



May 8, 2013

Mr. Ted Carter  
Materials Decommissioning Branch  
Decommissioning and Uranium Licensing Directorate  
Division of Waste Management and Environmental Protection  
Office of Federal and State Materials and Environmental Management Programs  
U.S. Nuclear Regulatory Commission  
11545 Rockville Pike  
Rockville, Maryland 20852-2738

Re: Docket No. 40-2259, License No. SUA-672 / Tailings Groundwater Path Forward / AL-1  
Well assay discussion

Dear Mr. Carter,

This letter and various attached documents is in response to the earlier request for a path forward from Mr. Michalak concerning the situation regarding the previously higher than expected groundwater values for Uranium in well AL-1 located at the Pathfinder Mines reclaimed Lucky Mc tailings (Gas Hills North) facility in Wyoming. Prior to the receipt of the letter and the later site meeting in the fall of 2012, the measured values for Uranium in well AL-1 have declined significantly since the peak observed in November 2011. Because the groundwater values continue to improve in well AL-1 and all measured constituents of groundwater on the site are within the defined target limits the recommended course of action is to continue the current sampling program while Pathfinder remains the licensee.

The following discussion outlines the current status of the groundwater sampling, and provides a summary of possible causes for the changes in water quality at well AL-1.

#### 1. Nature of Observations

The License and conditions of the site closure plan define the constituents of the site groundwater that are sampled on a quarterly basis. The metallic constituents include Uranium, Selenium, Nickel, Radium (Ra226+Ra228), Cadmium, Beryllium, Arsenic, Chromium, and Thorium (Th230). Non-metallic analyses are made for Chloride, Nitrate & Nitrite, Sulfate and TDS. Field measurements are also taken to determine water elevation, pH and conductivity. For Uranium, Selenium, Nickel, Radium (Ra226+Ra228), Cadmium, and Beryllium target POC limits have been identified as part of the site ACL. Arsenic, Chromium, and Thorium (Th230) also had pre-existing site standards.

PATHFINDER MINES CORPORATION

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Considering the long history of groundwater assays going back into the late 1970's of the metallic constituents, typically Cadmium, Beryllium, and Chromium, are below the detection limit of the laboratory. Arsenic and Thorium display assayable but consistently low values compared to either the POC target values for well T1-12 or site standards. Selenium and Nickel show some variability in the history of assays but have for at least ten years been below the well T1-12 POC target values.

Radium assays for the groundwater exhibit a range of variability with each assayed well occasionally exhibiting values near or slightly above the well T1-12 POC limit including the upgradient well T1-6. None of these observations indicate any apparent trend.

Values for Uranium in wells T1-6, T1-12 (the POC location), AL-7, and AL-6 (the POE location) since the termination of the corrective action program in the early 2000's have exhibited little obvious trend except for a modest increase in AL-6. These wells have had Uranium values substantially below the T1-12 POC target values over this timeframe.

Of primary concern expressed by the NRC about the water quality trends at the Lucky Mc site has been the increase in uranium values in well AL-1 beginning in the 3qtr 2010 sample notably peaking at 2.42mg/l in the sample taken 11-17-2011. Although the historical values for this well show at times great variability in this constituent; since late in 2003 the values had been relatively stable in a range typically below 0.20mg/l until the sample taken 5-30-2010 in which a trend of generally increasing values began which ended in the peak mentioned above. Since that peak in late 2011 the next 6 samples have shown a generally steep declining trend with the latest sample taken 4-1-2013 indicating a value of 1.28mg/l. See the attached Figures.

During roughly the same timeframe the uranium values in well AL-6, the POE location, also show a parallel increase, though much more modest, from approximately 0.6mg/l to roughly 0.8mg/l noticed in five of the past six samples. Well AL-7 is located approximately midway between AL-1 and AL-6 and has exhibited no obvious trend.

#### 1.1. Relation to water elevation and other constituents

Examination of the relevant assay data reveals that there is a likely association with increased Chloride values also noted during the period of elevated values for U. This is not unexpected as the primary reason for monitoring Chloride is its use as an indicator assay. In addition considering the long history of assays for well AL-1, there is also a probable correlation between the elevation of the water sampled and uranium values. See the attached figures.

## 2. Possible Sources of High U Water

### 2.1. Residual contamination

Pathfinder considers that the most likely source of the waters recently sampled with higher Uranium values, is remnant contamination originally sourced in the direction of the former remediation effort located near well T1-12 approximately 5,400ft SSE of well AL-1. This presumed contamination that possibly bypassed the corrective action effort or resulted from temporary disturbance caused by the cessation of corrective action has taken significant time to arrive at AL-1 since the termination of activities in the early 2000's. Another possibility is a similar source located somewhere east of the original tailings deposition pond potentially 7,500ft from AL-1. See the attached figures.

Both source potentials would involve a relatively small pool of contaminated water that has slowly migrated along the flank of Fraser draw. The timing of this occurrence matches well with the typical velocity of 1 to 10 ft/day if it is assumed that the migration began roughly around the time that the corrective action program was terminated following approval of the ACL for the site, in late 2002.

Recent improving values at well AL-1 and the slow but low amplitude parallel (possibly delayed) response in the nearby well AL-6 indicate that the probability of this being the true source is high.

## 2.2. Natural ore body

There is the possibility of a naturally occurring orebody as the source for the uranium values located in the vicinity of AL-1. Such orebodies are known to commonly exist in the local area of the tailings site.

For example during the final phase of tailings reclamation a hot spot of radioactivity was identified adjacent to the tailings reclamation and presumed to be a contaminated location. Upon excavating the area it was discovered that the source of radioactivity was a naturally occurring orebody located at a depth of about 1.5ft below local grade. See the attached figures.

Such a source would also exhibit a relationship with changing local water levels providing an episodic liberation of uranium and other assay constituents. However while such an orebody could explain the uranium values and associated elevated Cl and SO<sub>4</sub> levels doing so while at a near neutral pH and without a parallel response indicated in Ra levels this possibility is considered unlikely.

## 2.3. New contamination

The possibility that there is some new source of contamination originating within the tailings system cannot be ignored. The clearly defined flowpaths present in the corrective action area indicate that the only route out of the tailings system is intersected precisely at well T1-12, the POC location, which to date has not seen any increases in assay values for Uranium or other constituents. In fact for most assay items the values for well T1-12 have been flat or slowly decreasing in response since the termination of corrective action. See the above figures for assay values and Figure

1.2-2 from the ACL documentation (Copy included).

Because of the assay history in well T1-12 of generally declining values for all assay constituents this potential is considered unlikely.

#### 2.4. Other potential source

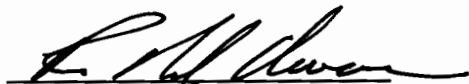
During the research of historical records of the property it was discovered that during the early 1980's a pond was located immediately upstream (<50ft) of the location of well AL-1. Although it is not clear what the pond was used for or it's lifetime, because it is present during the time when Tailings Dam #4 was constructed the most likely use was to provide make-up water for compaction the clay core in Tailings Dam #4. Of note Fraser draw was the disposal channel for mine dewatering efforts as part of the normal mine operation that occurred from the early 1950's through the late 1980's when commercial operation ceased. See the annotated photograph.

It is possible that during early periods of dewatering operations when regulatory limits had not been established contaminated water from the mine was present in Fraser draw. The remnants of that water, possibly enhanced by the pond discovered as noted above, could be providing the elevated source for well AL-1. However high uranium values in discharged water without elevated radium in the case of the early operational methods is not likely. Because the radium values in AL-1 have been relatively stable this possible source is considered of low probability.

#### 3. Recommendation

- 3.1. Pathfinder recommends maintaining the current sampling program noting that the values for Uranium in well AL-1 continue to show a declining trend roughly a steep as the previous ascending trend tends to confirm the above hypothesis that the cause is temporary and is in the process of resolving. Currently all constituent values for the POC location of well T1-12 are easily within the defined target limits and that all values for all other sampling locations on the site are also performing within the same target limits even in the hypothetical case of extension to other well location and have been for some extended time.

Sincerely,



R. Mark Owens  
General Manager  
Pathfinder Mines Corporation

Encls.

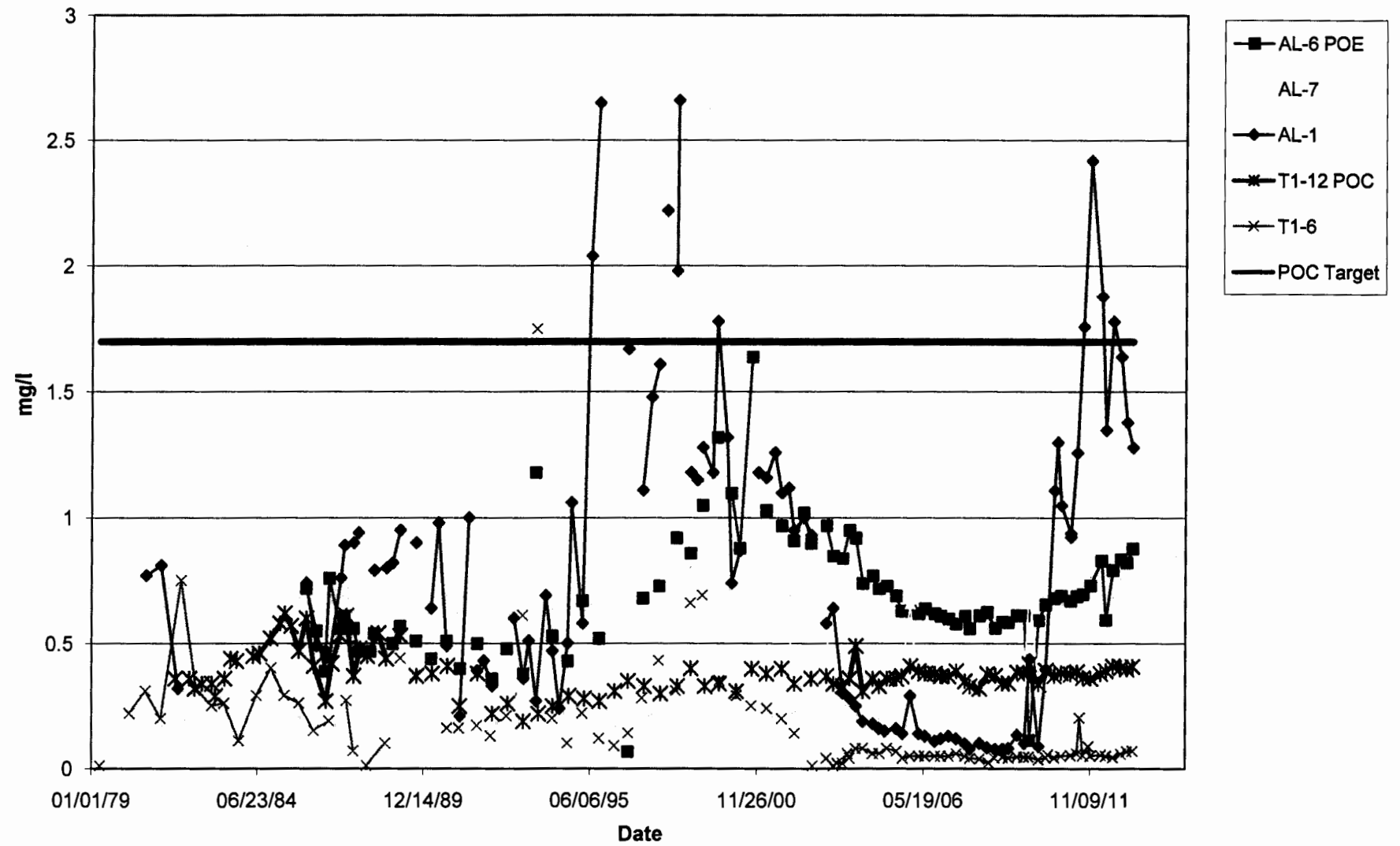
Cc: Michael Norato - NRC

**Groundwater Analysis History Charts**  
**Monitor Wells**

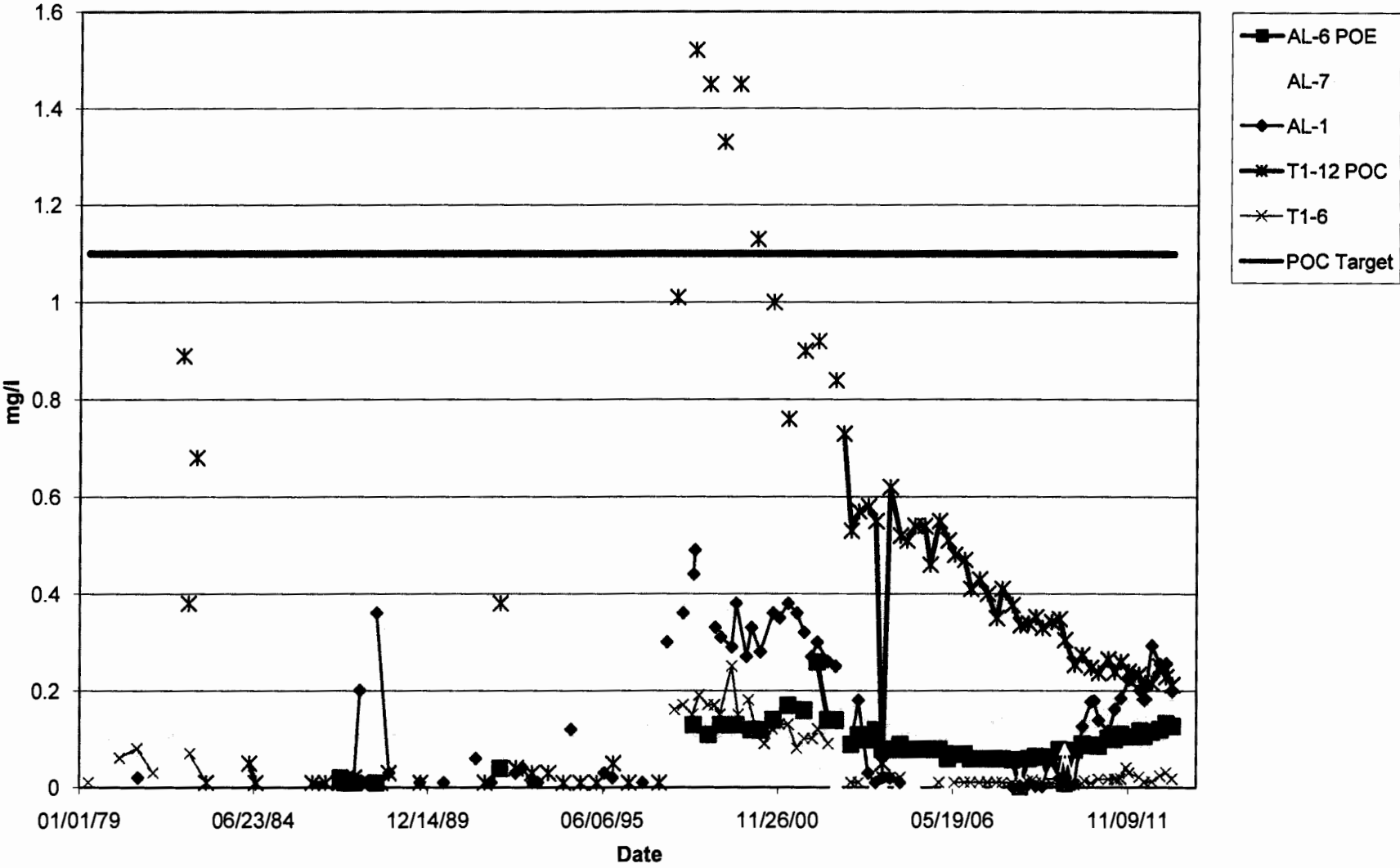
- T1-6
- T1-12 (POC)
- AL-1
- AL-7
- AL-6 (POE)

U, Se, Ni, Ra, pH, Cl, NO<sub>3</sub> & NO<sub>2</sub>, SO<sub>4</sub>, and TDS

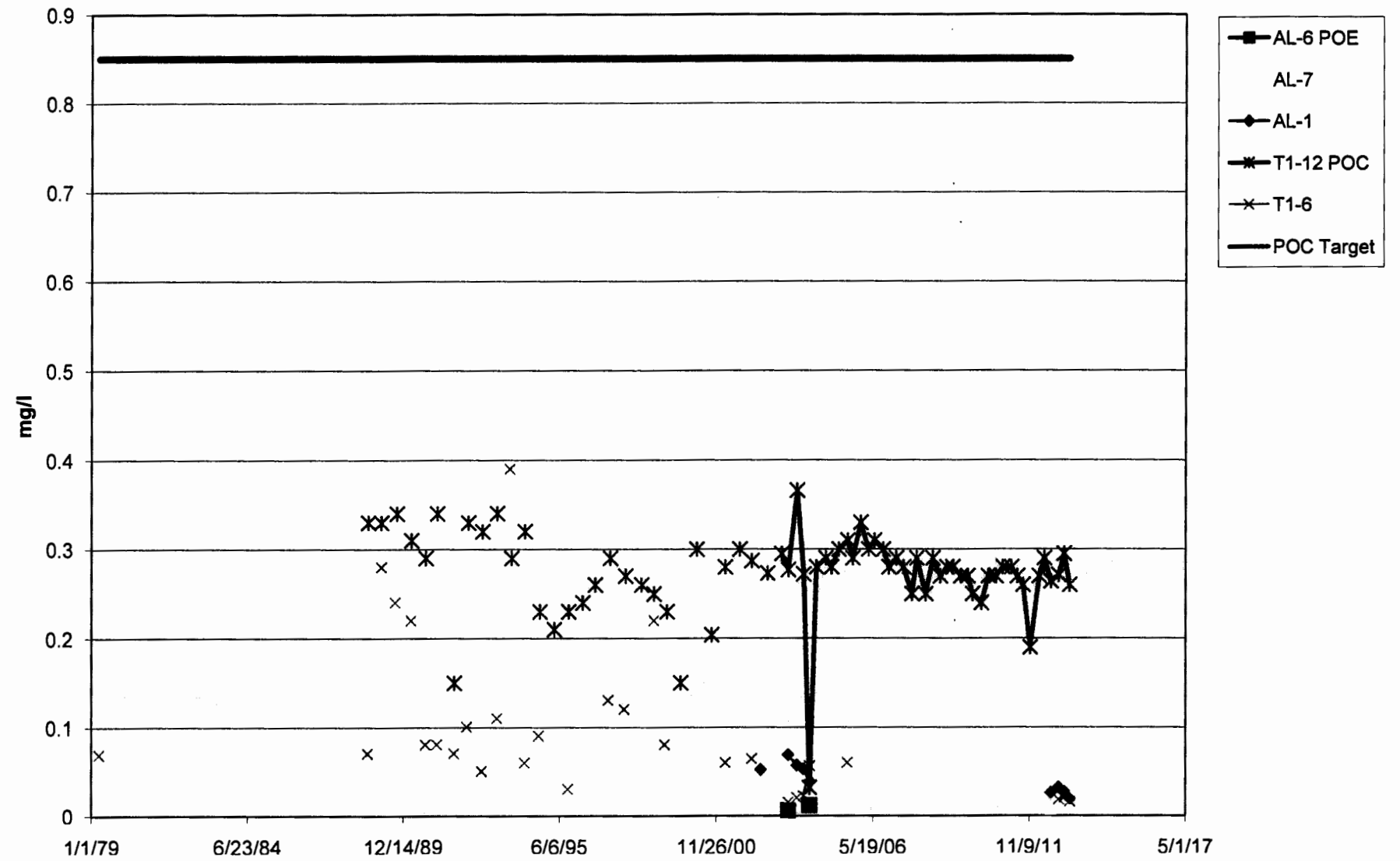
# Unat (mg/l)



Se (mg/l)

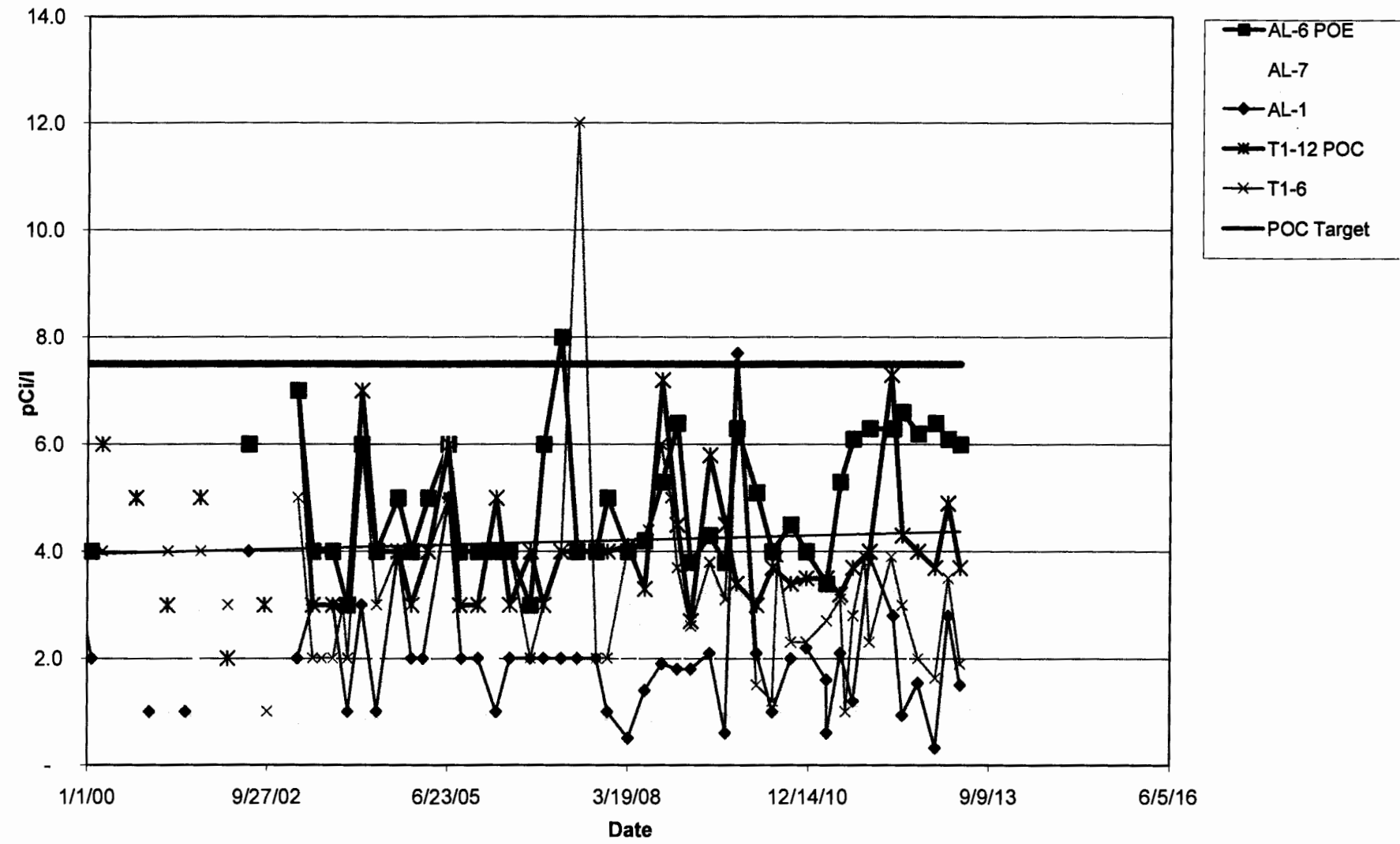


# Ni (mg/l)

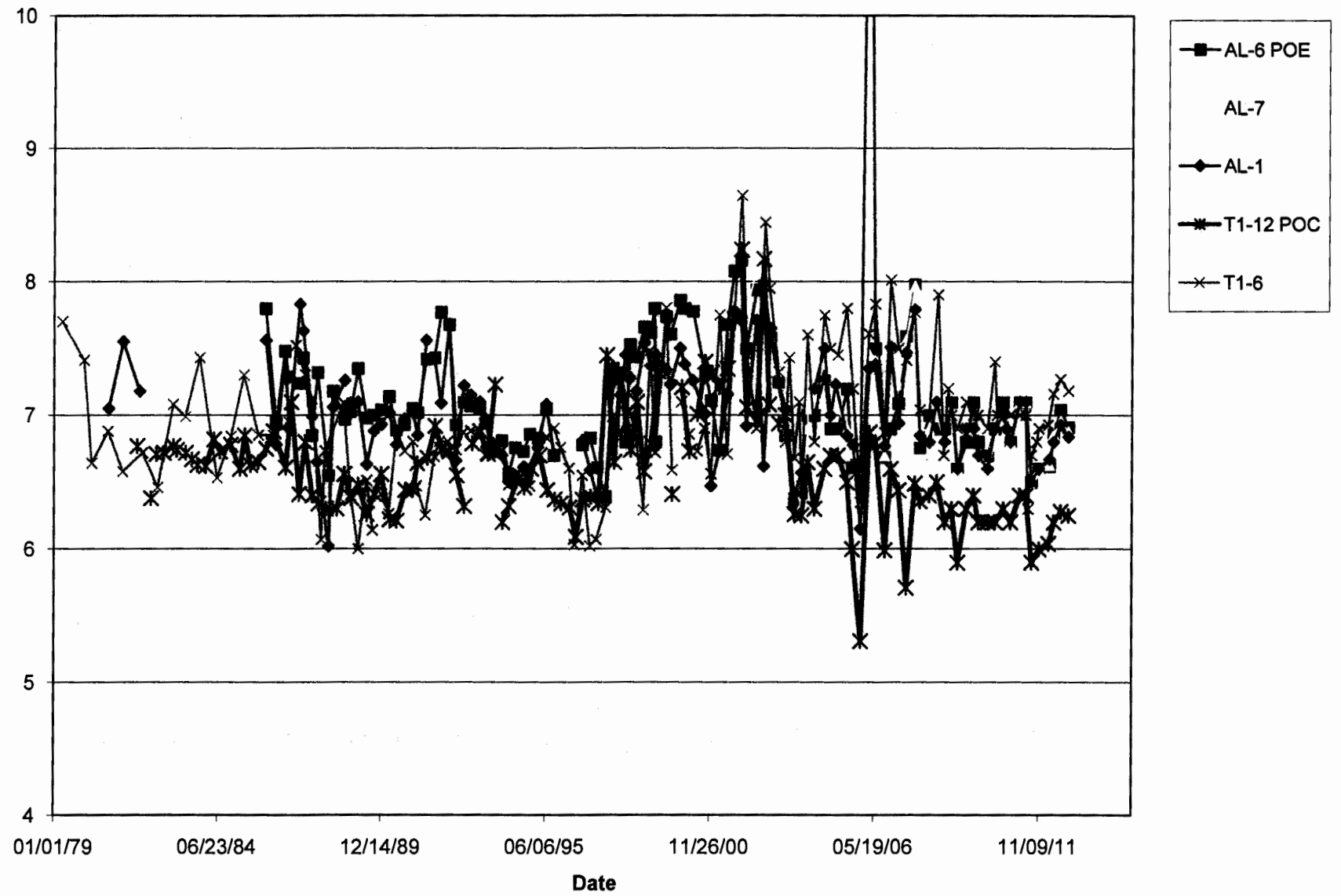




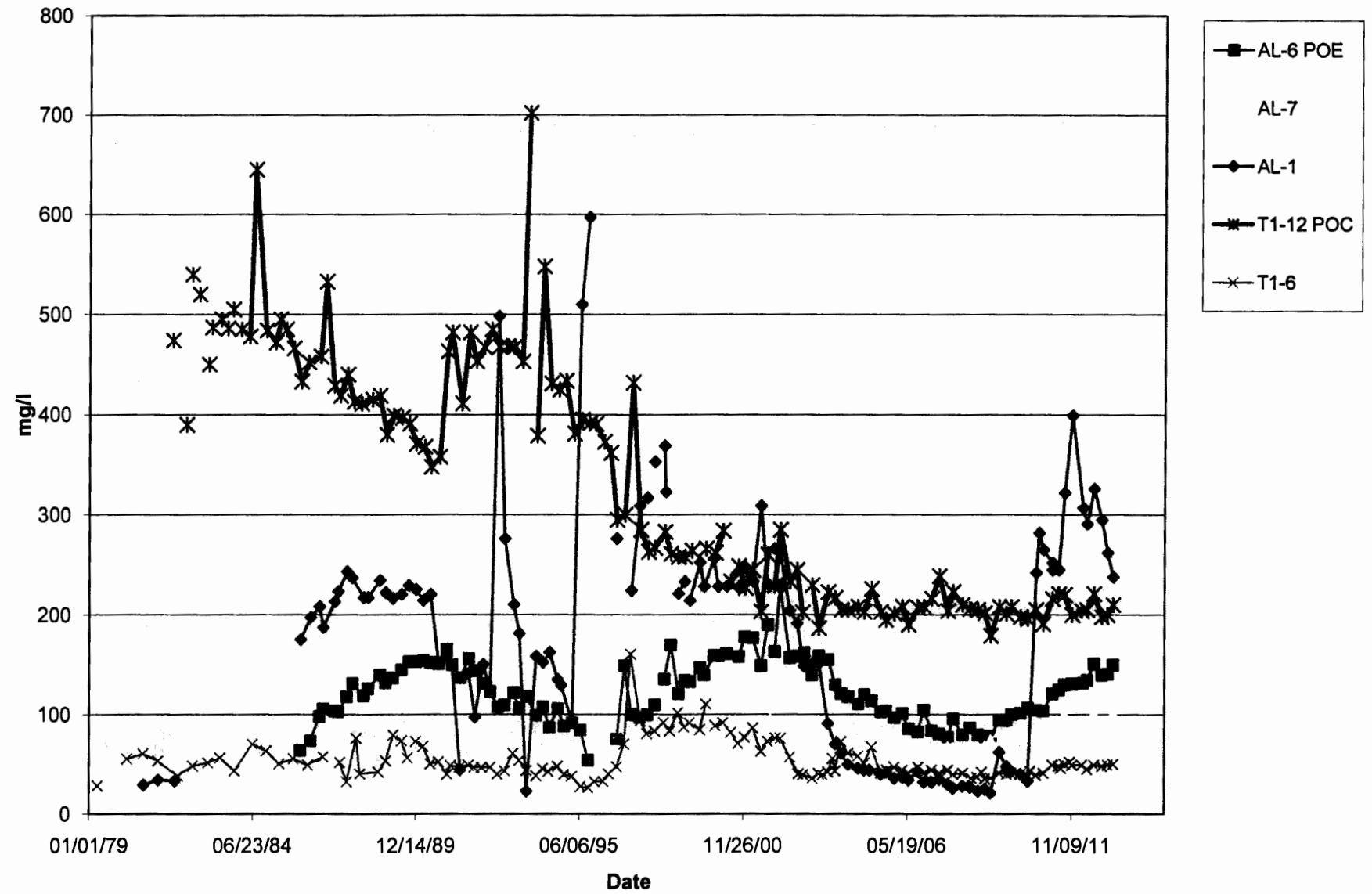
Ra226+Ra228 (pCi/l)



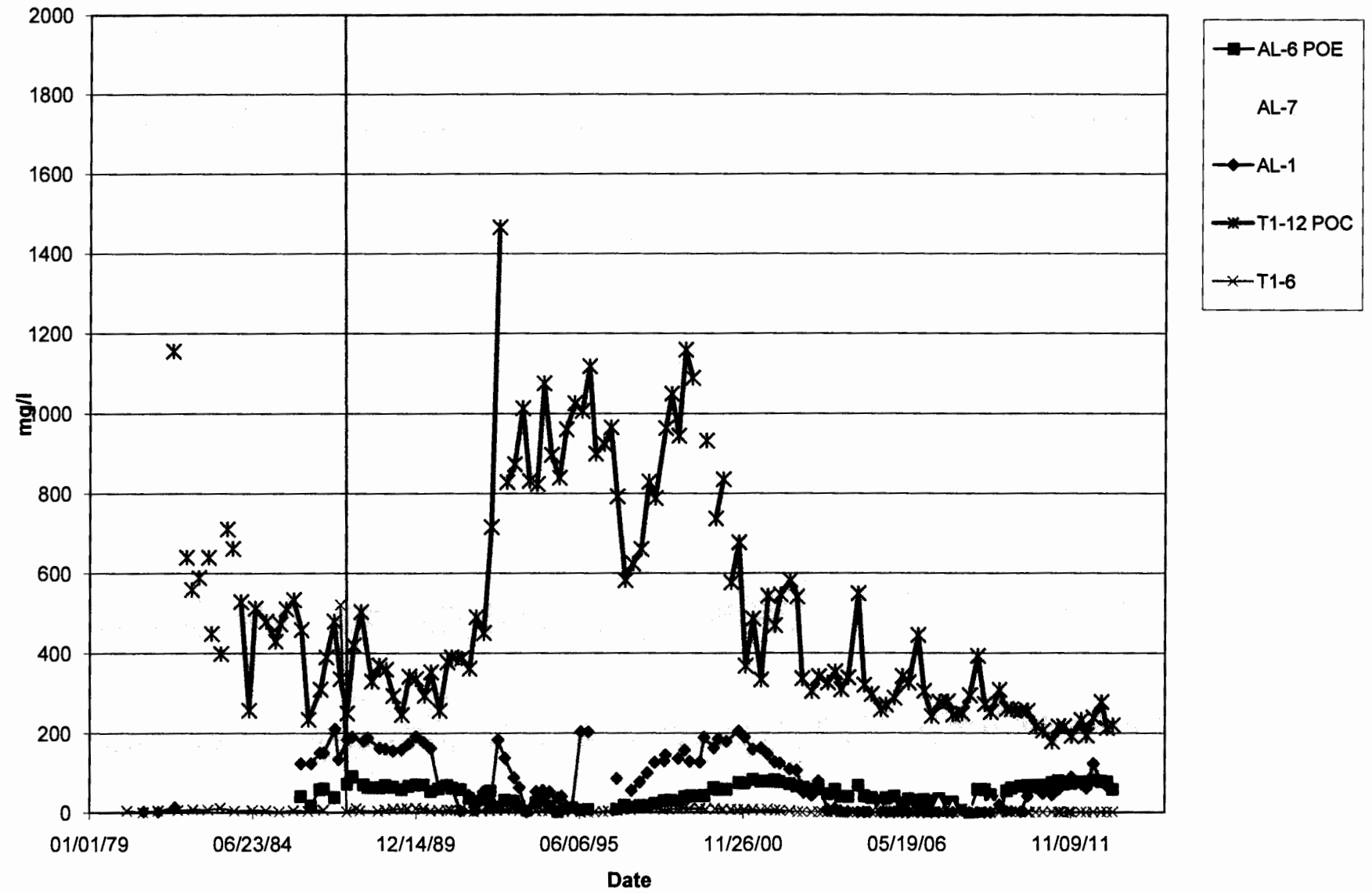
pH(f) (std. units)



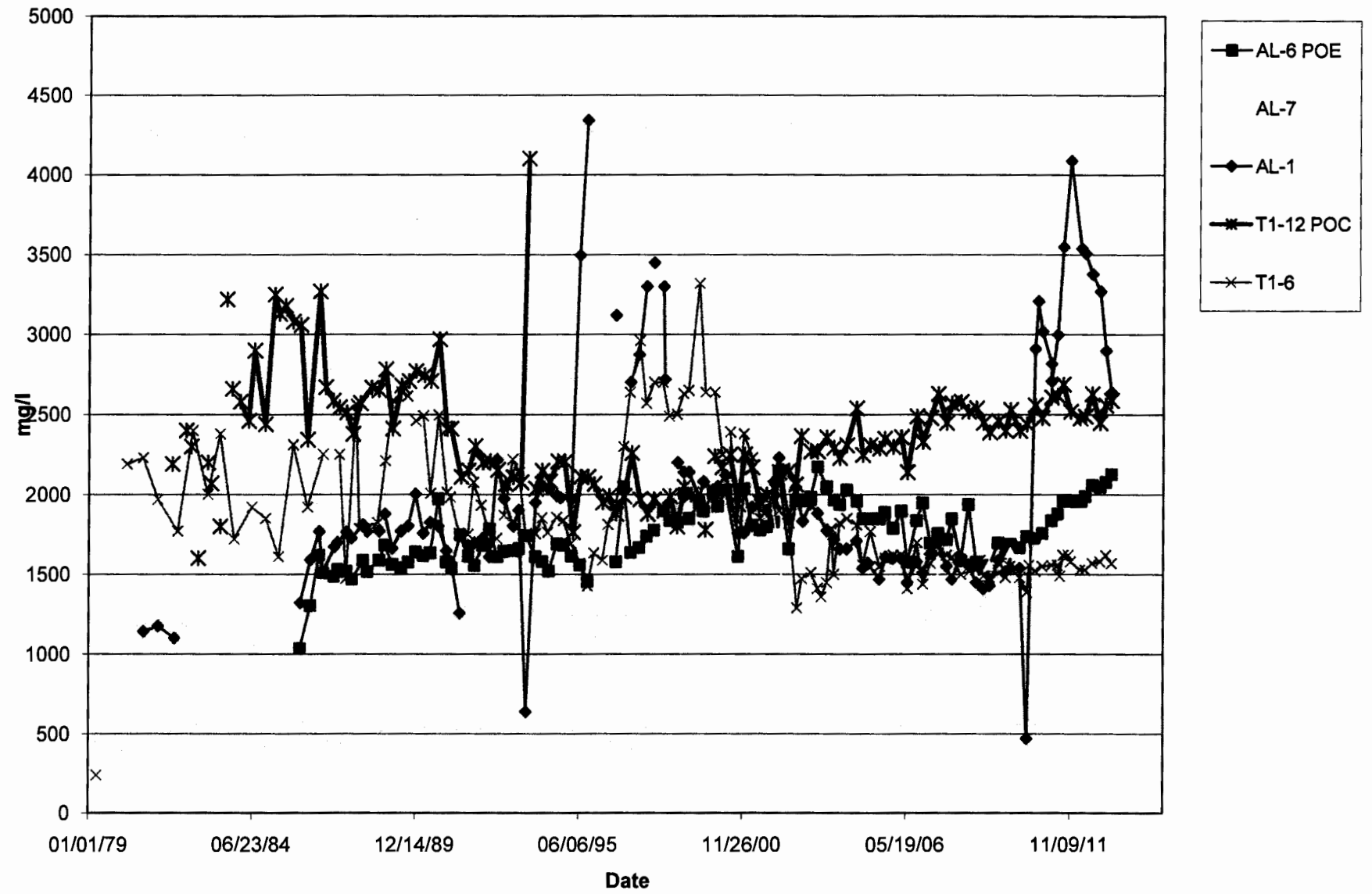
Cl (mg/l)



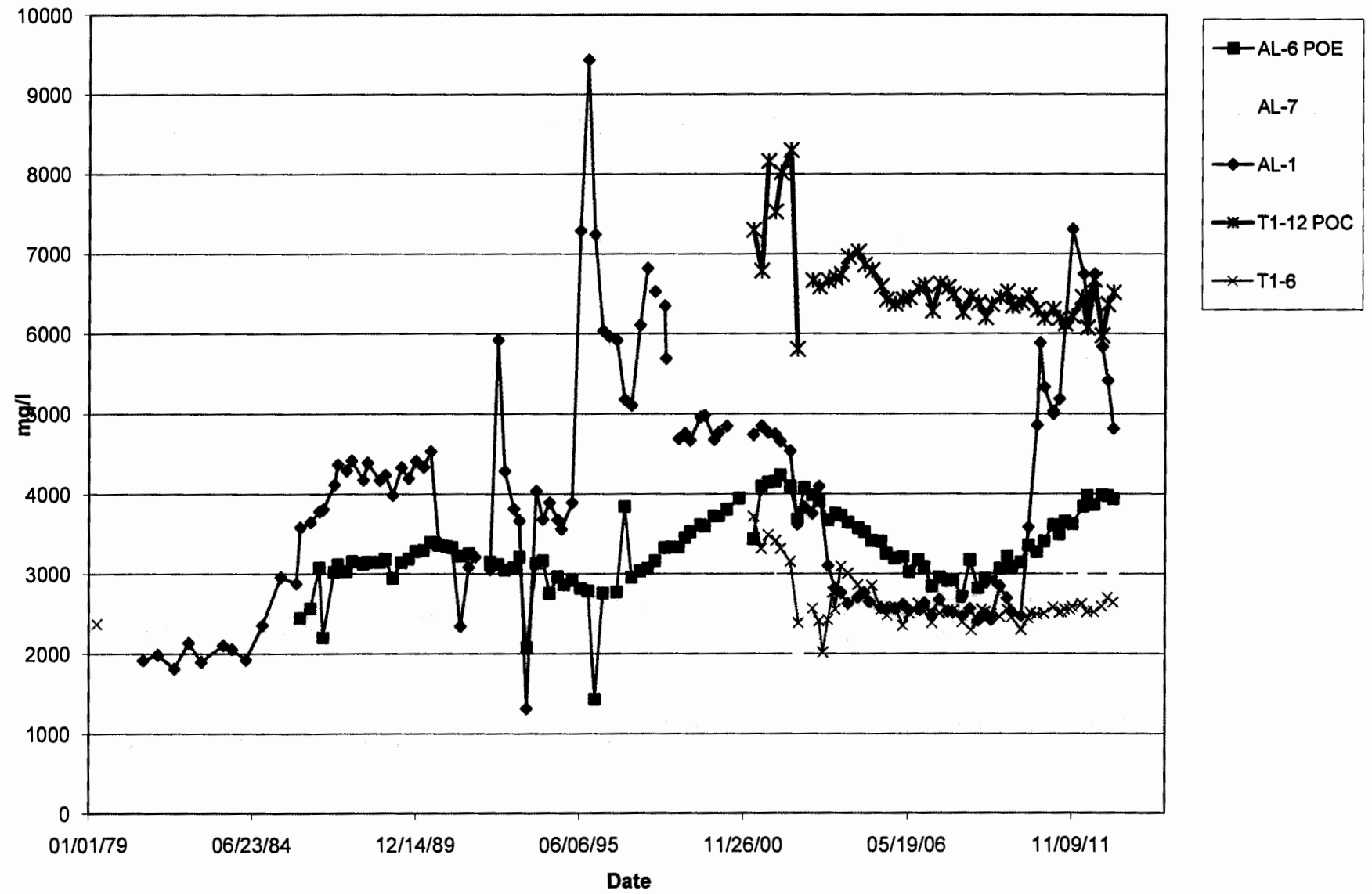
NO<sub>3</sub>+NO<sub>2</sub> (mg/l)



# SO4 (mg/l)

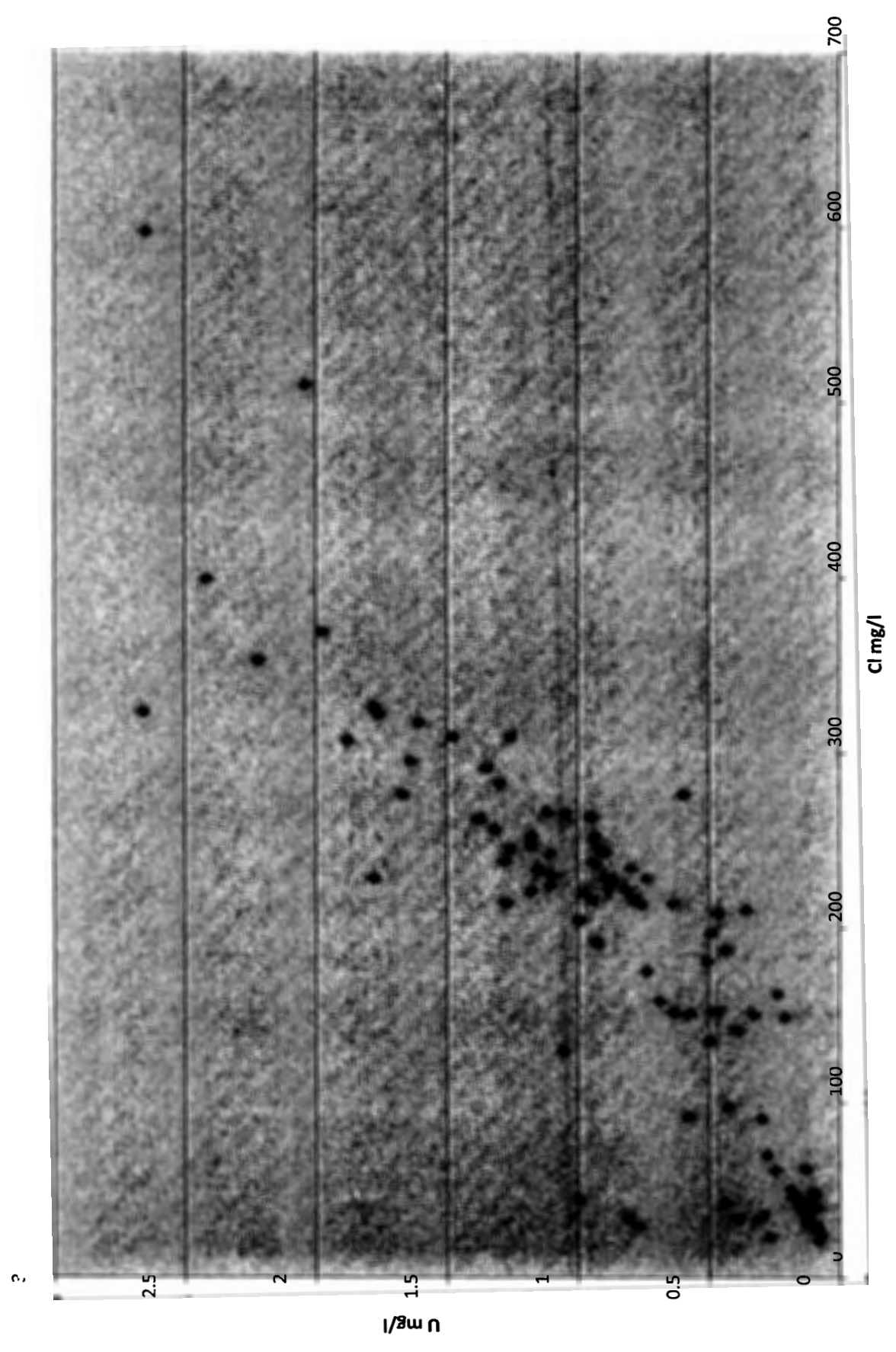


TDS (mg/l)



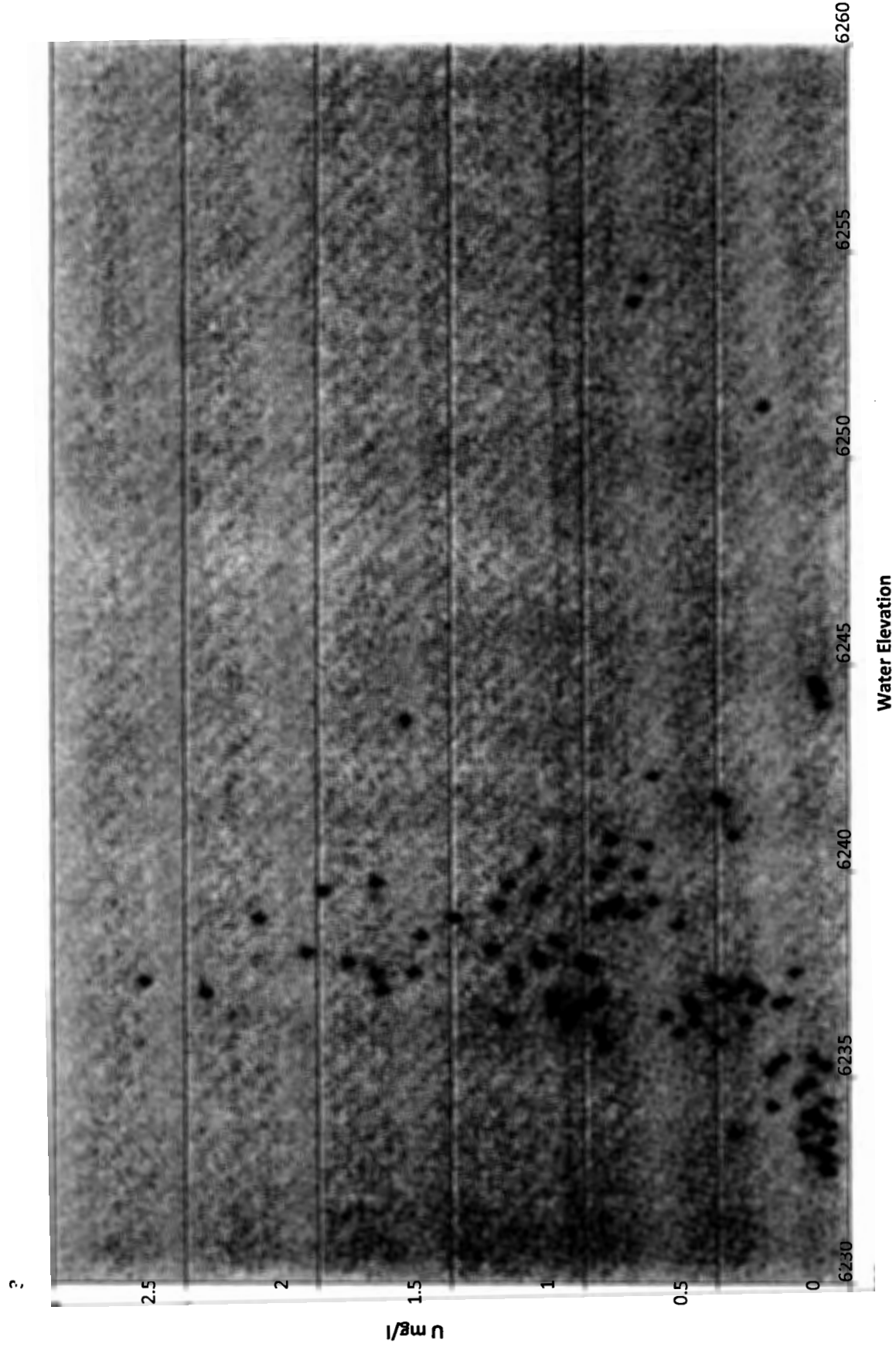
**Correlation Charts**  
AL-1 U vs. Water Elevation  
AL-1 U vs. CI

**Al-1**  
U vs. Cl

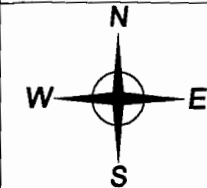
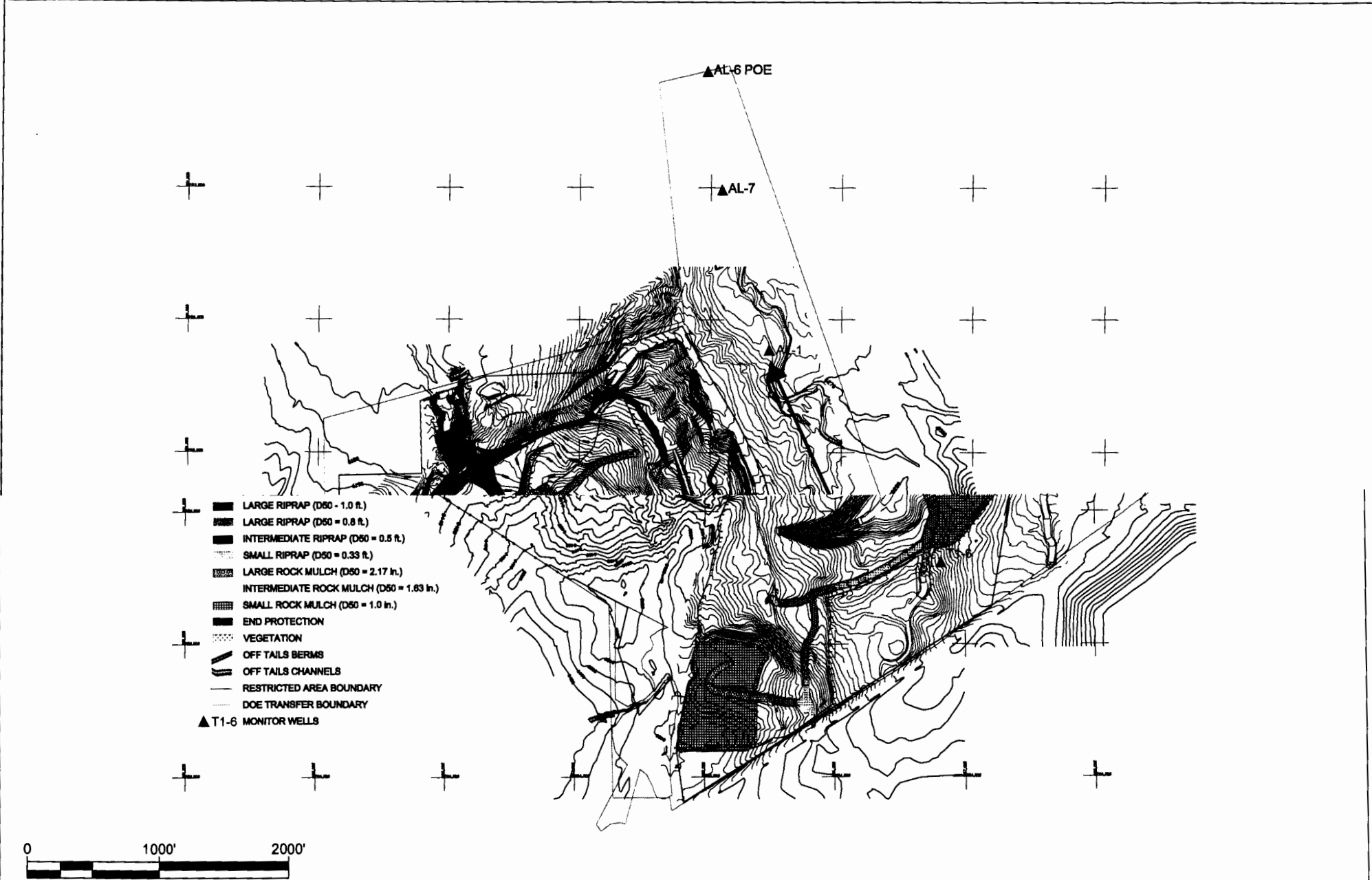




**AI-1**  
**U vs. Water Elevation**



Potential Residual Contaminant Flowpath



Geology: RMO  
Enviro: RMO  
Drafting: RMO  
Date: 4-5-2013

State: Wyoming County: Fremont  
Scale: 1"=1000'  
Drawing ID: Path Forward As Built.dwg

**AREVA NC /Pathfinder Mines  
Corporation**

**Lucky Mc Tailings Site**

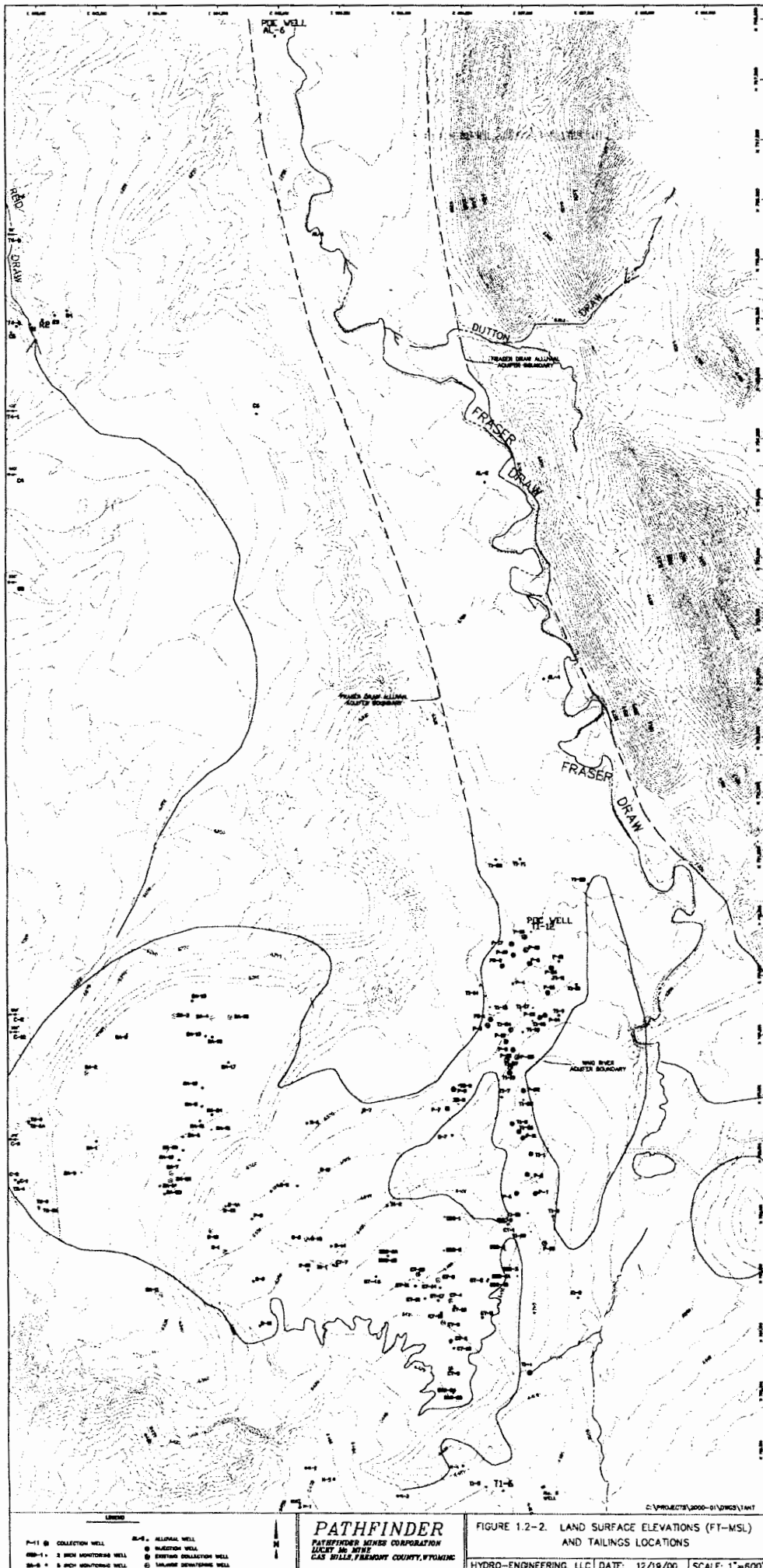


**Example of naturally occurring uranium near surface in the vicinity of the  
Lucky Mc tailings site – Annotated photograph**

# Uranium Occurrence Discovered Adjacent to Tailings – 12/13/2004



ACL Figure 1.2-2



- LEGEND
- P-11 • COLLECTION WELL
  - P-12 • 2 INCH MONITORING WELL
  - P-13 • 2 INCH MONITORING WELL
  - P-14 • 2 INCH MONITORING WELL
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  - P-99 • 2 INCH MONITORING WELL
  - P-100 • 2 INCH MONITORING WELL

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LUCKY 36 MINE  
CAS HILLS, FREMONT COUNTY, WYOMING

FIGURE 1.2-2. LAND SURFACE ELEVATIONS (FT-MSL) AND TAILINGS LOCATIONS

HYDRO-ENGINEERING, LLC DATE: 12/19/00 SCALE: 1"=600'

Former water pond near well AL-1 – Annotated photograph



## AL- 1 Vicinity - 1981

Well AL-1

Pond in Fraser Draw

Aerial Photograph – September 1981  
Annotations – RMO February 2013