NMED DOE Oversight Bureau

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ASSESSING GROUND-WATER RECHARGE THROUGH THE PAJARITO FAULT ZONE, UPPER PAJARITO CANYON, LOS ALAMOS, NEW MEXICO

DALE, M.[1], GOFF, F.[2], GRANZOW, K.[1], LONGMIRE, P.[3], and COUNCE, D.[3], (1) NMED DOE Oversight Bureau, 134 State Road 4, Suite A, White Rock, NM 87544, mdale@lanl.gov, (2) Earth and Planetary Sciences Dept., University of New Mexico, Albuquerque, NM 87131, (3) Los Alamos National Laboratory, EES Division, MS D469, Los Alamos, NM 87545

PURPOSE/OBJECTIVE

HOW WAS THE OBJECTIVE FULLFILED?

RESULTS

CONCLUSIONS

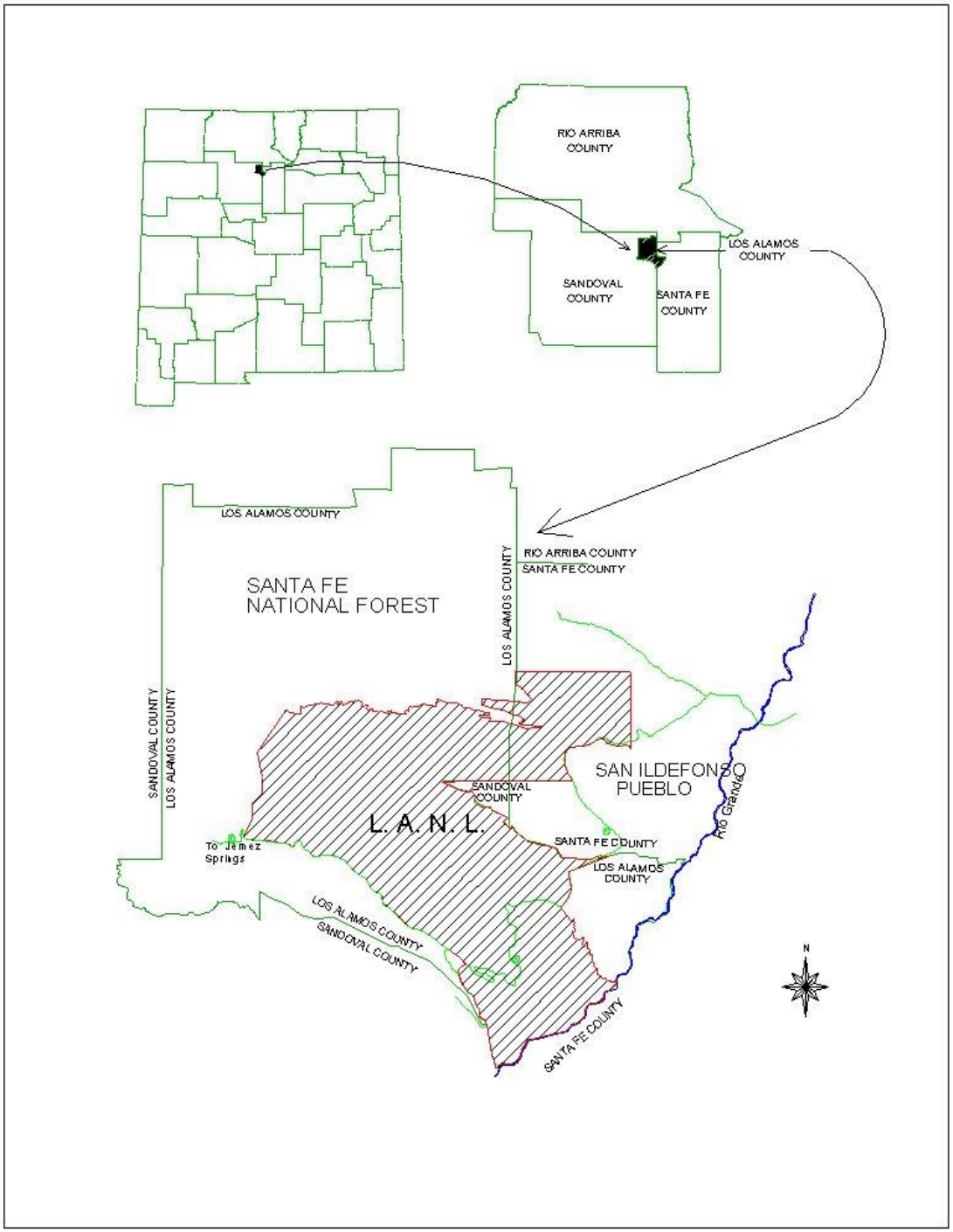
OBJECTIVE:

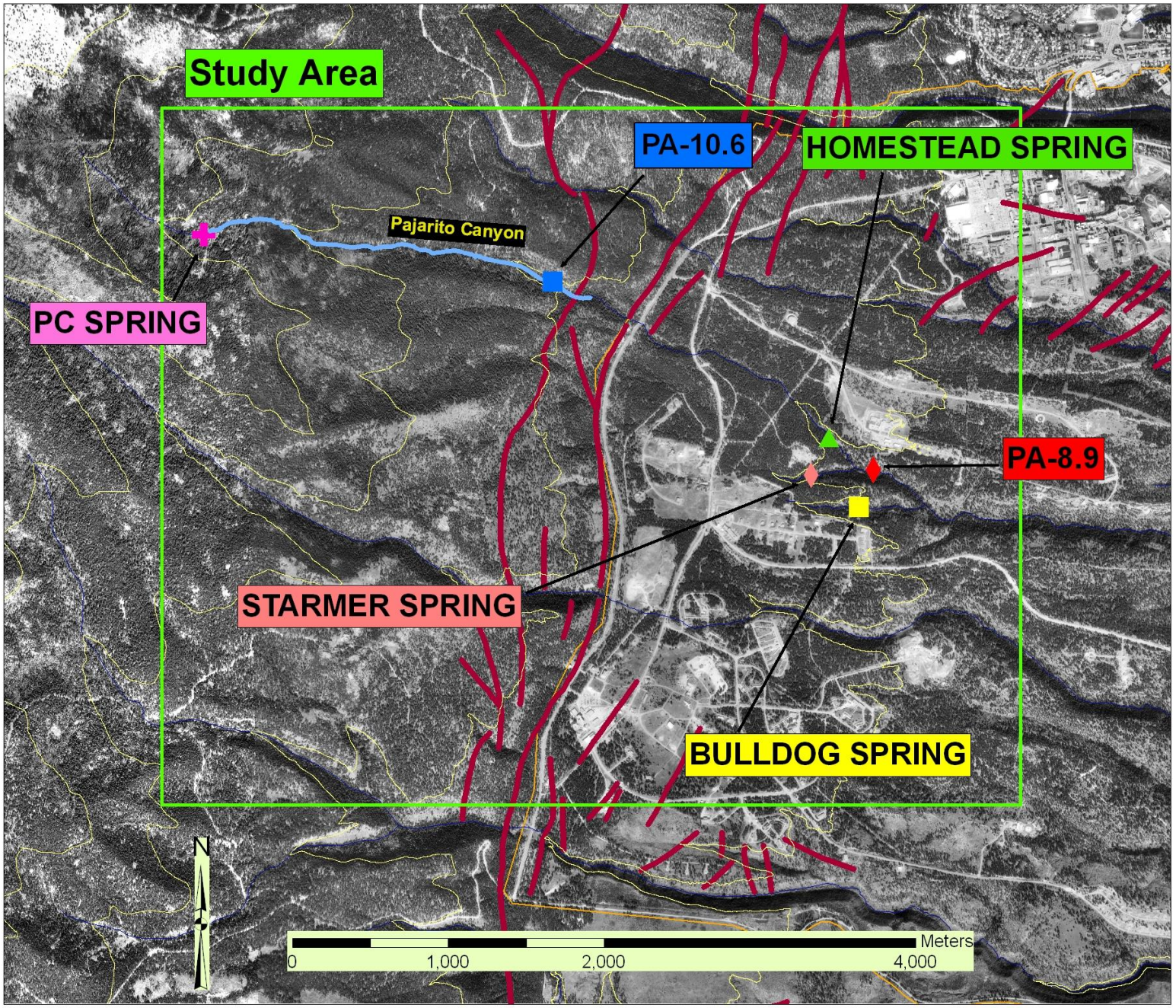
Determine the role of the Pajarito fault zone (PFZ) with respect to recharge to down-gradient bedrock springs.

WHY?

HOW WAS THE OBJECTIVE FULLFILED?

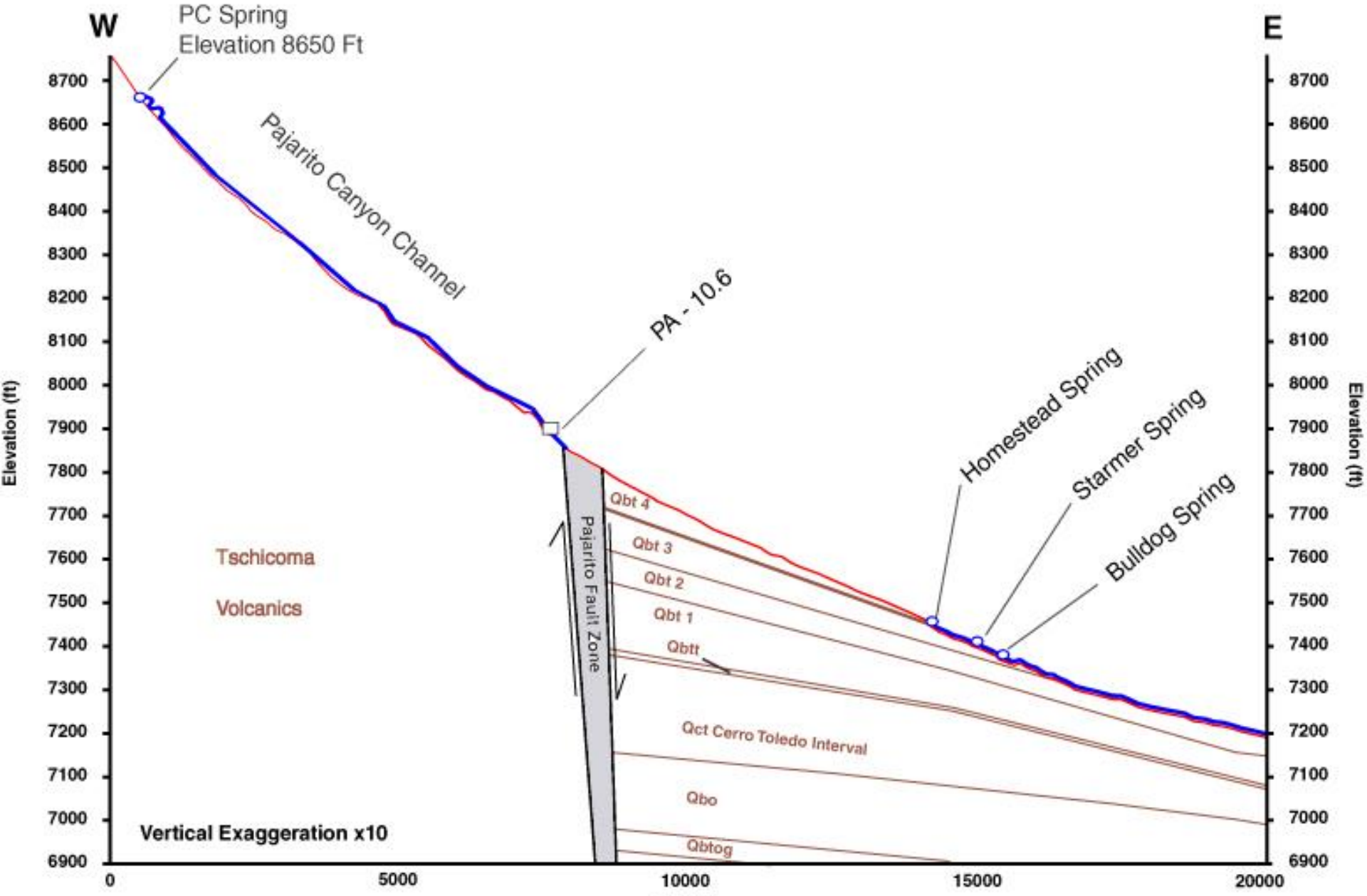
- By collecting and comparing hydrochemical and flow data at the suspect recharge waters at the PFZ (PA-10.6) and the downgradient springs (discharge).


RIO ARRIBA COUNTY
LOS ALAMOS COUNTY
SANDOVAL COUNTY
SANTA FE COUNTY
LOS ALAMOS COUNTY
SANTA FE NATIONAL FOREST
RIO ARRIBA COUNTY
SANTA FE COUNTY
LOS ALAMOS COUNTY
SANDOVAL COUNTY
LOS ALAMOS COUNTY
SAN ILDEFONSO PUEBLO
SANDOVAL COUNTY
L. A. N. L.
To Jemez Springs
SANTA FE COUNTY
LOS ALAMOS COUNTY
Río Grande
LOS ALAMOS COUNTY
SANDOVAL COUNTY
SANTA FE COUNTY
N


Study Area
PA-10.6
HOMESTEAD SPRING
Pajarito Canyon
PC SPRING
PA-8.9
STARMER SPRING
BULLDOG SPRING
N
Meters
0
1,000
2,000
4,000


Westward view of Upper Pajarito Canyon Watershed (10/24/01)

Stream Channel Profile and Cross-Section (West to East)




View of surface expression
of fault zone exposed by
scouring, approximately
200 feet east of PA-10.6 (6/29/00)
6 29 00


Homestead Spring
0.3 M

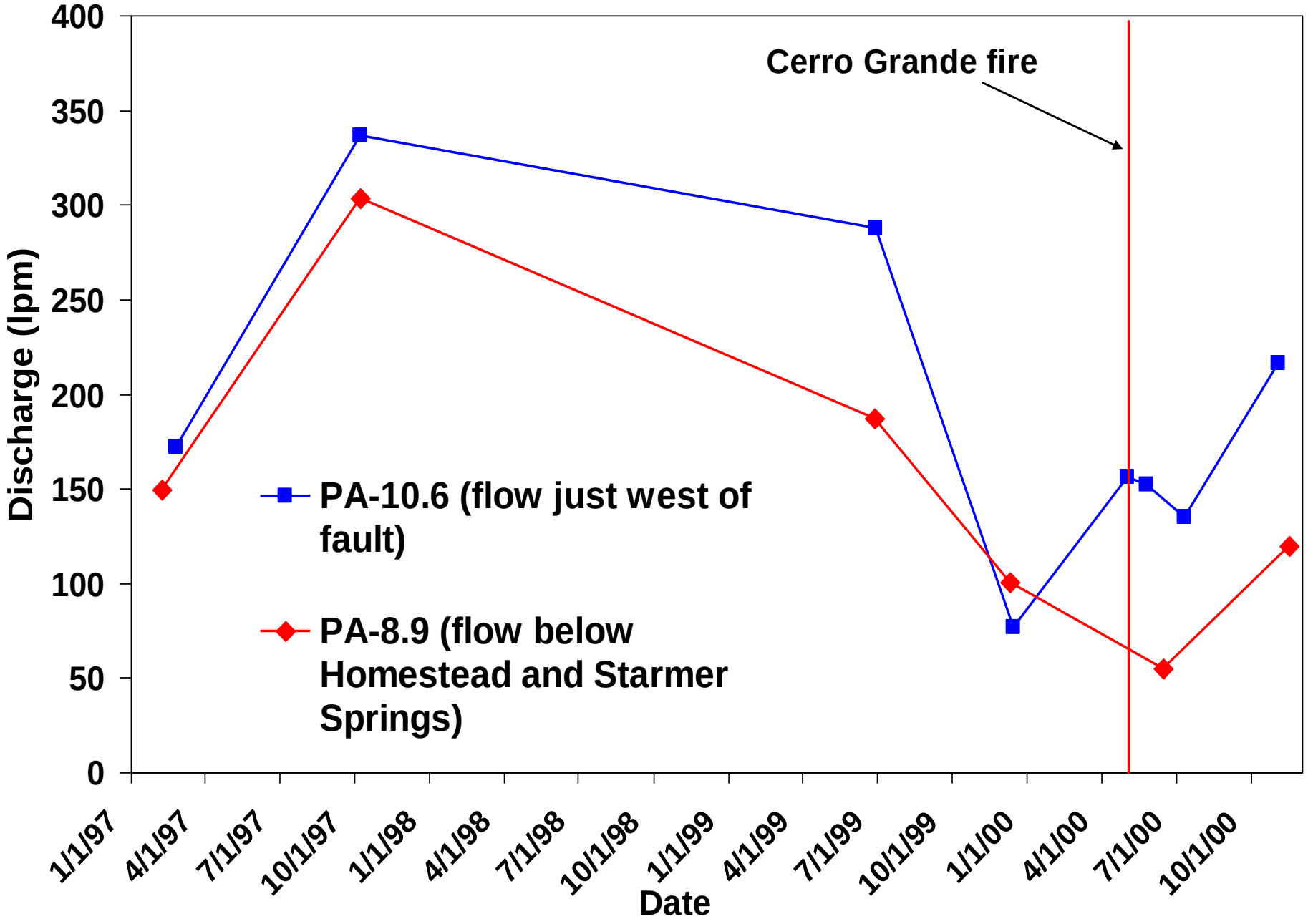

Fault expression, south wall
15 12:21 AM


Starmer Spring (3/12/01)
1 M

Bulldog Spring (3/12/01)

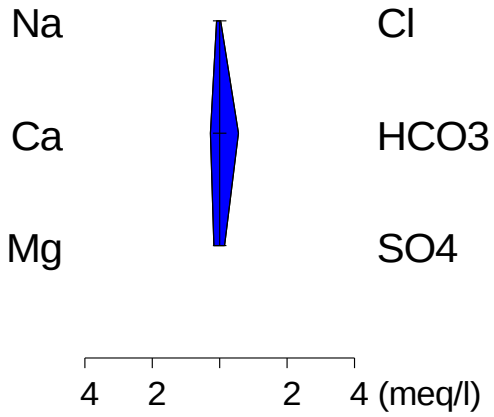
Seepage Run Data

Seepage measurements/runs across the PFZ on October 7, 1997 and June 29, 1999 resulted in a loss of 114 lpm (0.07 cfs) and 134 lpm (0.08 cfs), respectively.

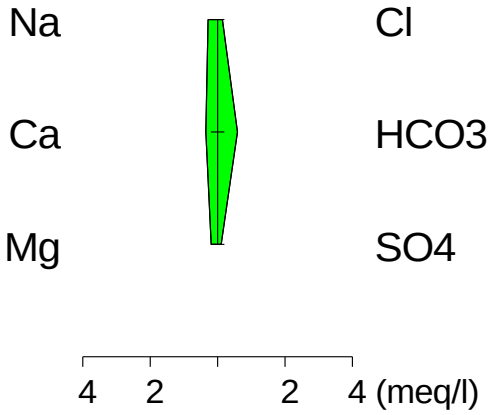

Cerro Grande fire
PA-10.6 (flow just west of fault)
PA-8.9 (flow below Homestead and Starmer Springs)
Discharge (lpm)
400
350
300
250
200
150
100
50
0
1/1/97
4/1/97
7/1/97
10/1/97
1/1/98
4/1/98
7/1/98
10/1/98
1/1/99
4/1/99
7/1/99
10/1/99
1/1/00
4/1/00
7/1/00
10/1/00
Date

Pre-Fire

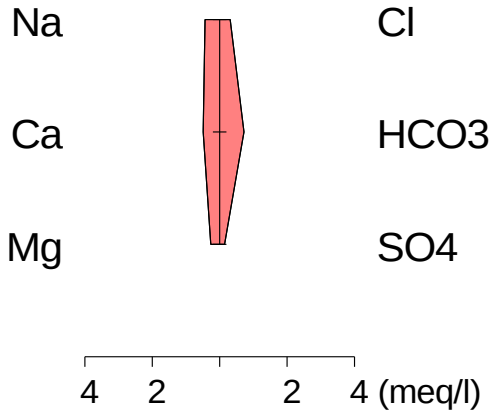
PA-10.6



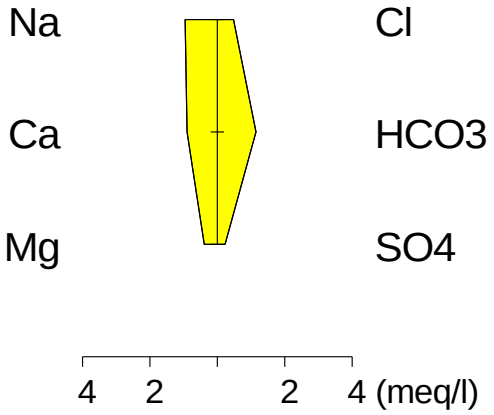
Homestead



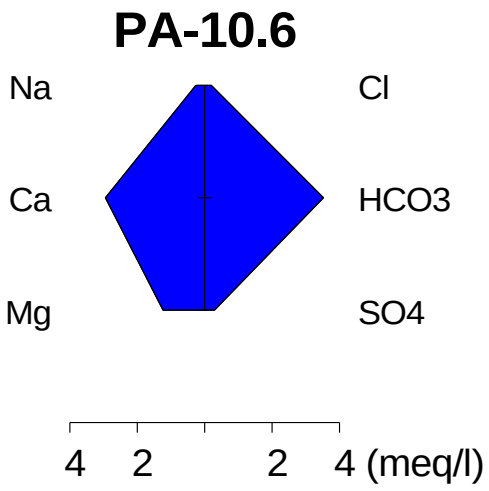
Starmer Spring

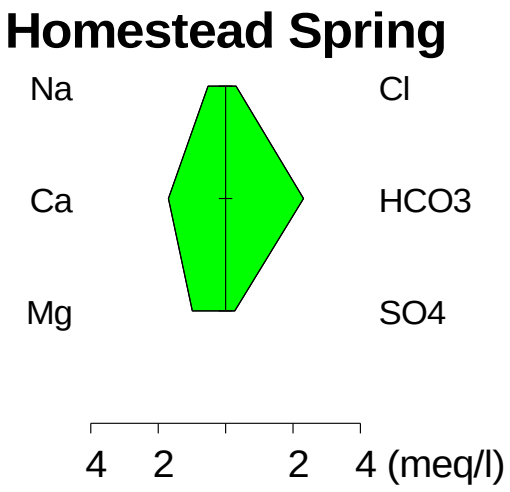


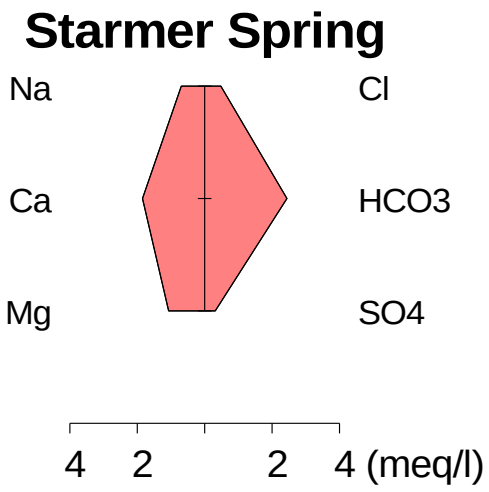
Bulldog Spring

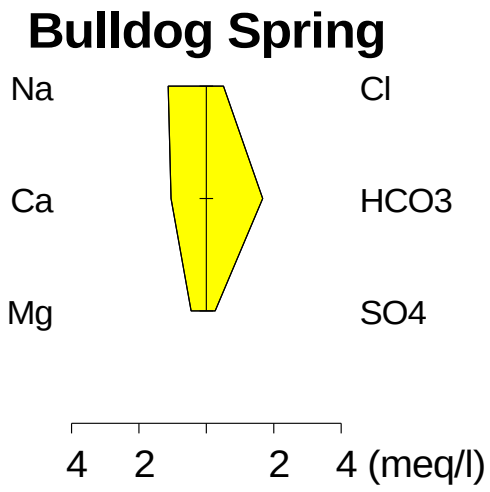


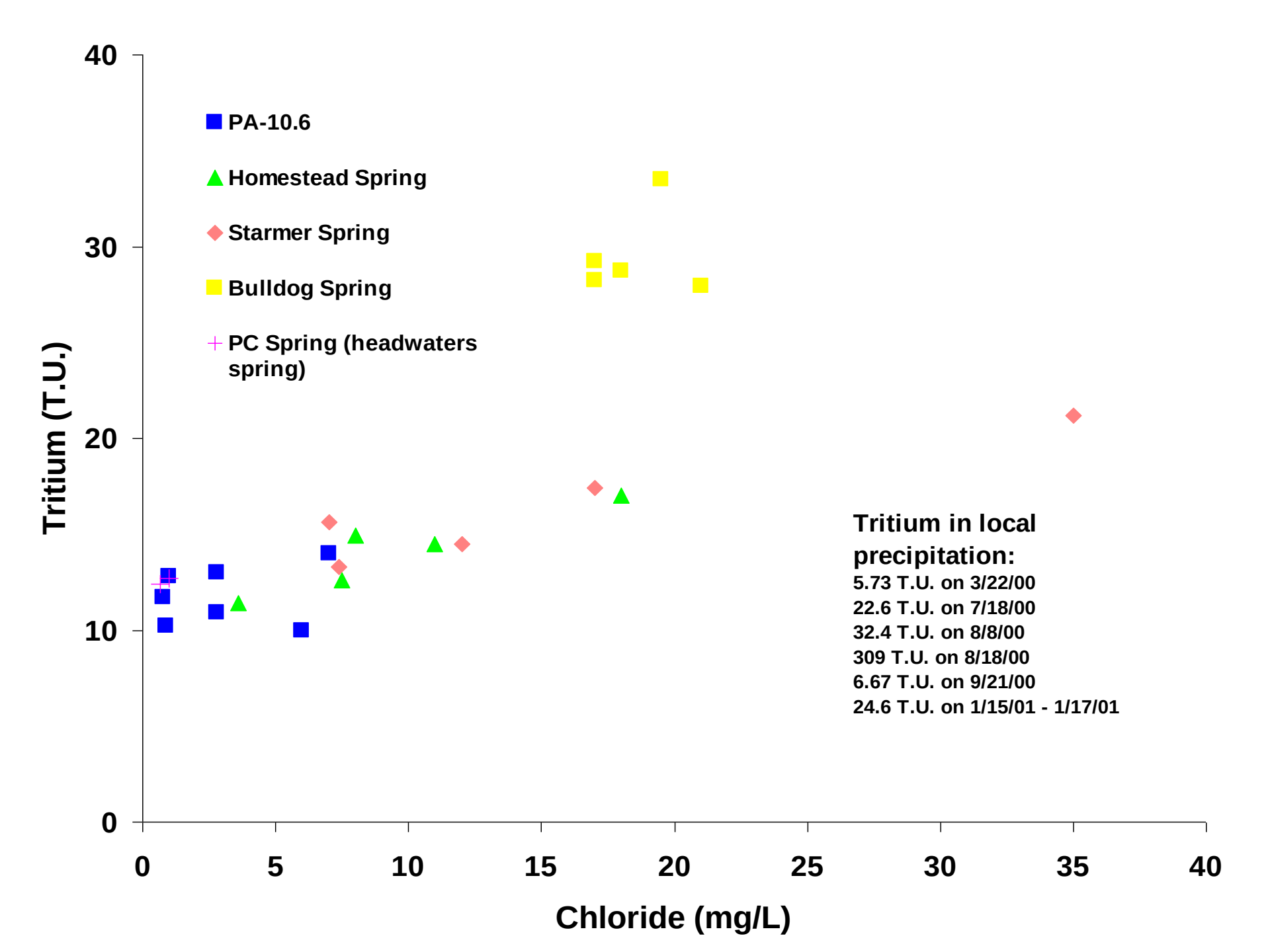
Post-Fire

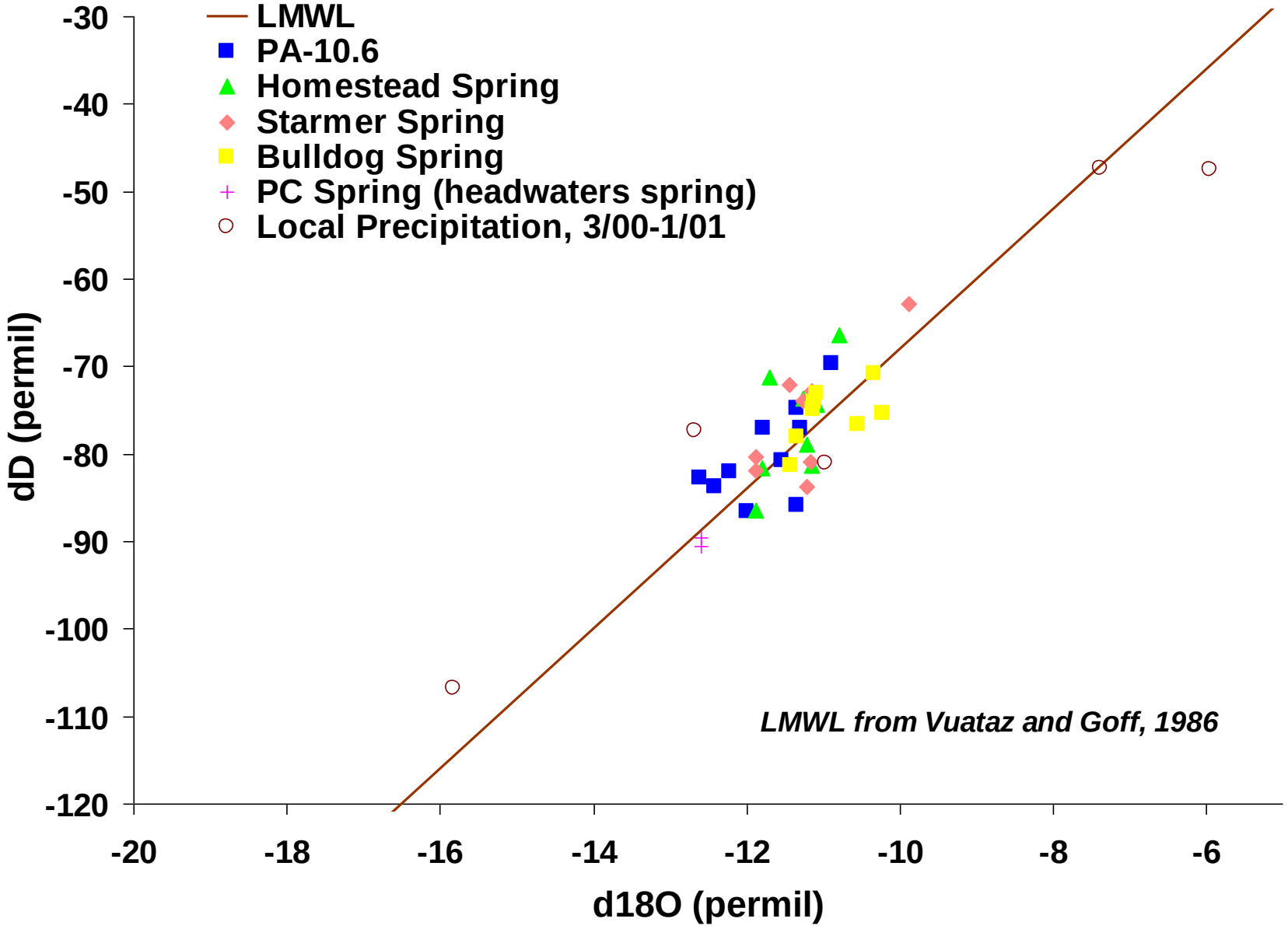

PA-10.6
Na
Cl
Ca
HCO3
Mg
SO4
4 2 2 4 (meq/l)

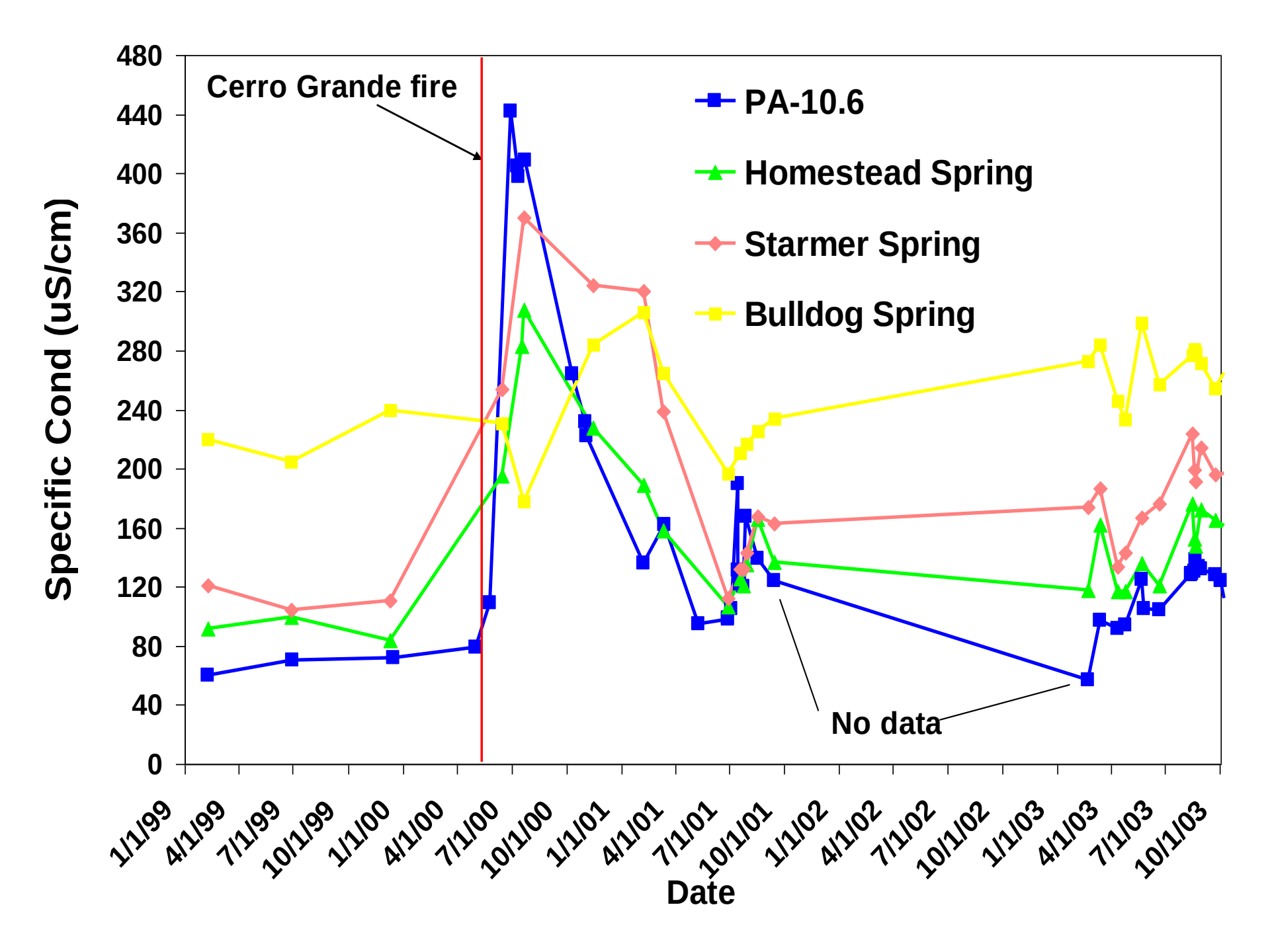

Homestead Spring
Na
Cl
Ca
HCO3
Mg
SO4
4 2 2 4 (meq/l)

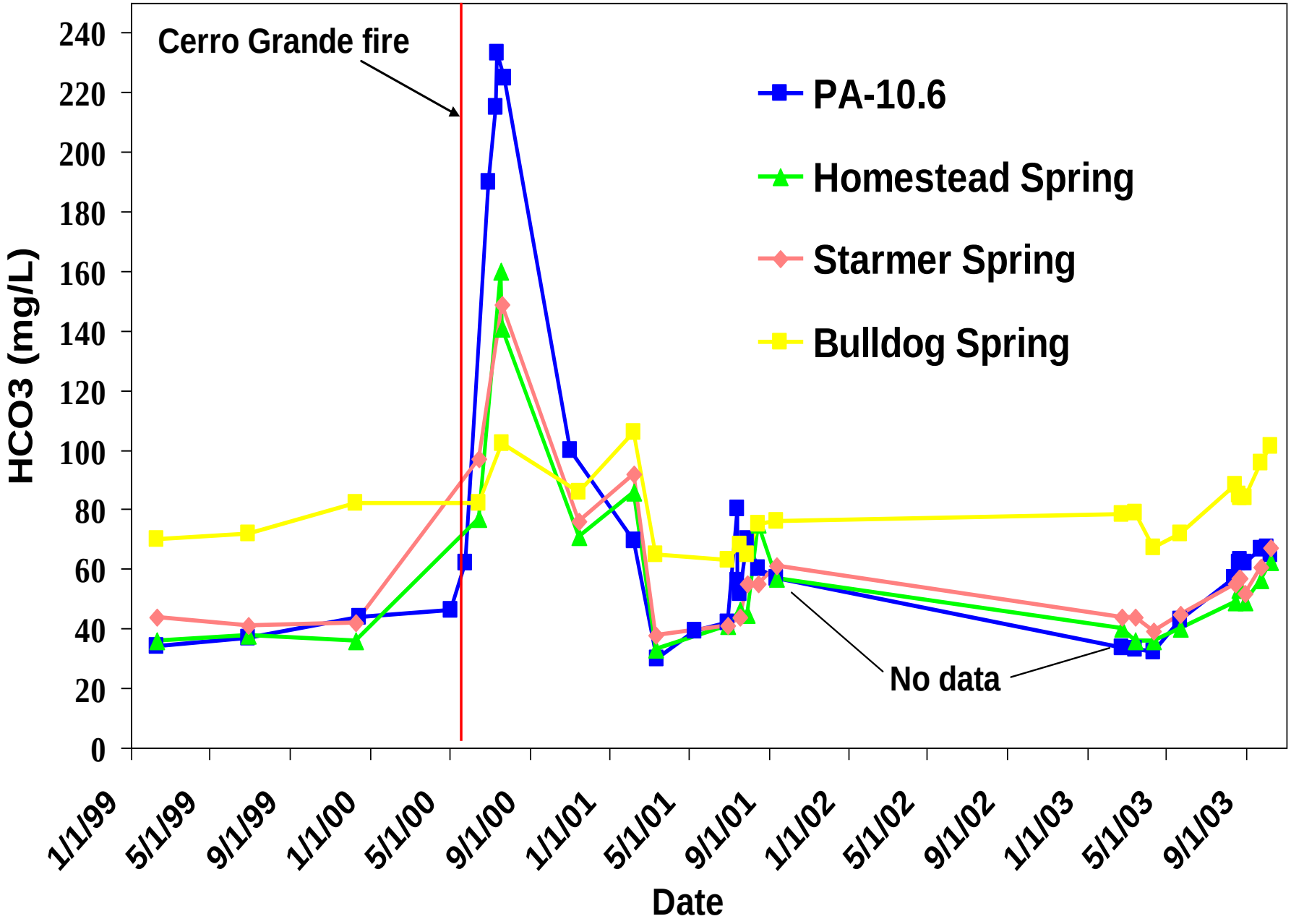

Starmer Spring
Na
Cl
Ca
HCO3
Mg
SO4
4 2 2 4 (meq/l)


Bulldog Spring
Na
Cl
Ca
HCO3
Mg
SO4
4 2 2 4 (meq/l)


40
30
20
10
0
Tritium (T.U.)
0
5
10
15
20
25
30
35
40
Chloride (mg/L)
PA-10.6
Homestead Spring
Starmer Spring
Bulldog Spring
PC Spring (headwaters spring)
Tritium in local precipitation:
5.73 T.U. on 3/22/00
22.6 T.U. on 7/18/00
32.4 T.U. on 8/8/00
309 T.U. on 8/18/00
6.67 T.U. on 9/21/00
24.6 T.U. on 1/15/01 - 1/17/01


LMWL
PA-10.6
Homestead Spring
Starmer Spring
Bulldog Spring
PC Spring (headwaters spring)
Local Precipitation, 3/00-1/01
LMWL from Vuataz and Goff, 1986
dD (permil)
d18O (permil)
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-20
-18
-16
-14
-12
-10
-8
-6


Specific Cond (uS/cm)
480
440
400
360
320
280
240
200
160
120
80
40
0
Cerro Grande fire
PA-10.6
Homestead Spring
Starmer Spring
Bulldog Spring
No data
1/1/99
4/1/99
7/1/99
10/1/99
1/1/00
4/1/00
7/1/00
10/1/00
1/1/01
4/1/01
7/1/01
10/1/01
1/1/02
4/1/02
7/1/02
10/1/02
1/1/03
4/1/03
7/1/03
10/1/03
Date


Cerro Grande fire
PA-10.6
Homestead Spring
Starmer Spring
Bulldog Spring
No data
HCO3 (mg/L)
Date
0
20
40
60
80
100
120
140
160
180
200
220
240
1/1/99
5/1/99
9/1/99
1/1/00
5/1/00
9/1/00
1/1/01
5/1/01
9/1/01
1/1/02
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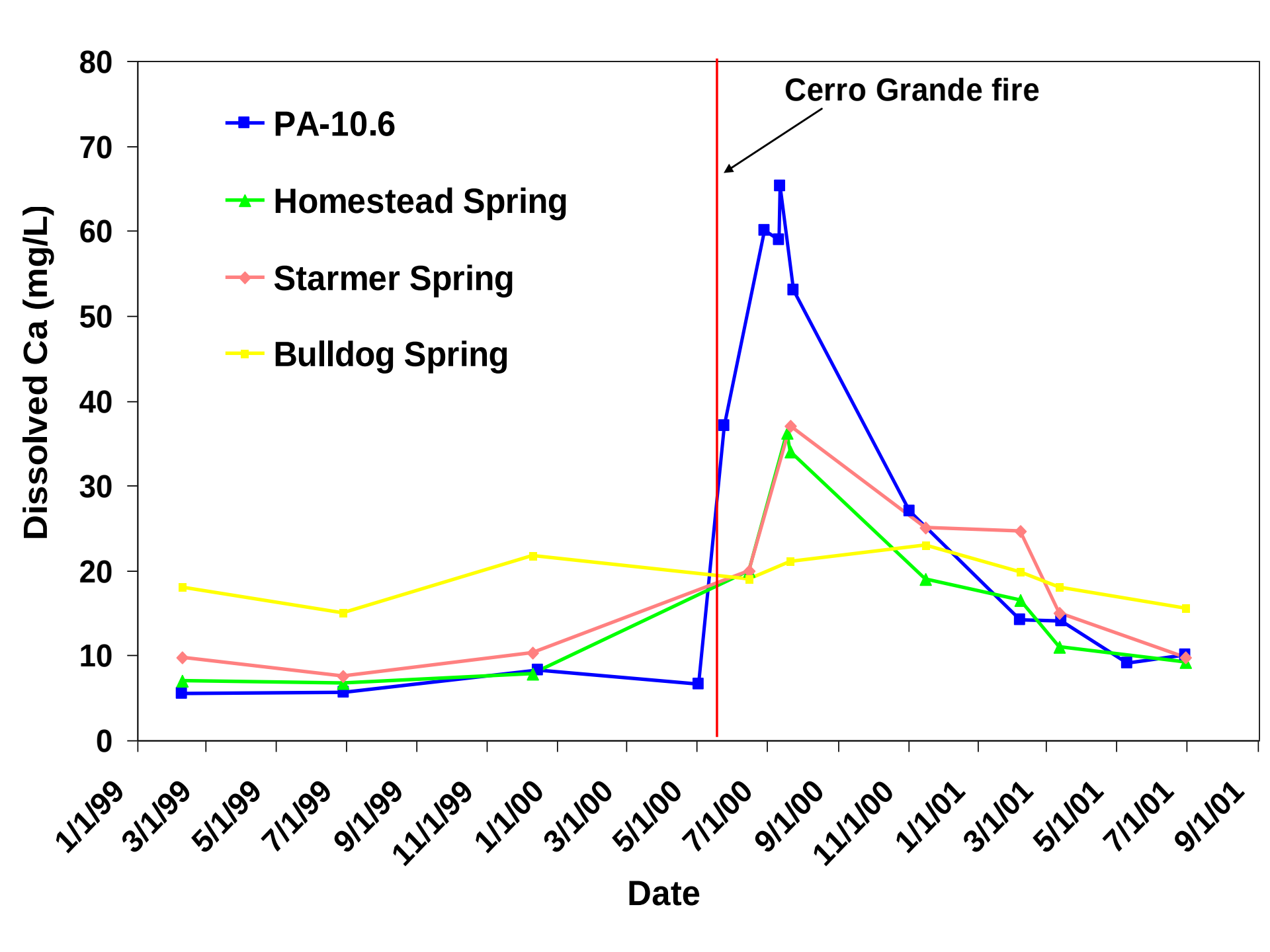
9/1/02
1/1/03
5/1/03
9/1/03


Cerro Grande fire
PA-10.6
Homestead Spring
Starmer Spring
Bulldog Spring
Dissolved Ca (mg/L)
0
10
20
30
40
50
60
70
80
1/1/99
3/1/99
5/1/99
7/1/99
9/1/99
11/1/99
1/1/00
3/1/00
5/1/00
7/1/00
9/1/00
11/1/00
1/1/01
3/1/01
5/1/01
7/1/01
9/1/01
Date

Additional Post-Fire Hydrochemical Changes

- Increases in dissolved chloride and sodium at PA-10.6 were not observed.

- Dissolved sulfate and potassium increased at PA-10.6 by factors of about 10 and five respectively. Slight increases were observed at Homestead and Starmer Springs.

- Dissolved strontium (Sr) and magnesium (Mg) increased at PA-10.6 by factors of about seven and five respectively. Dissolved Sr and Mg at Homestead and Starmer Springs increased by a factor of about four to five.

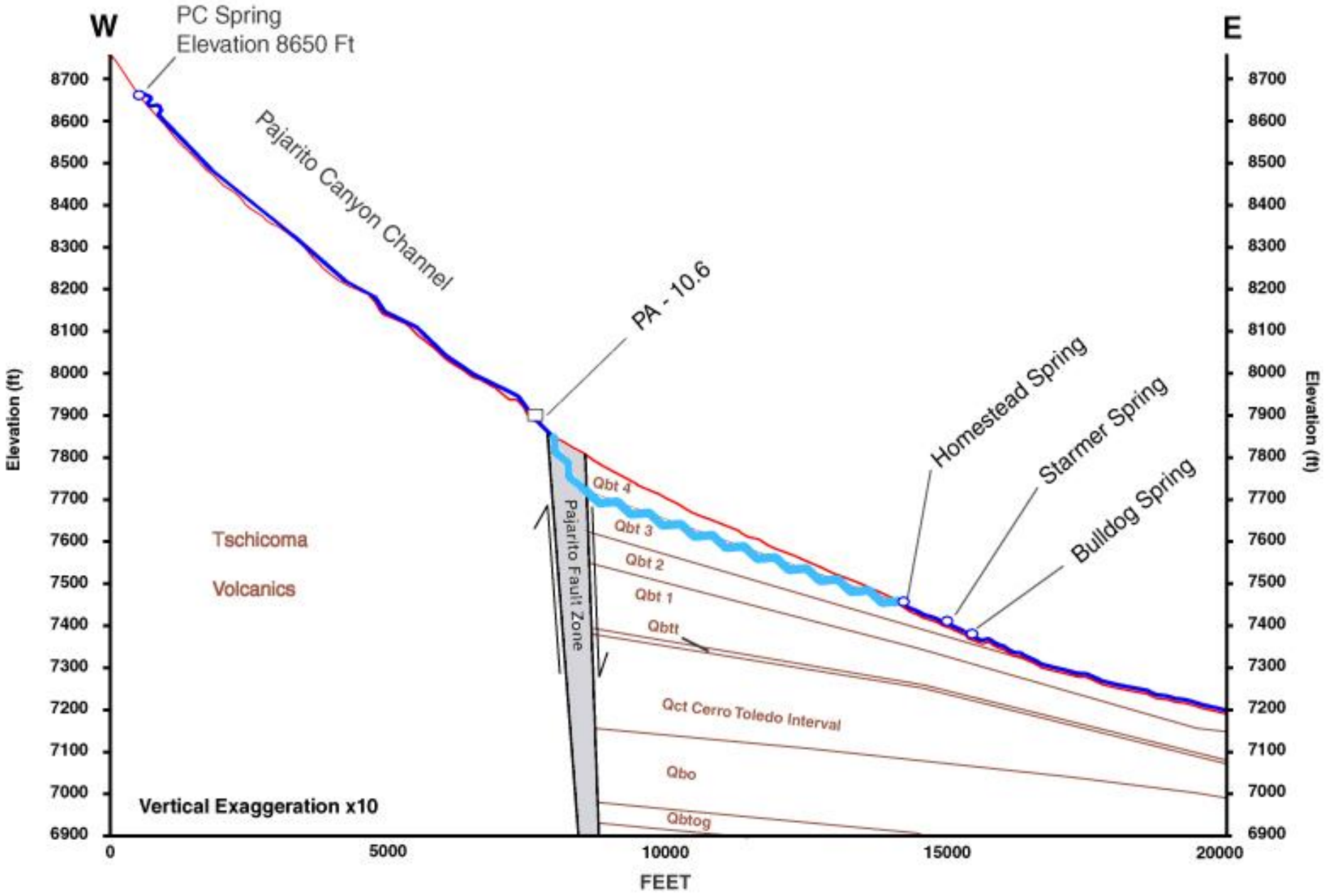
- Dissolved manganese increased at PA-10.6 by a factor of about 500 but did not increase at Homestead and Starmer Springs.

- In most cases, solute concentrations were greater at PA-10.6 than the springs. This suggests that:

  (1) the springs may have experience local recharge that diluted the PA-10.6 fire-impacted recharge waters and/or;

  (2) the spring waters are mixing along the flow path with respected to age, i.e., pre-fire with post-fire waters.

Stream Channel Profile and Cross-Section (West to East)



Conclusions

- Seepage-run data show loss of 114 (0.07 cfs) and 134 lpm (0.08 cfs) across the PFZ.
- Water-balance measurements at the PFZ (PA-10.6) and below springs nearly equivalent.
- Localized snowmelt provides some recharge to the springs.
- **Hydrogeochemical data collected from 1997 through 2003 indicate the PFZ is a recharge conduit between PA-10.6 and some springs (Homestead and Starmer).**
- Water quality at PA-10.6 impacted by monsoonal flooding after the Cerro Grande fire; impacts traced to Homestead and Starmer Springs in less than one month.
- Bulldog Spring, which contains LANL derived contaminants, is recharged by a nearby source with some contribution from PA-10.6.