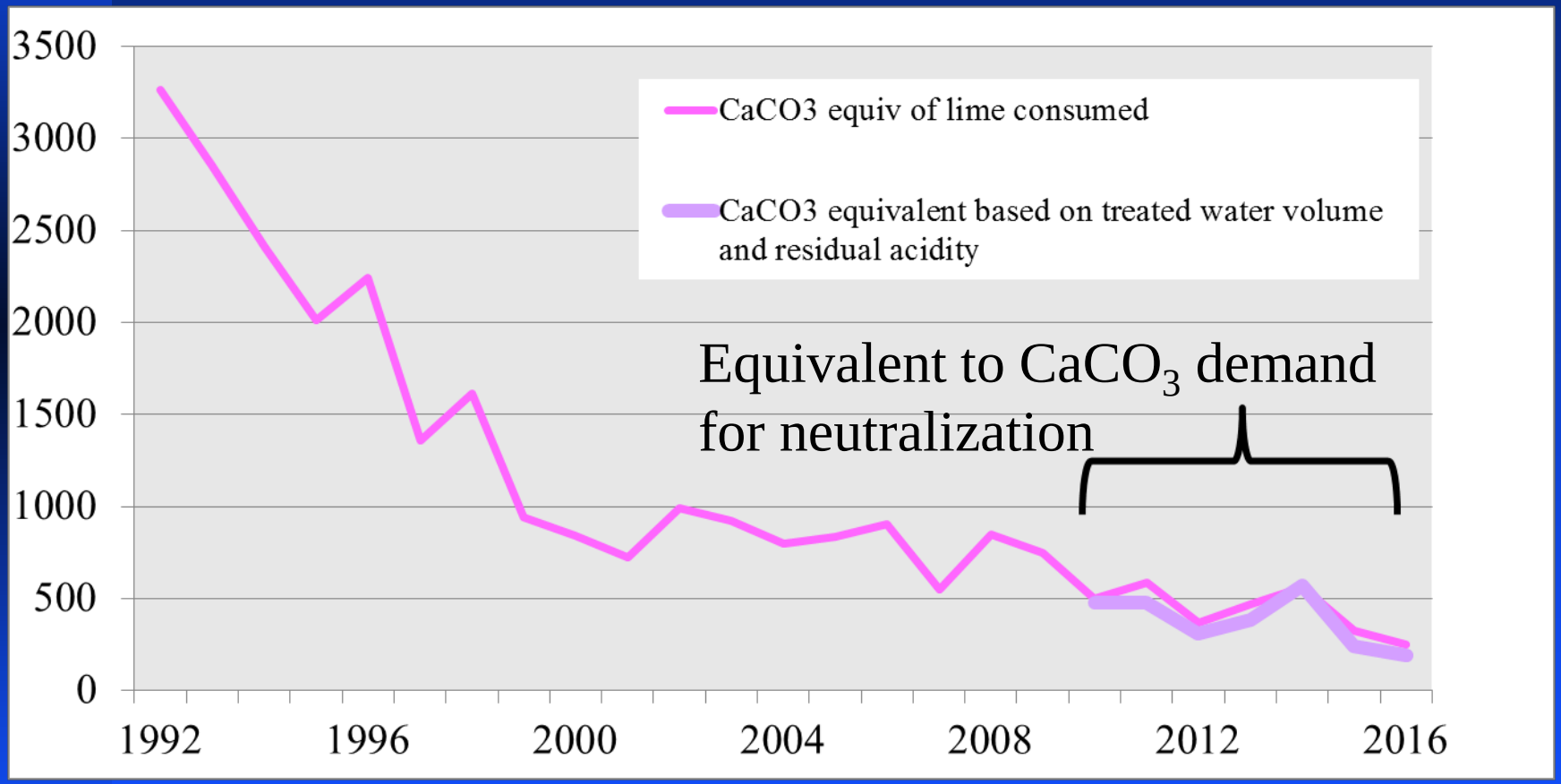
Objectives

- We are noticing a decrease in mine water acidity. Why?
  - Changes in in-situ neutralization?
  - Impact of neutral pH groundwater or precip recharge?
  - Waste rock weathering into smaller particles?
  - Is AMD burning out?
- Can you measure or calculate the impact of the sludge on the acidity of the mine water?
  - Are there short term impacts that can be identified after each dredging period?

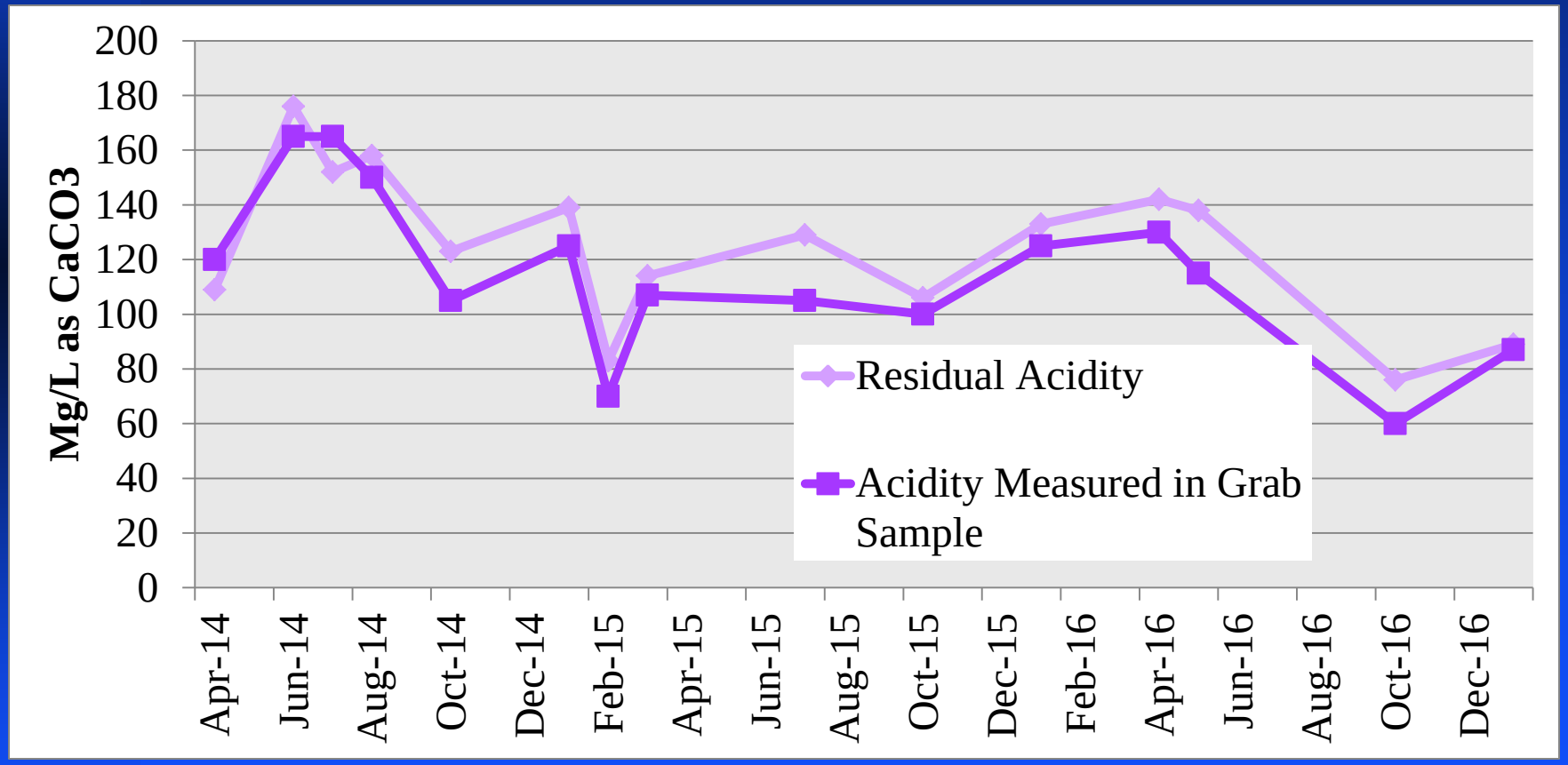
Groundwater Chemistry Evaluation

- Generated acidity (initial acidity)
  - Calculated acidity as a result of oxidation of sulfide minerals
  - Equivalent to SO_4^{-2} concentration (original H_2SO_4)
- Residual acidity
  - Calculated acidity due to mineral acidity (H^+) and conc. of metallic ions (Al, Fe, Mn, Cu and Zn)
  - Equivalent to $CaCO_3$ demand for neutralization
- % Acidity removed in-situ in the waste rock
  - Difference between (initial and residual)/initial)

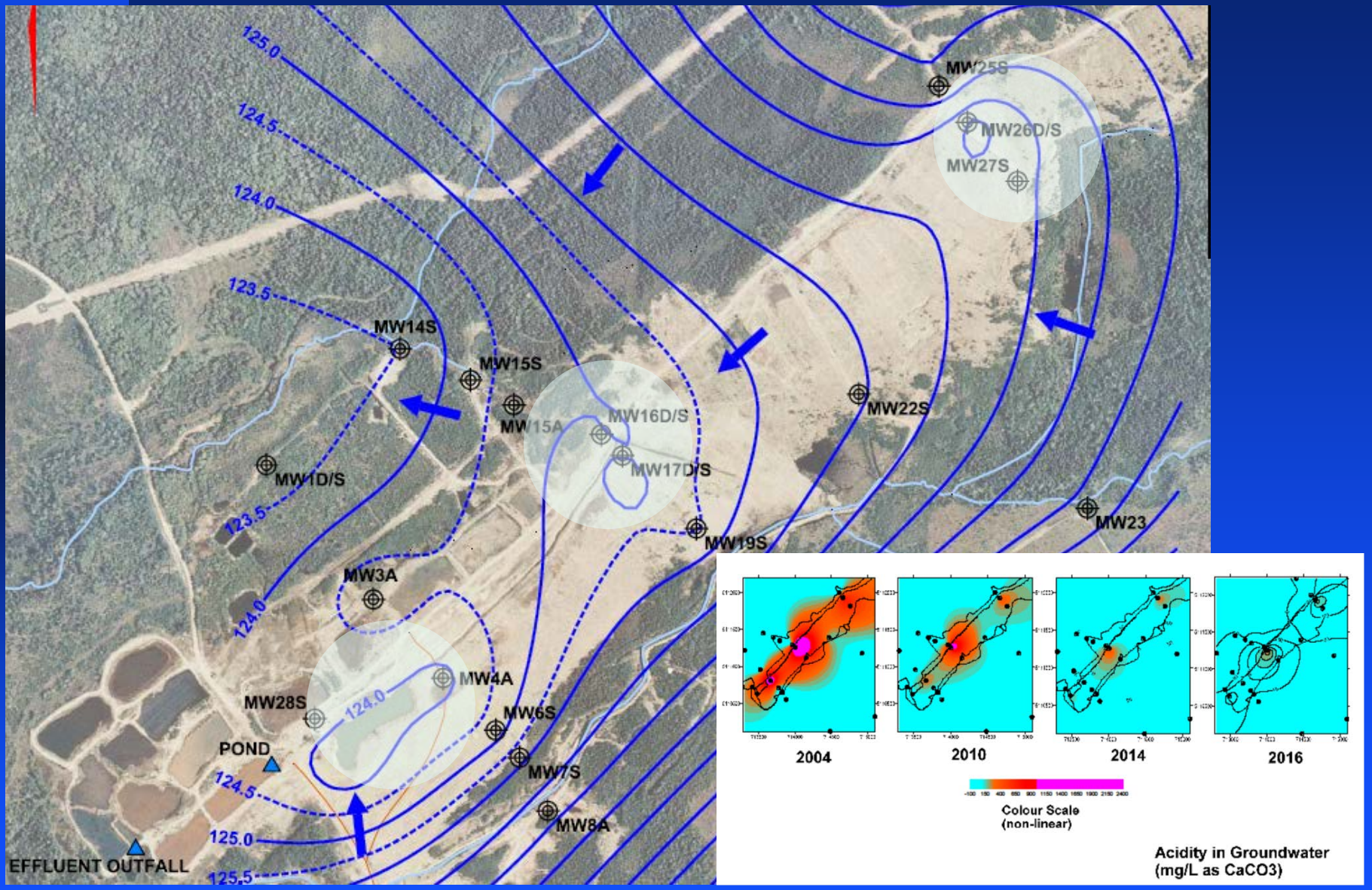
Compare Consumed $CaCO_3$ versus Calculated Residual Acidity Demand



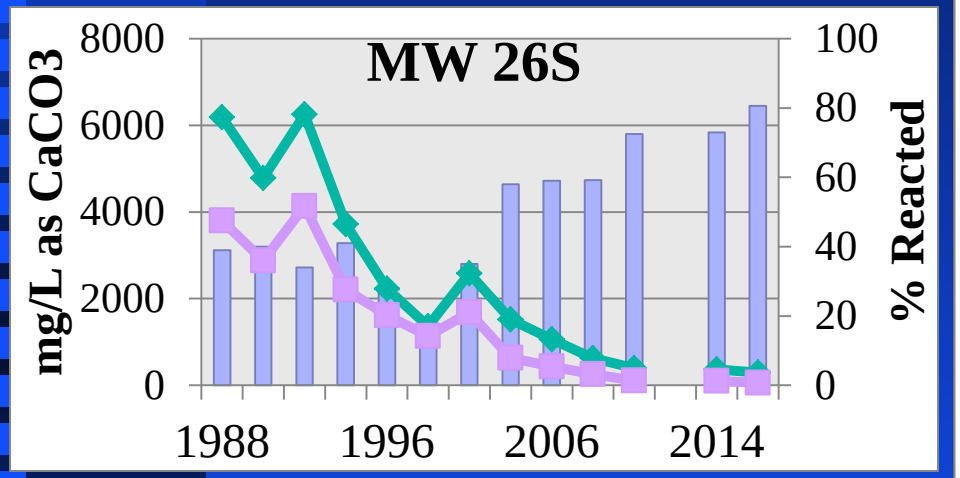
Comparison of Calculated Residual Acidity versus Measured Acidity

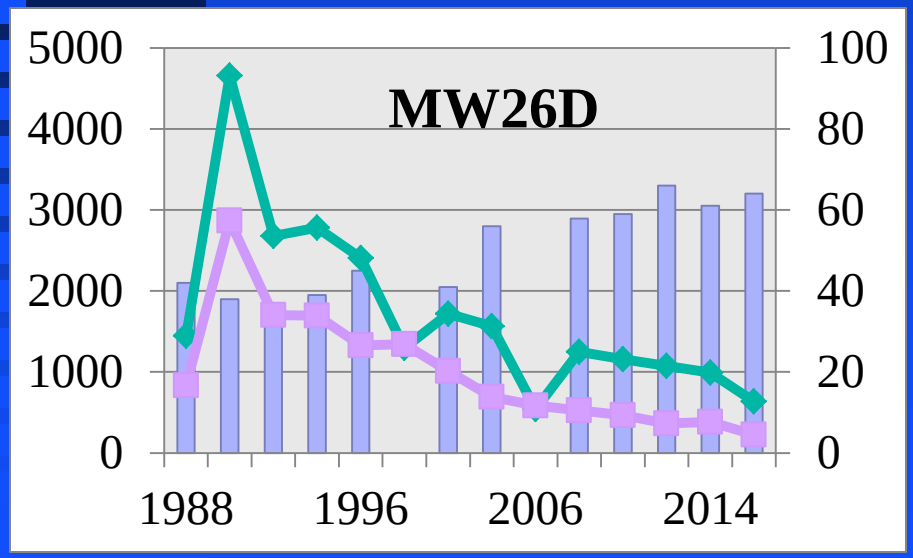


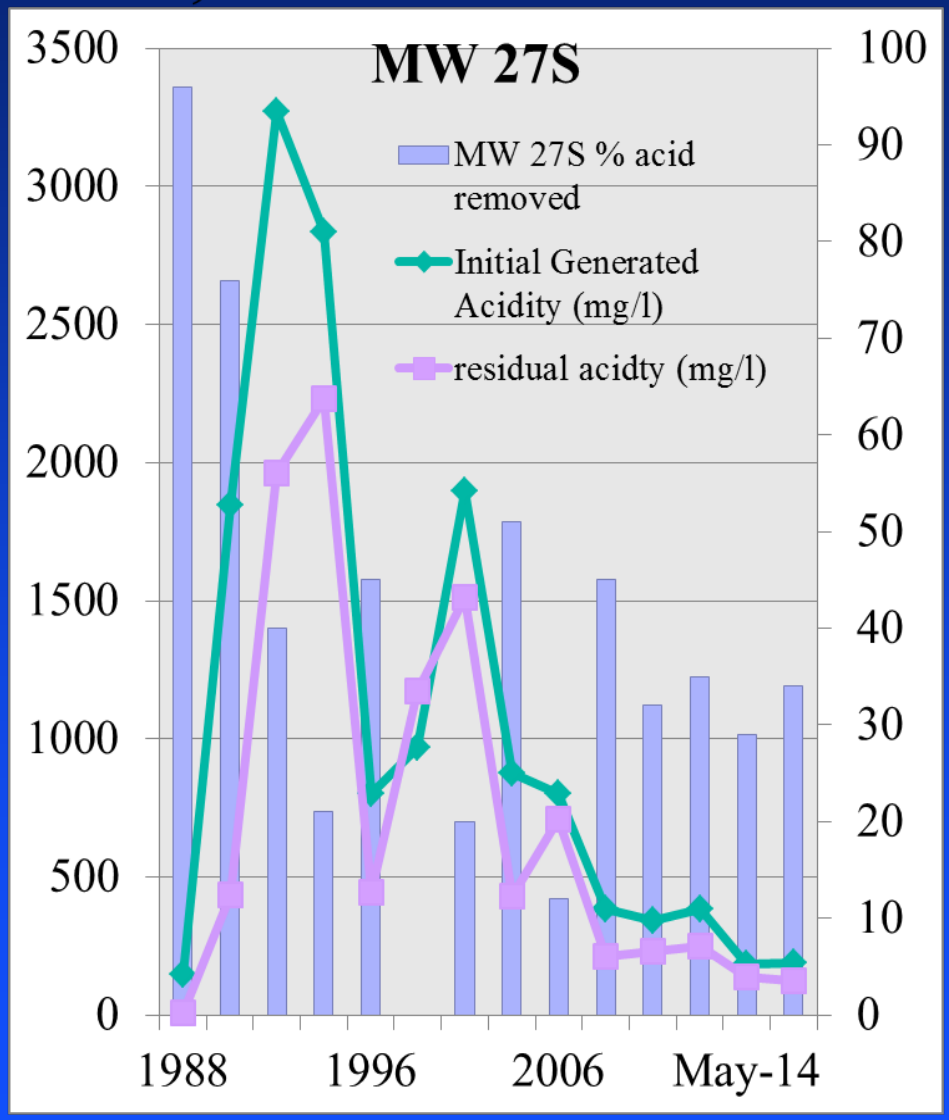
Groundwater Monitoring



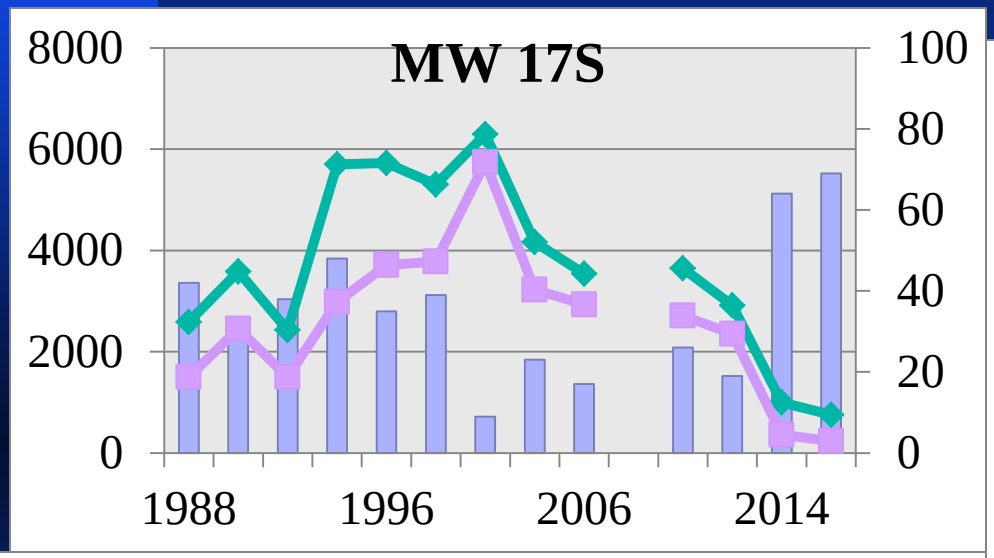
Initial and Residual Acidity in Mine Water Well 26S, 26D and 27

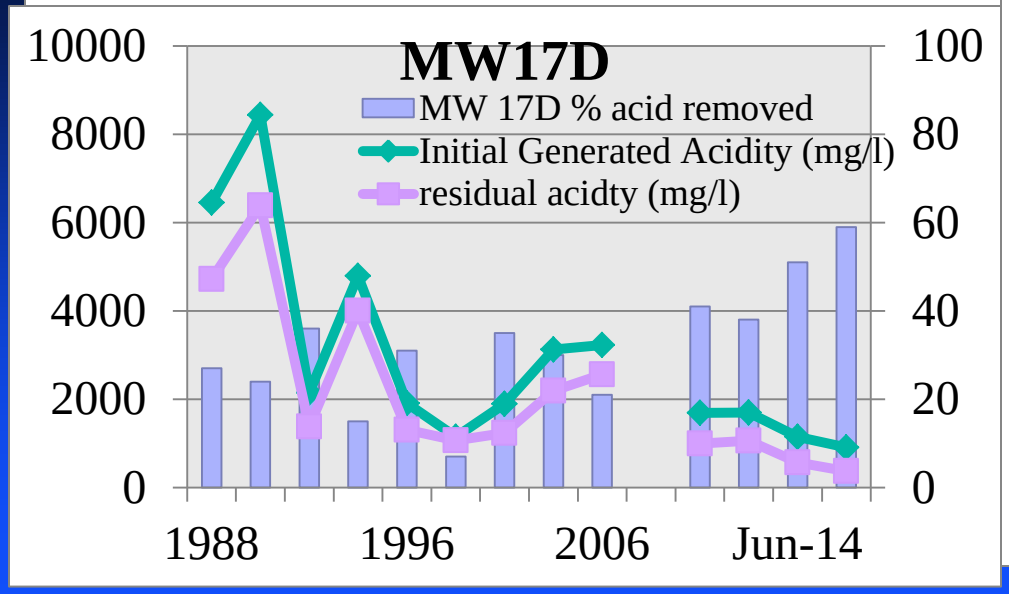


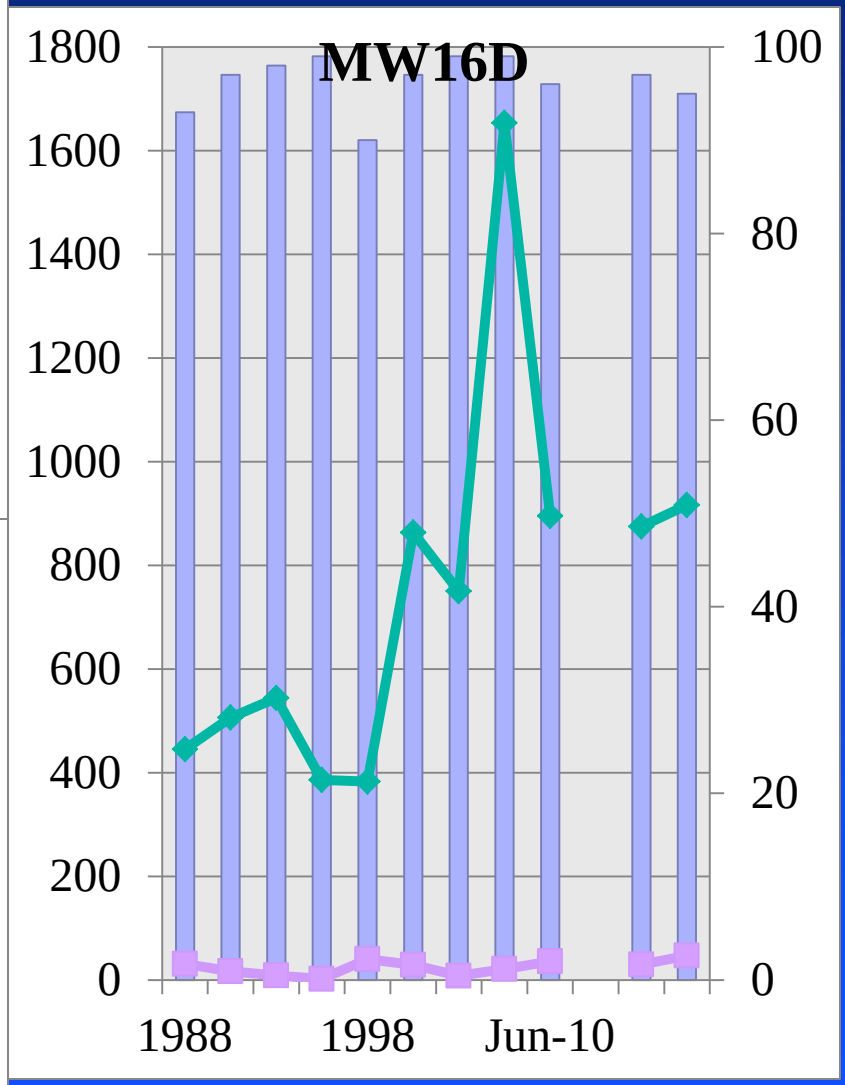




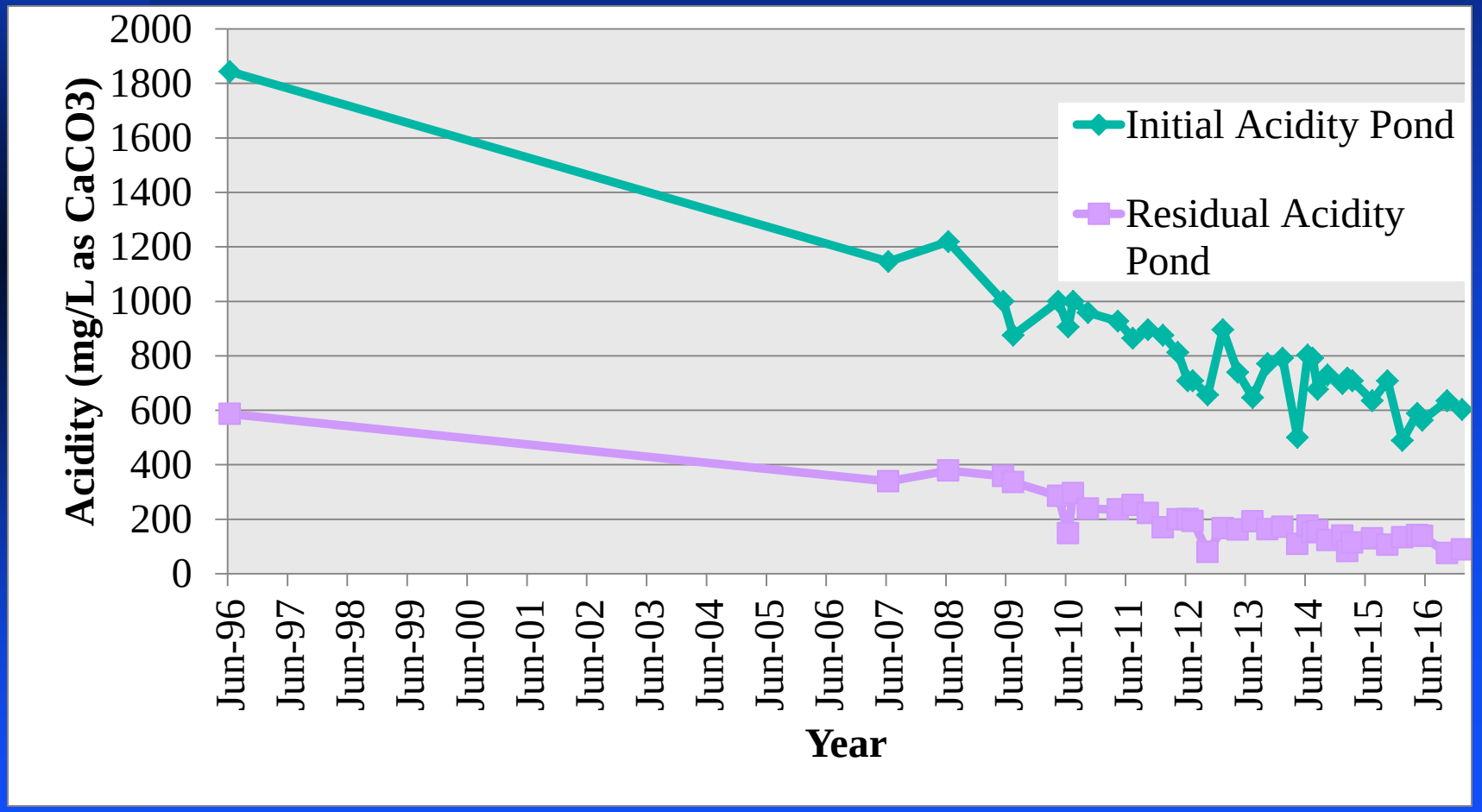
Initial and Residual Acidity in Mine Water Wells 17S, 17D and 16D



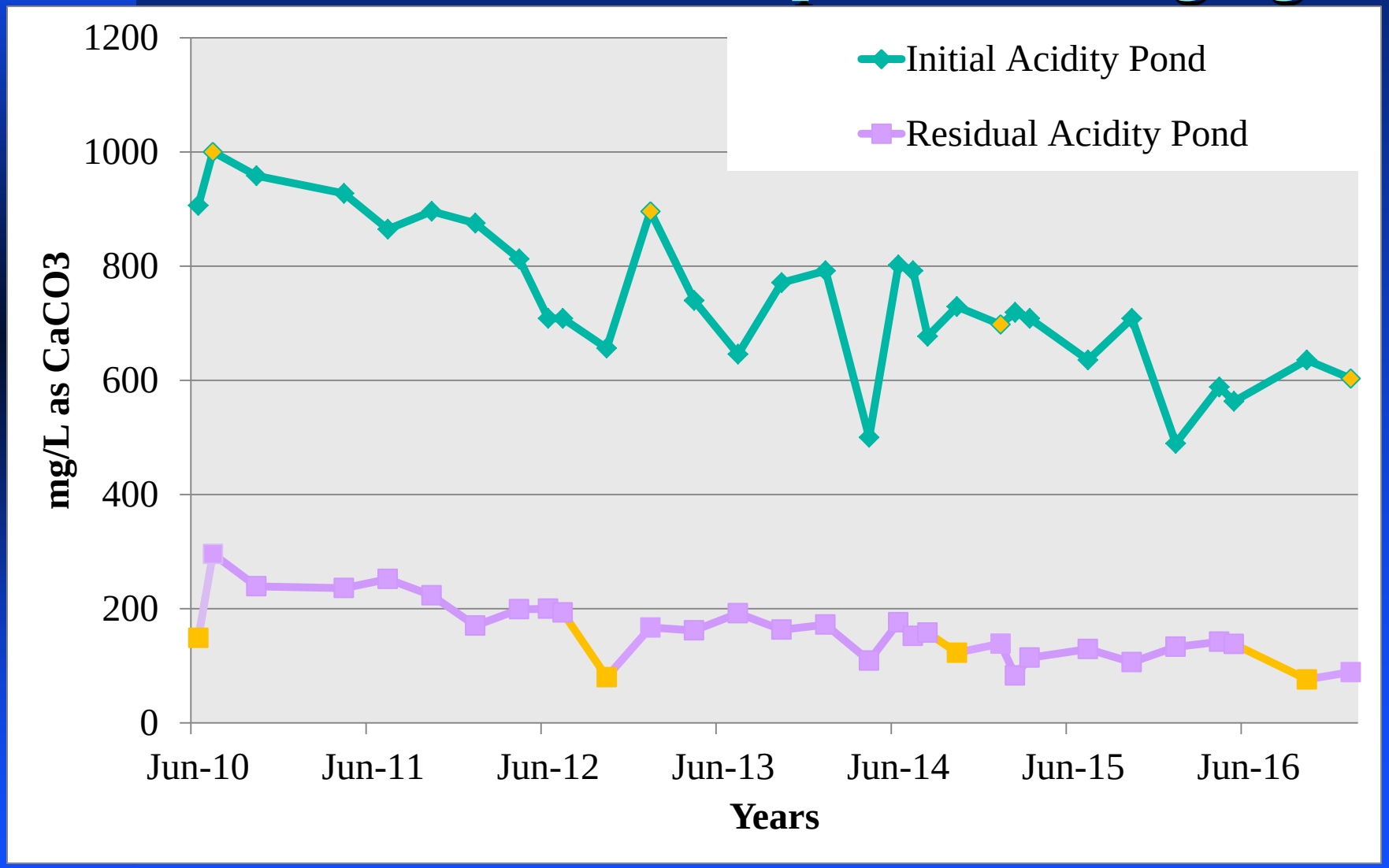




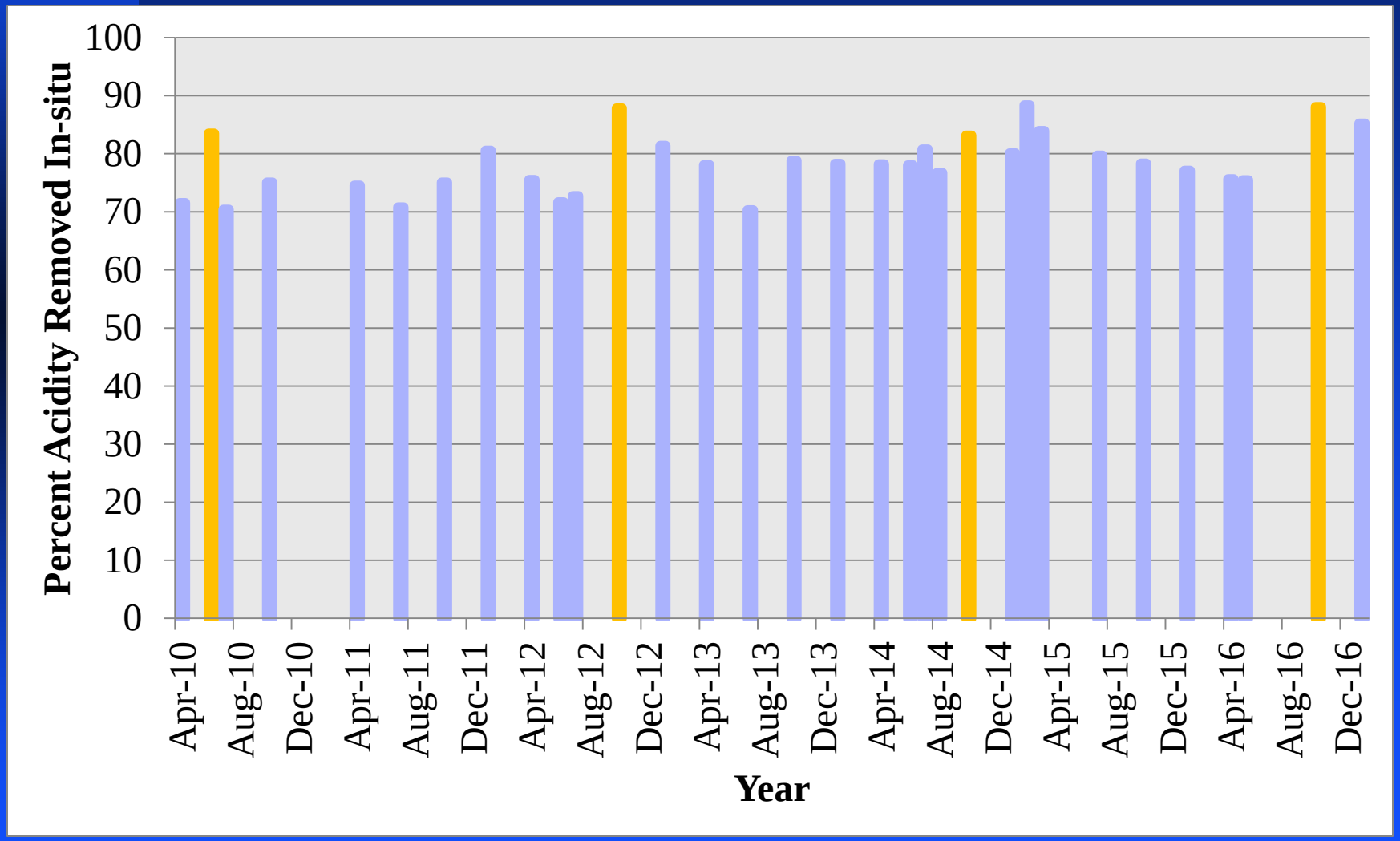
Comparison of Initial and Residual Acidity in Mine Water Pond



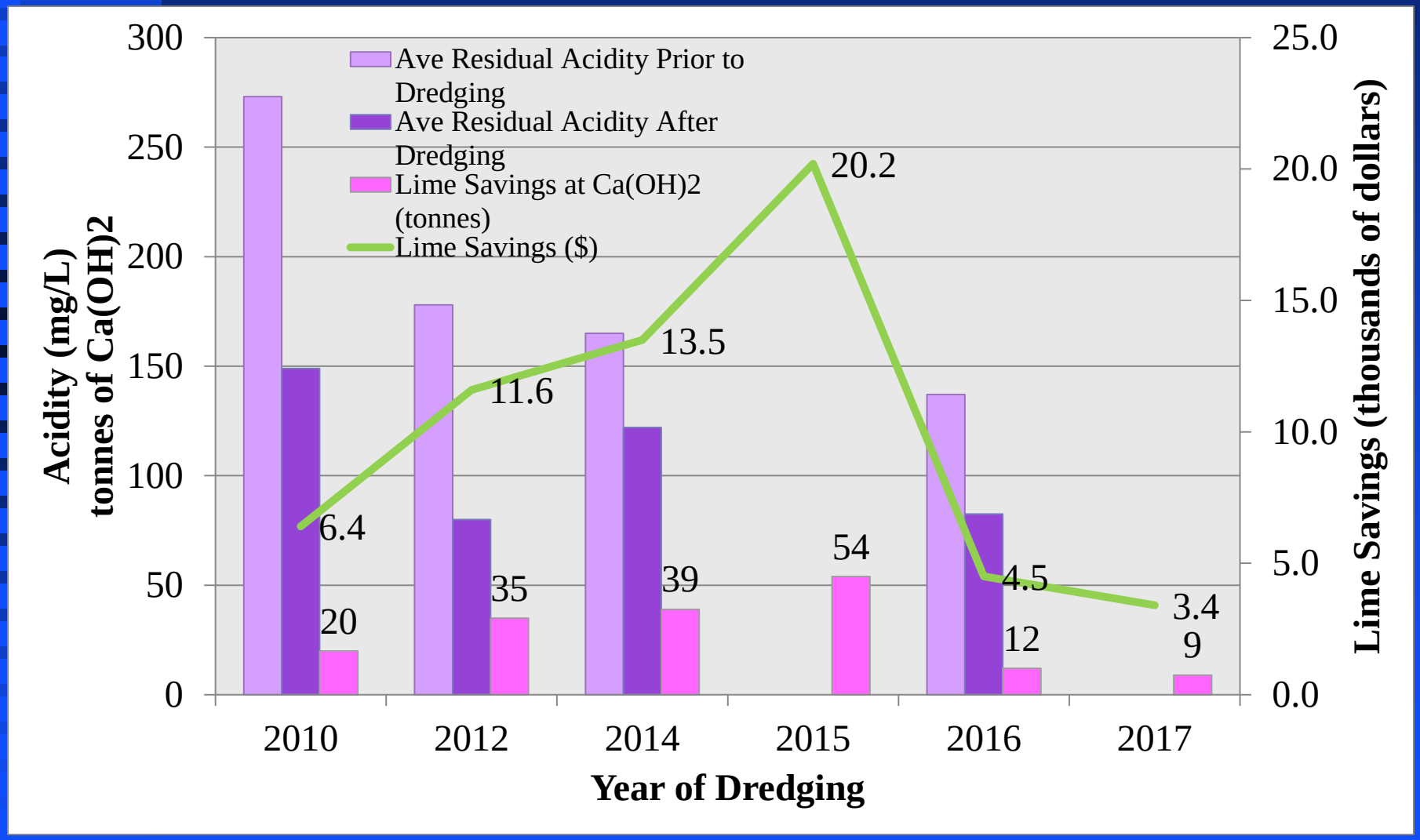
Comparison of Initial and Residual Acidity in Mine Water Pond- Impact of Dredging



Mine Water Pond -% Acidity Removed In-situ



Estimated Lime Savings after Dredging



Conclusions

- Decreases in initial mine water acidity a result of acid generation "burning out"-less acid production.
  - SO_4 decreasing , (example well 26 above the sludge influence)
  - mine water pH increasing
    - lower Al conc so partial dissolution of feldspars and mica?
- In-situ neutralization is occurring.
  - Residual acidity is much less than initial acidity
  - We saw in well 16D that we can have initial acidity but have it mostly neutralized in-situ.

Conclusions

- The percentage of acidity removed in-situ is increasing.
  - Waste rock weathering (smaller particle size… increased surface area)?
  - Trend will most likely continue but those sites at higher percentages seem to taper off and not hit 100%
  - Based at what we saw at well 16D, we may not need to hit 100%.
  - At what point will the residual acidity be negligible at the mine water pond but “spot” neutralization may be required at specific areas within the mine site?
    - Look at surface amendments to increase alkalinity?

Conclusions

- There are some measurements that can be made on the impact of the sludge on the acidity of the mine water.
  - The effect of dredging can be monitored by acidity and pH changes as a plug or plume flow in the mine water pond chemistry.
  - Almost $60K in estimated lime savings from last 4 dredging episodes
  - Propose to look at potential cost savings to recycle sludge directly back into waste rock during low groundwater flow periods to reduce dredging costs.

Impact of Sludge Towards Stabilization of the Fire Road Mine

In memory of K.D.Phinney[2]

1946-February 2017

[1] NB Power
[2] Consulting Chemist./Chemical Engineer

Énergie NB Power