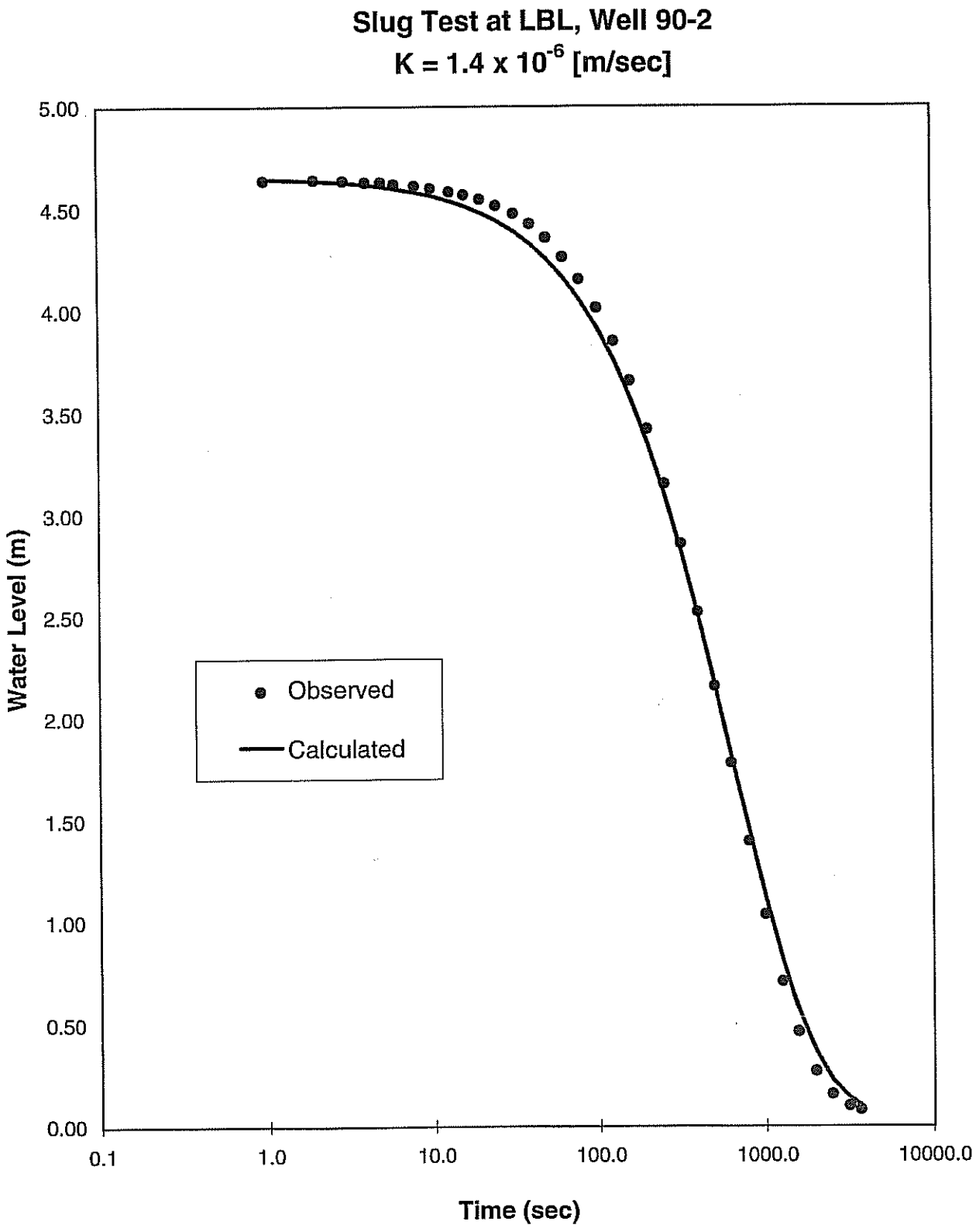
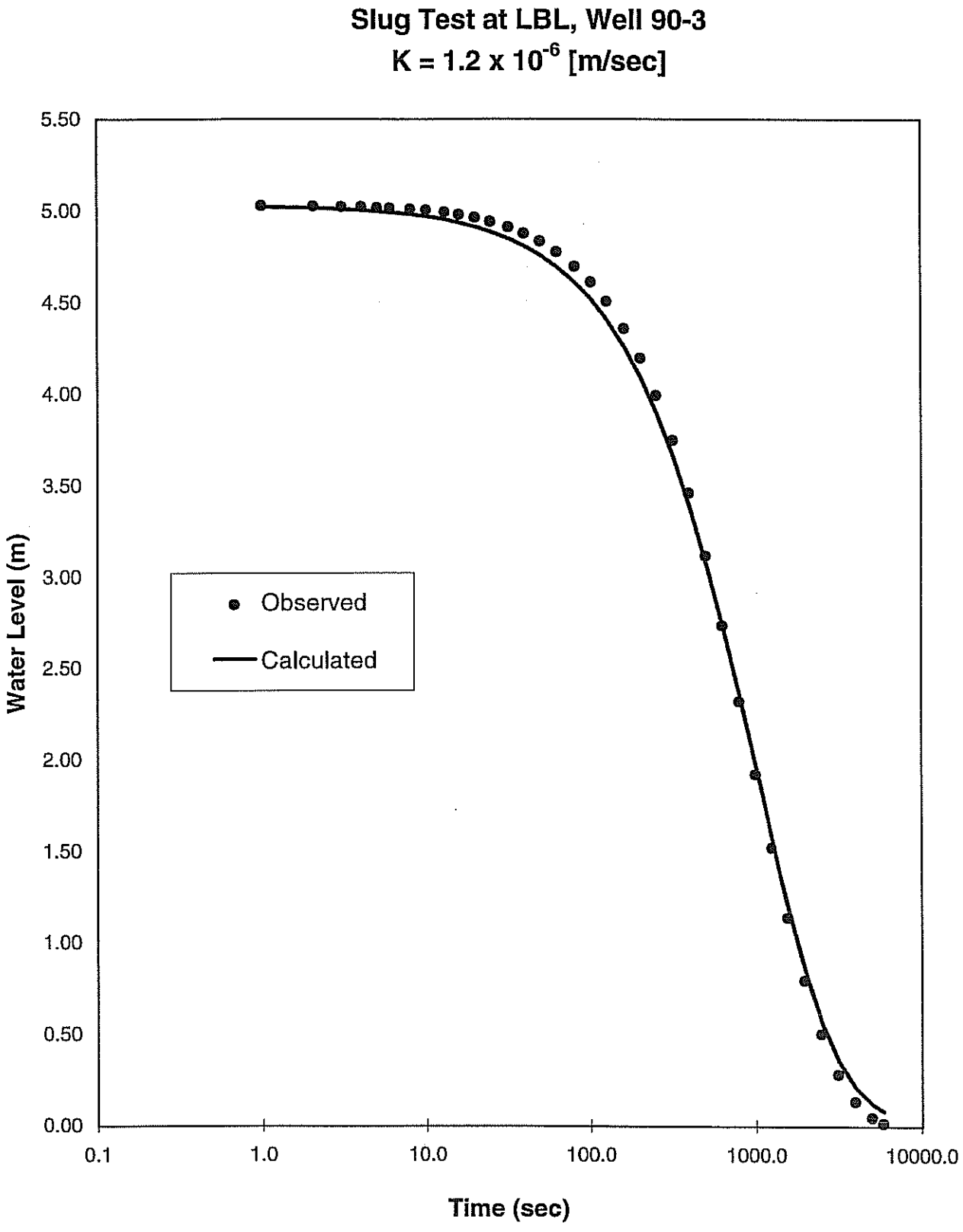
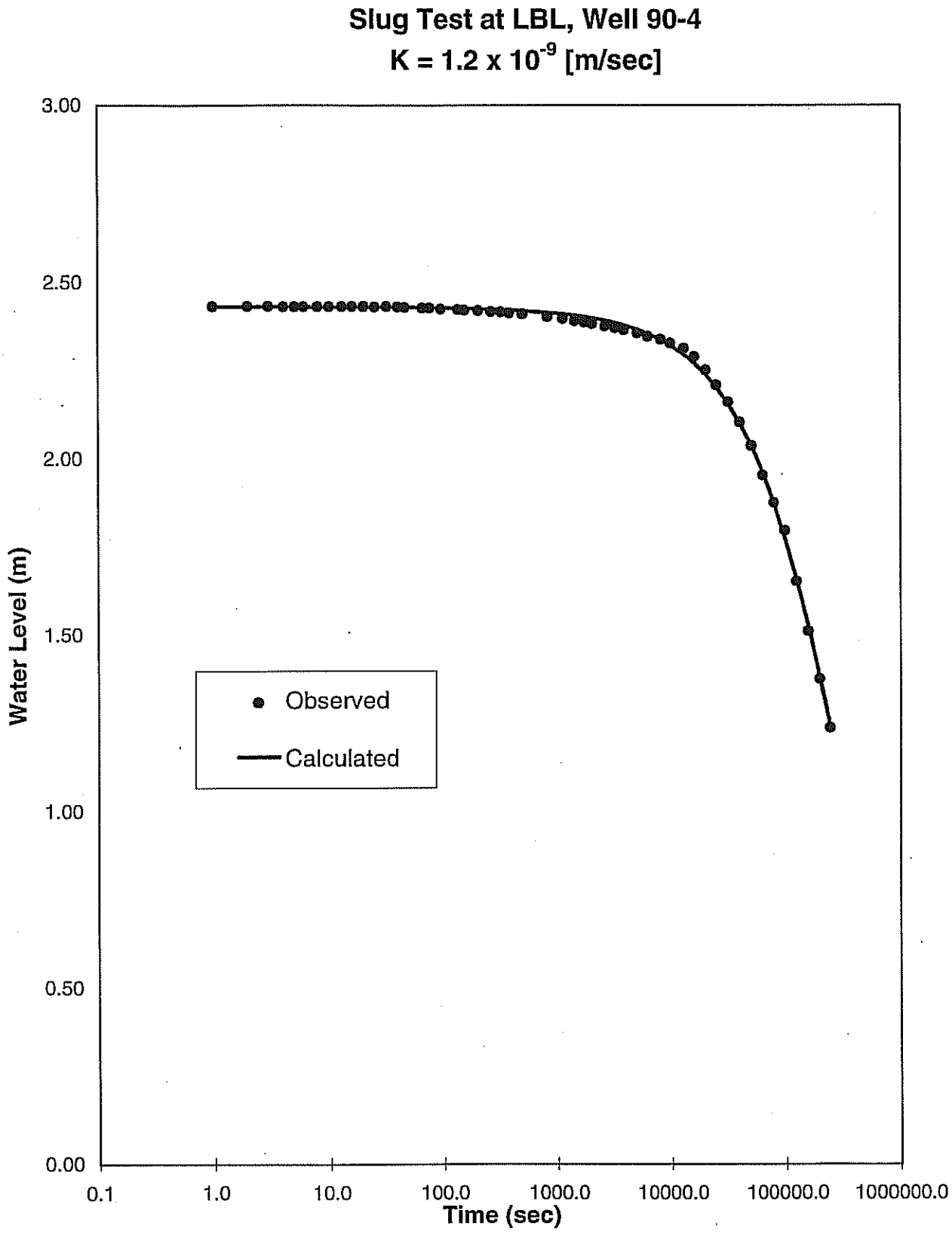
Appendix A

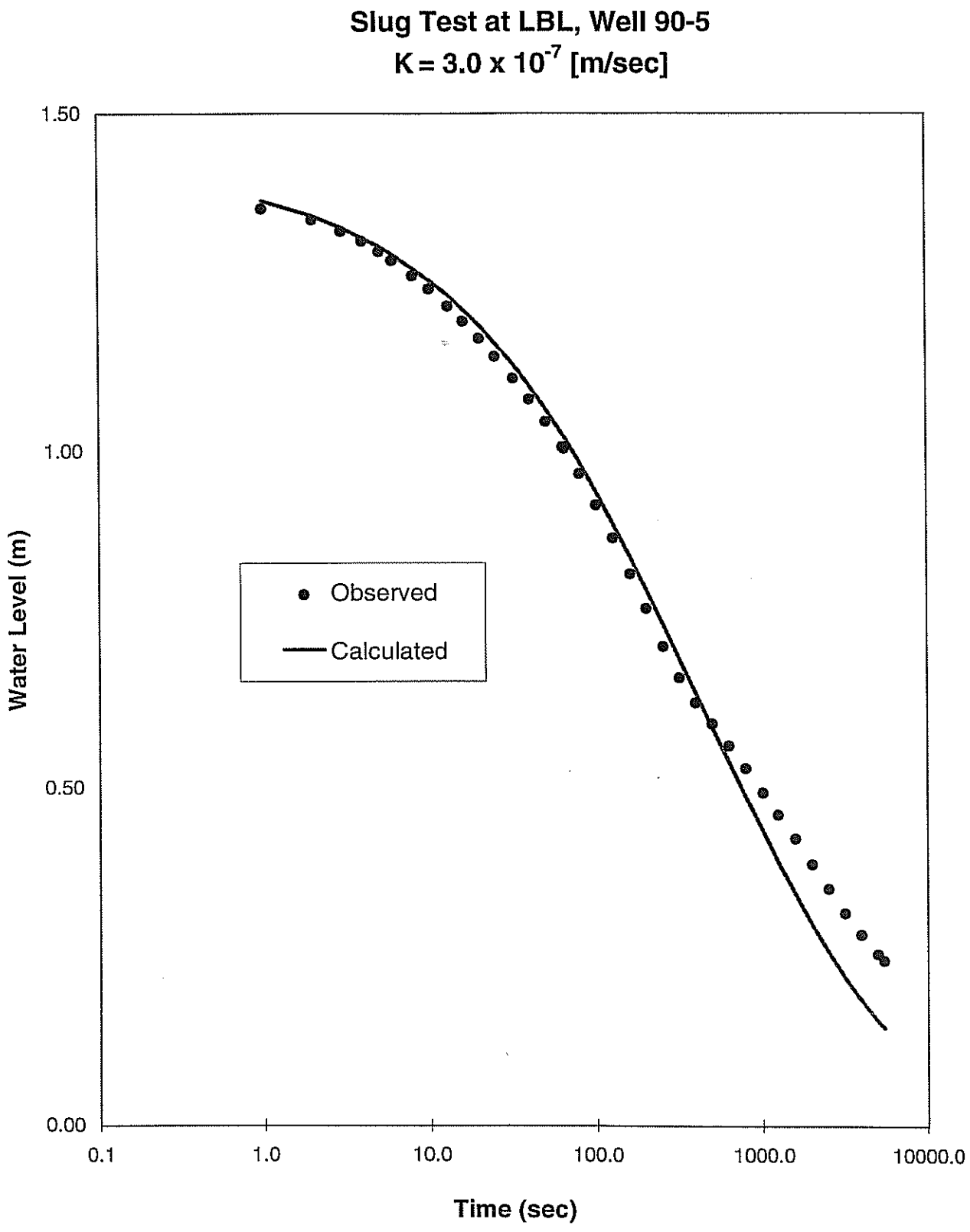
Hydrogeological Test Data

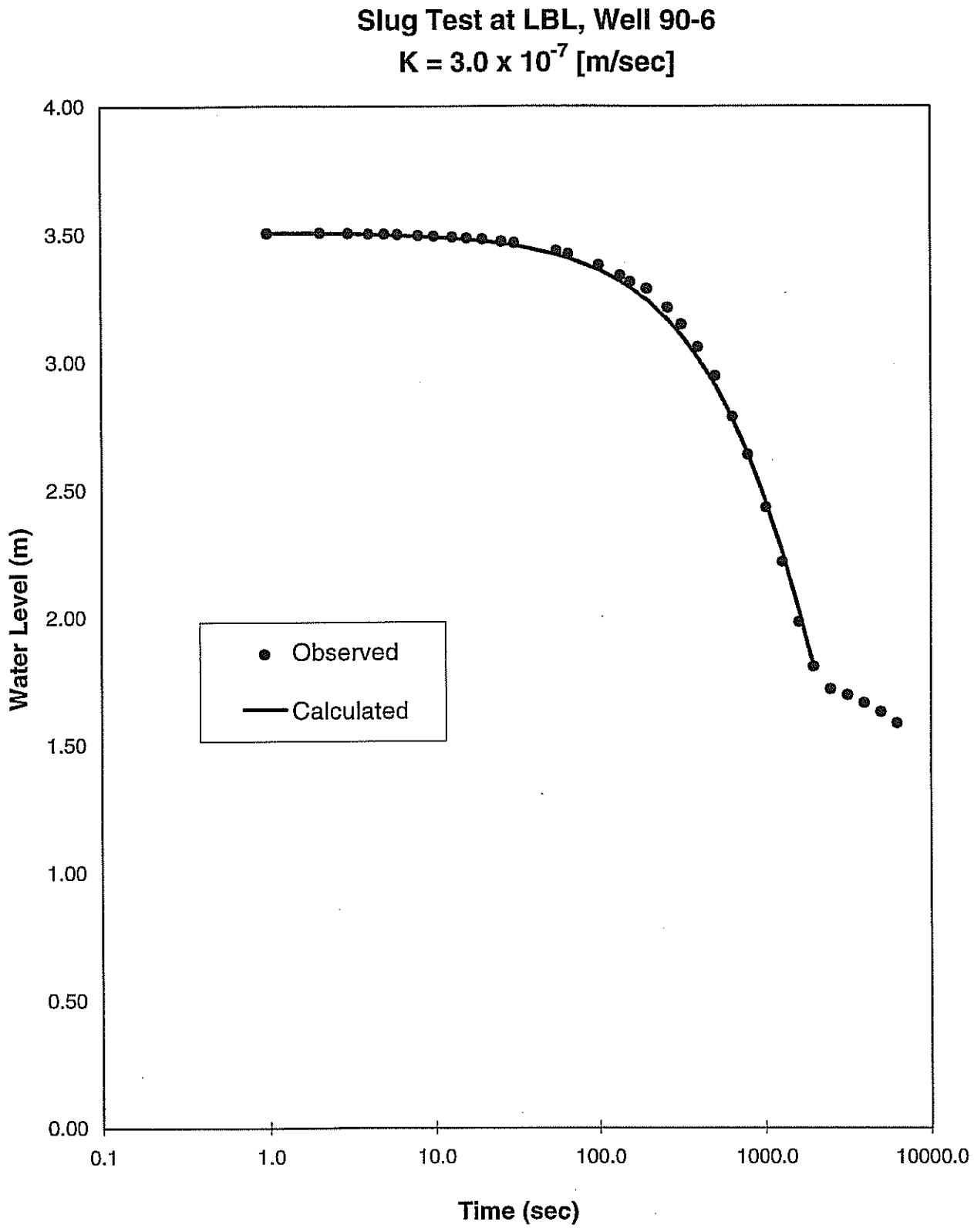
Slug Test Data

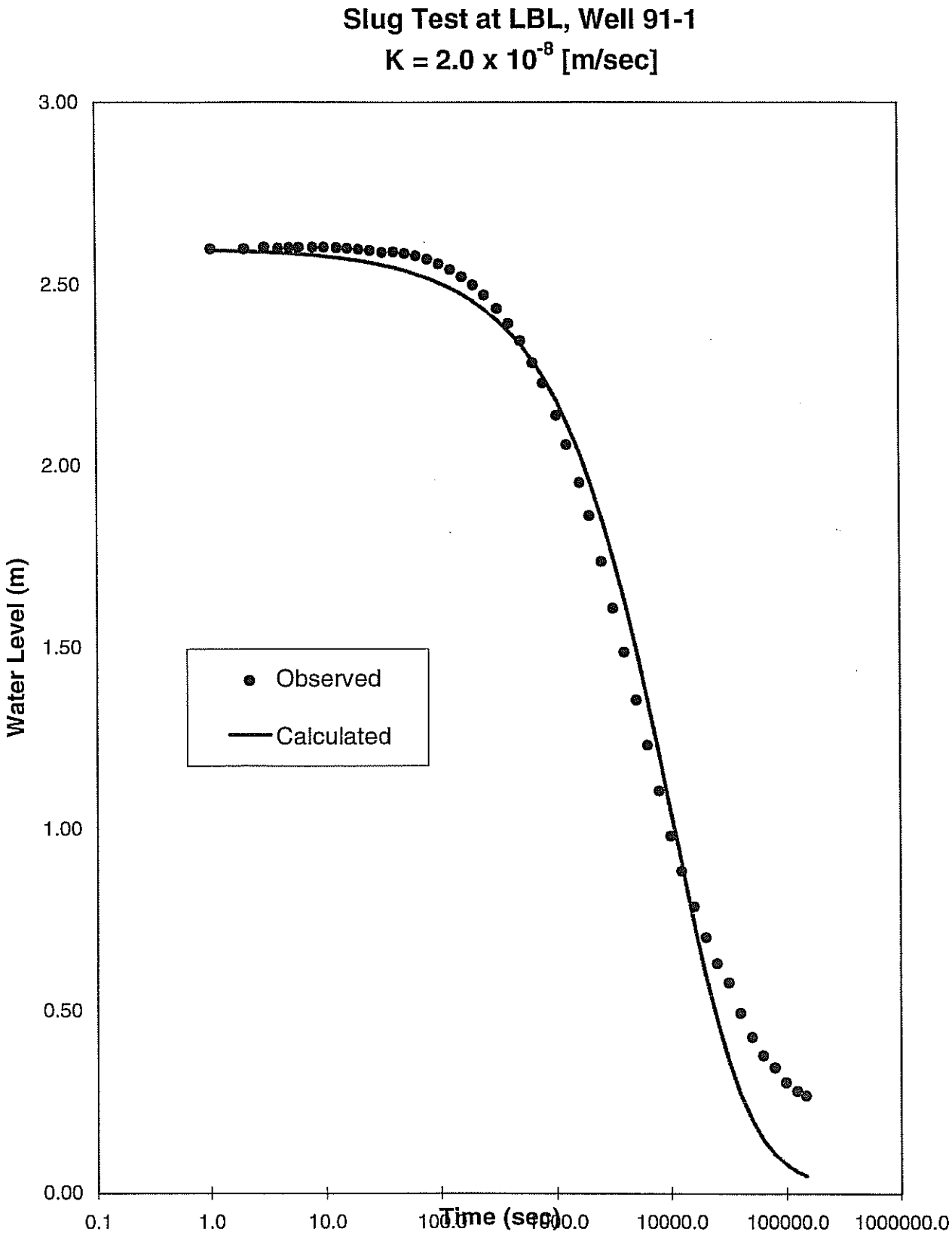

Slug Test at LBL, Well 90-2
K = 1.4 x 10^-6 [m/sec]
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

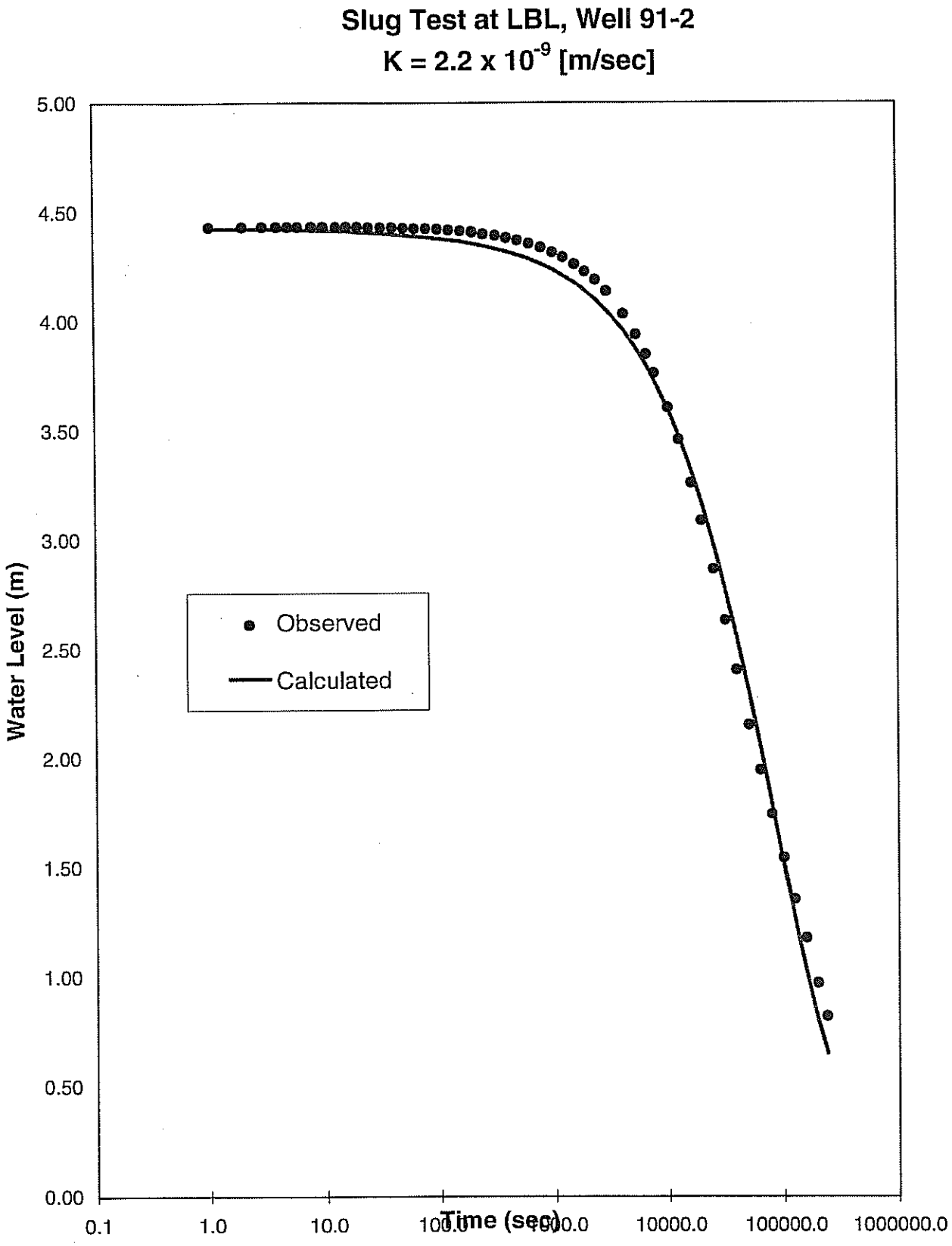

Slug Test at LBL, Well 90-3
K = 1.2 x 10^-6 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

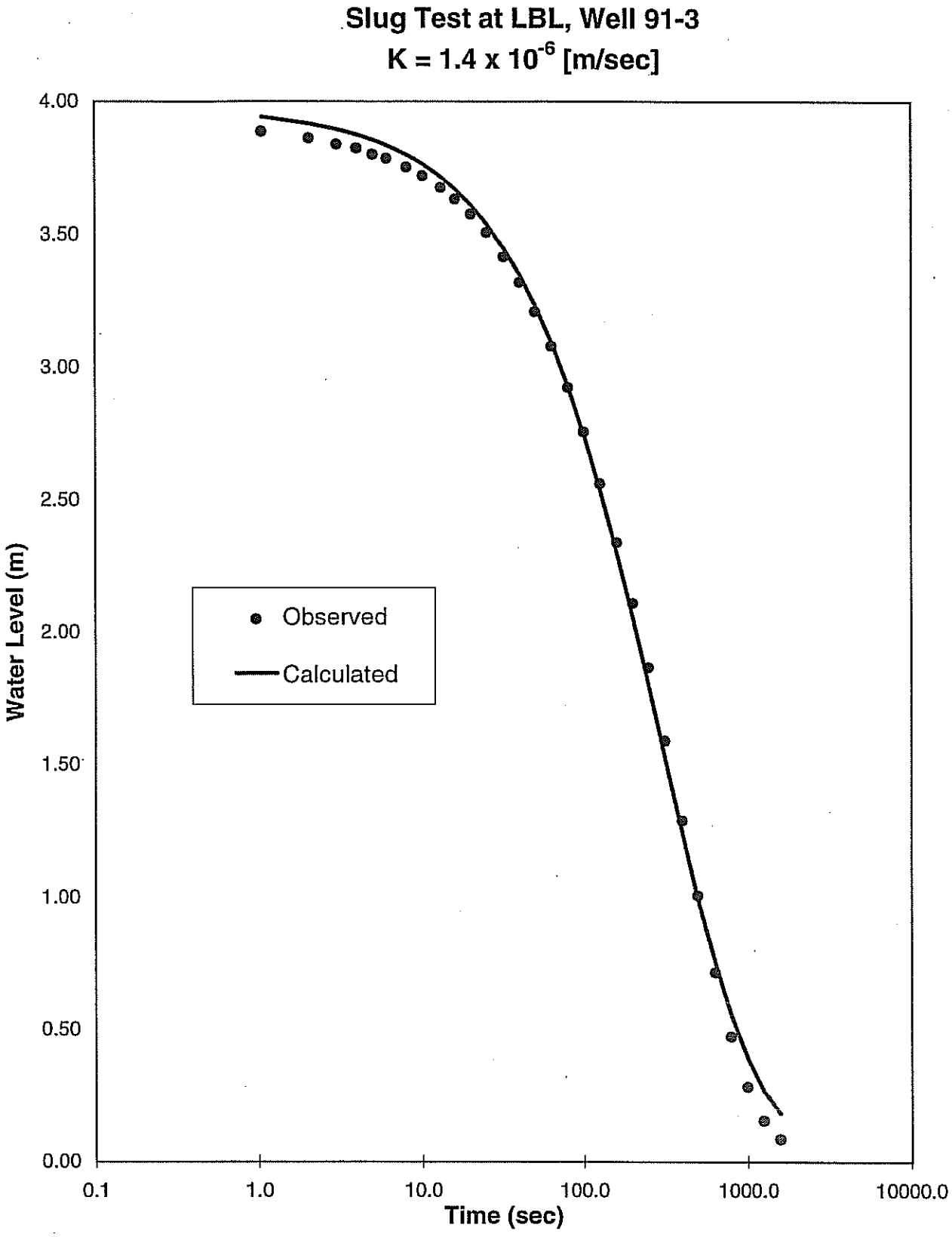

Slug Test at LBL, Well 90-4
K = 1.2 x 10^-9 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

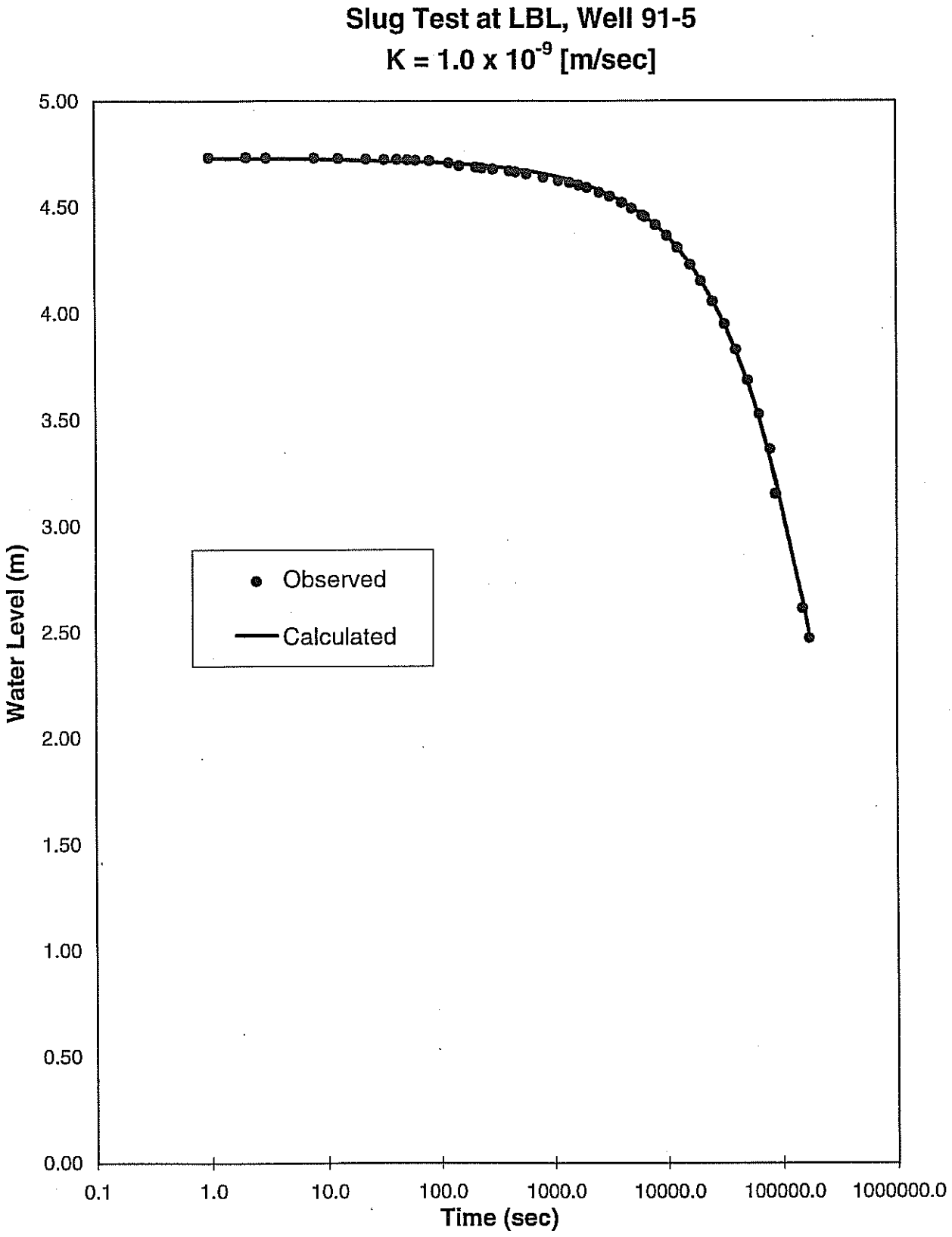

Slug Test at LBL, Well 90-5
K = 3.0 x 10^-7 [m/sec]
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

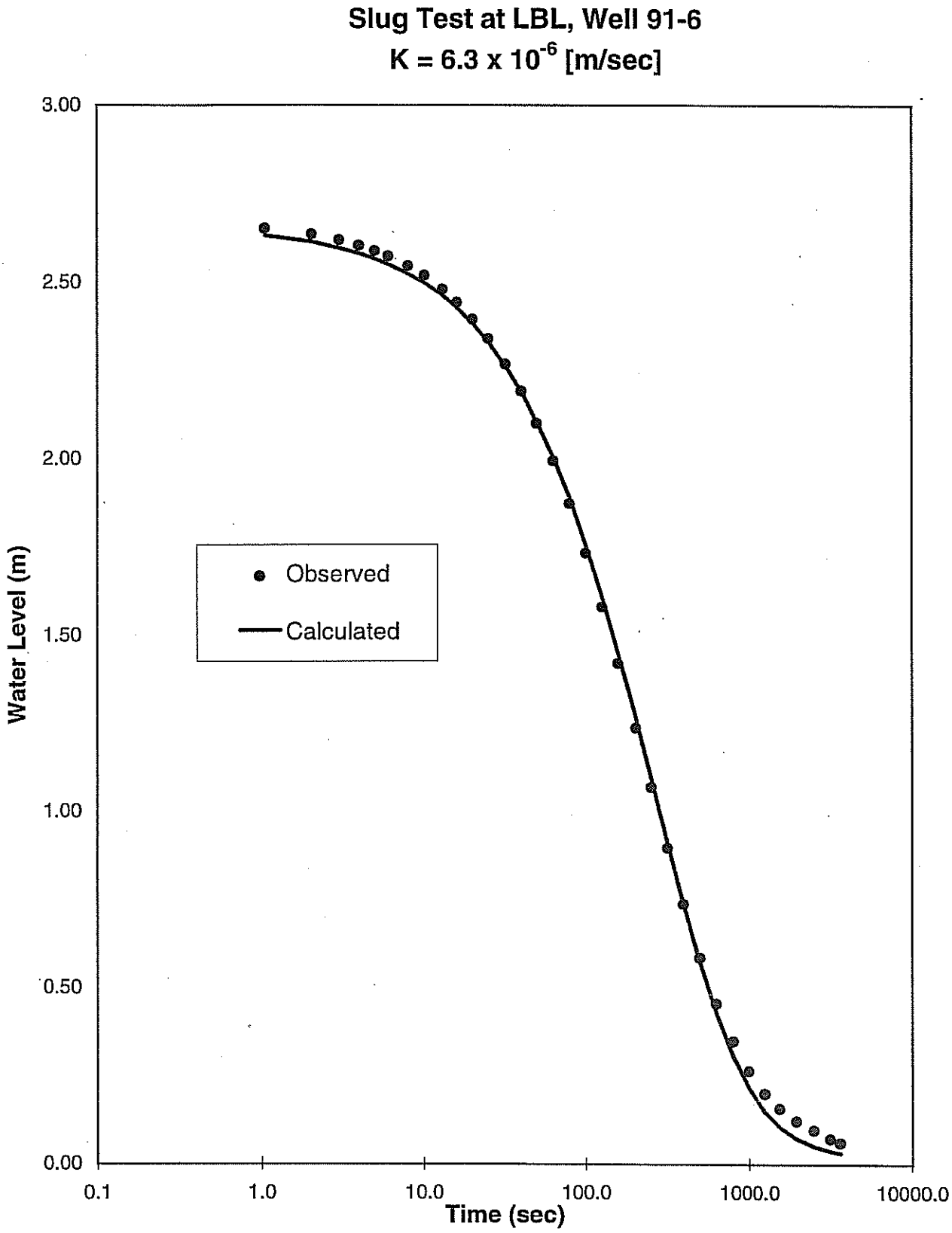

Slug Test at LBL, Well 90-6
K = 3.0 x 10^-7 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

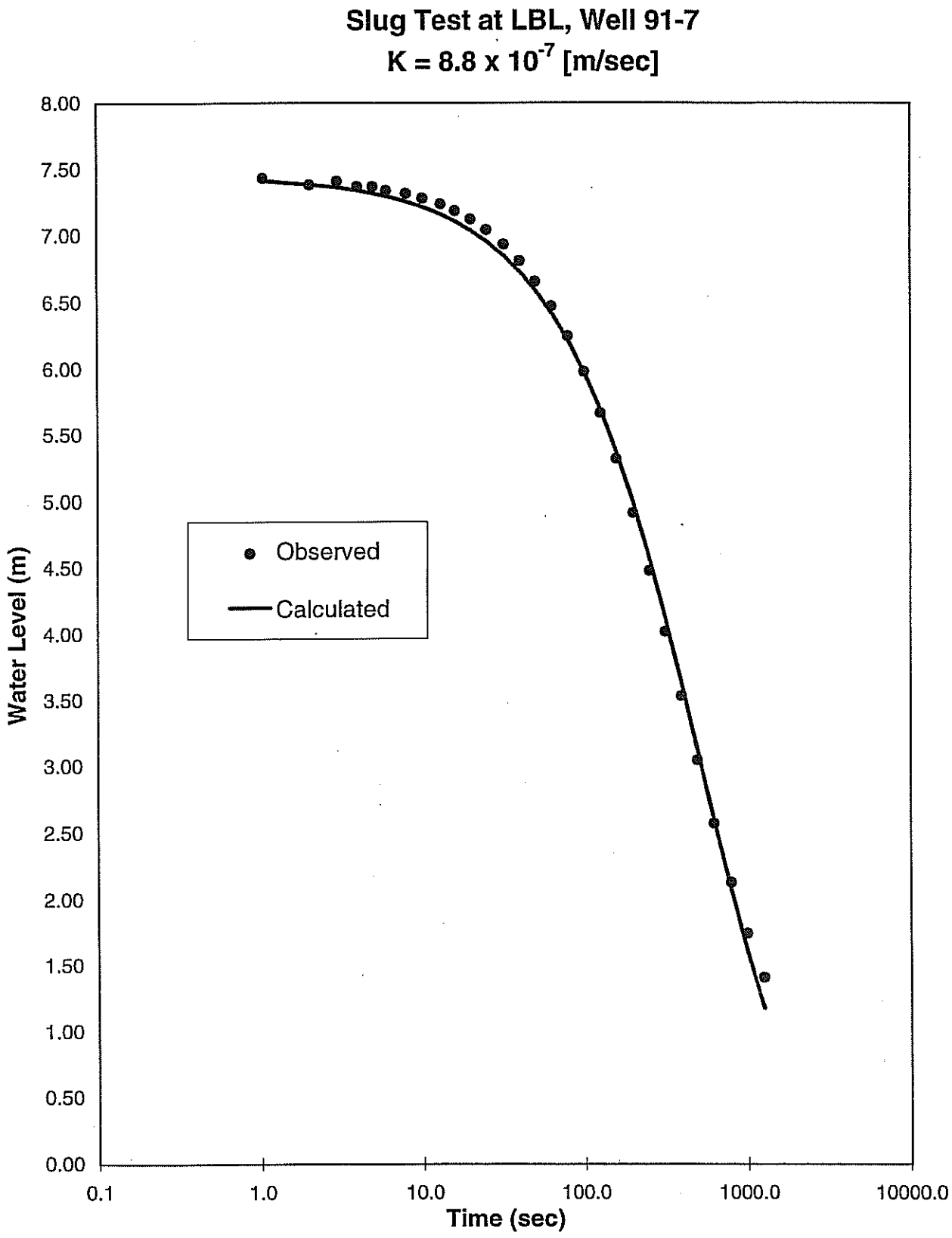

Slug Test at LBL, Well 91-1
K = 2.0 x 10^-8 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

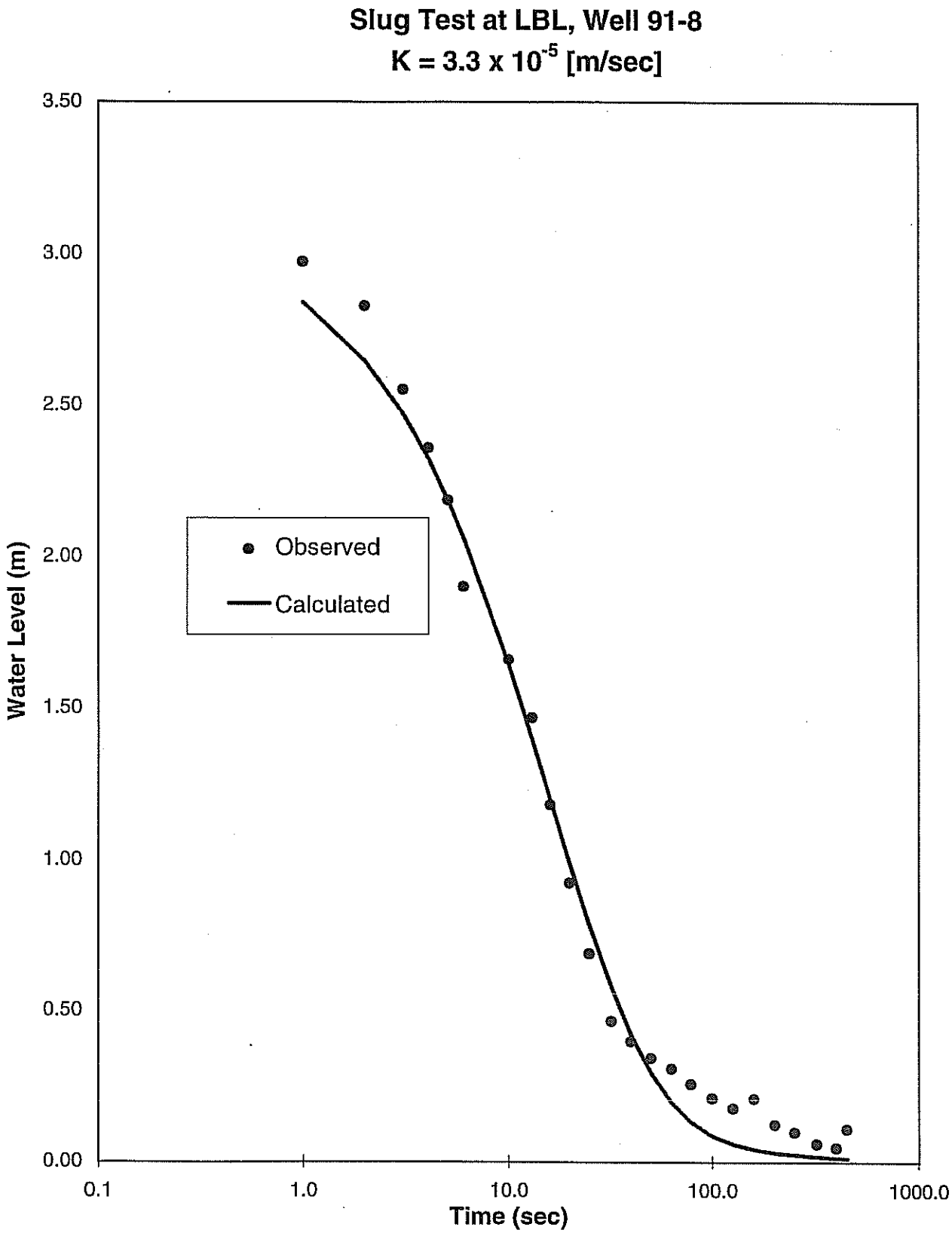

Slug Test at LBL, Well 91-2
K = 2.2 x 10^-9 [m/sec]
Water Level (m)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

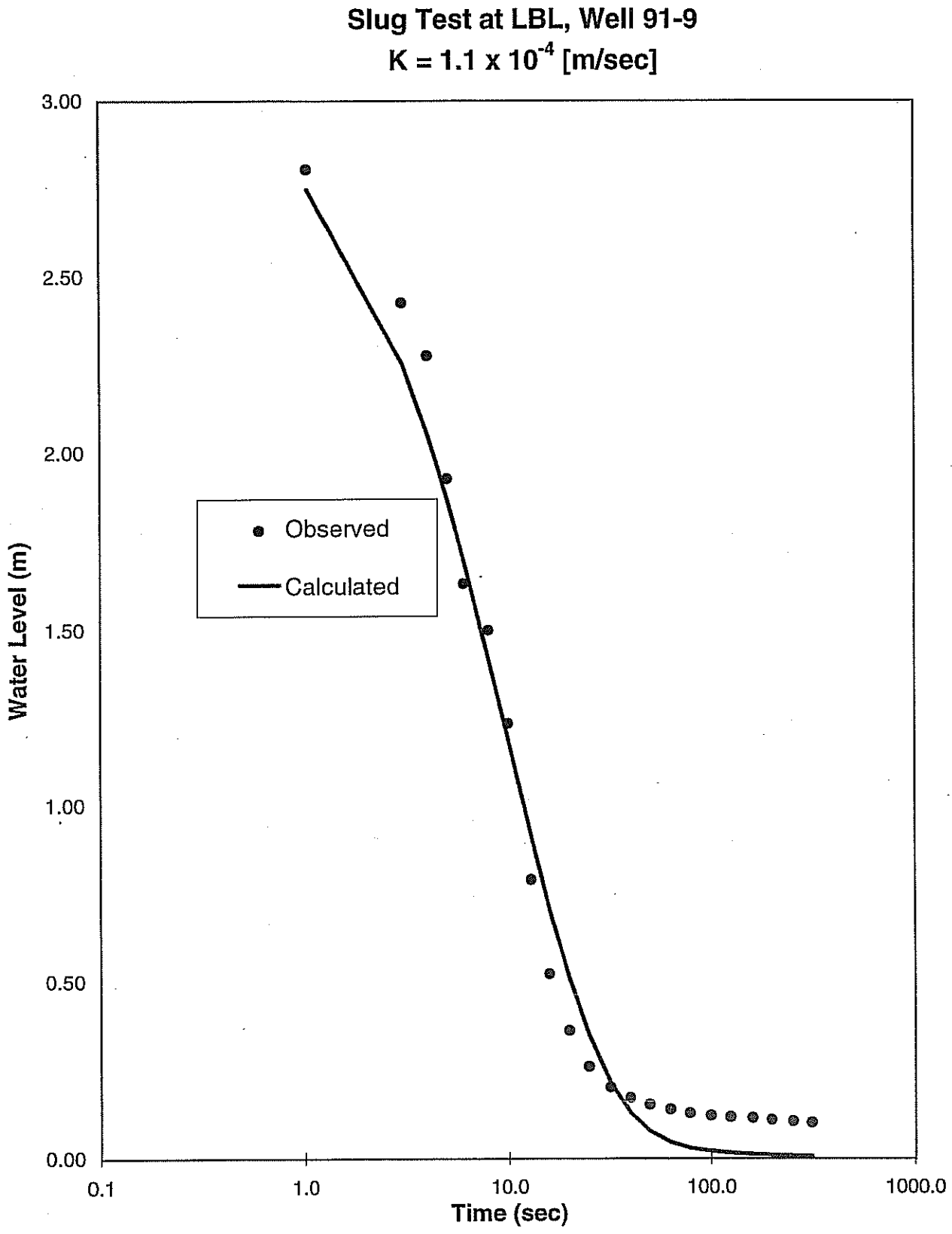

Slug Test at LBL, Well 91-3
K = 1.4 x 10^-6 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

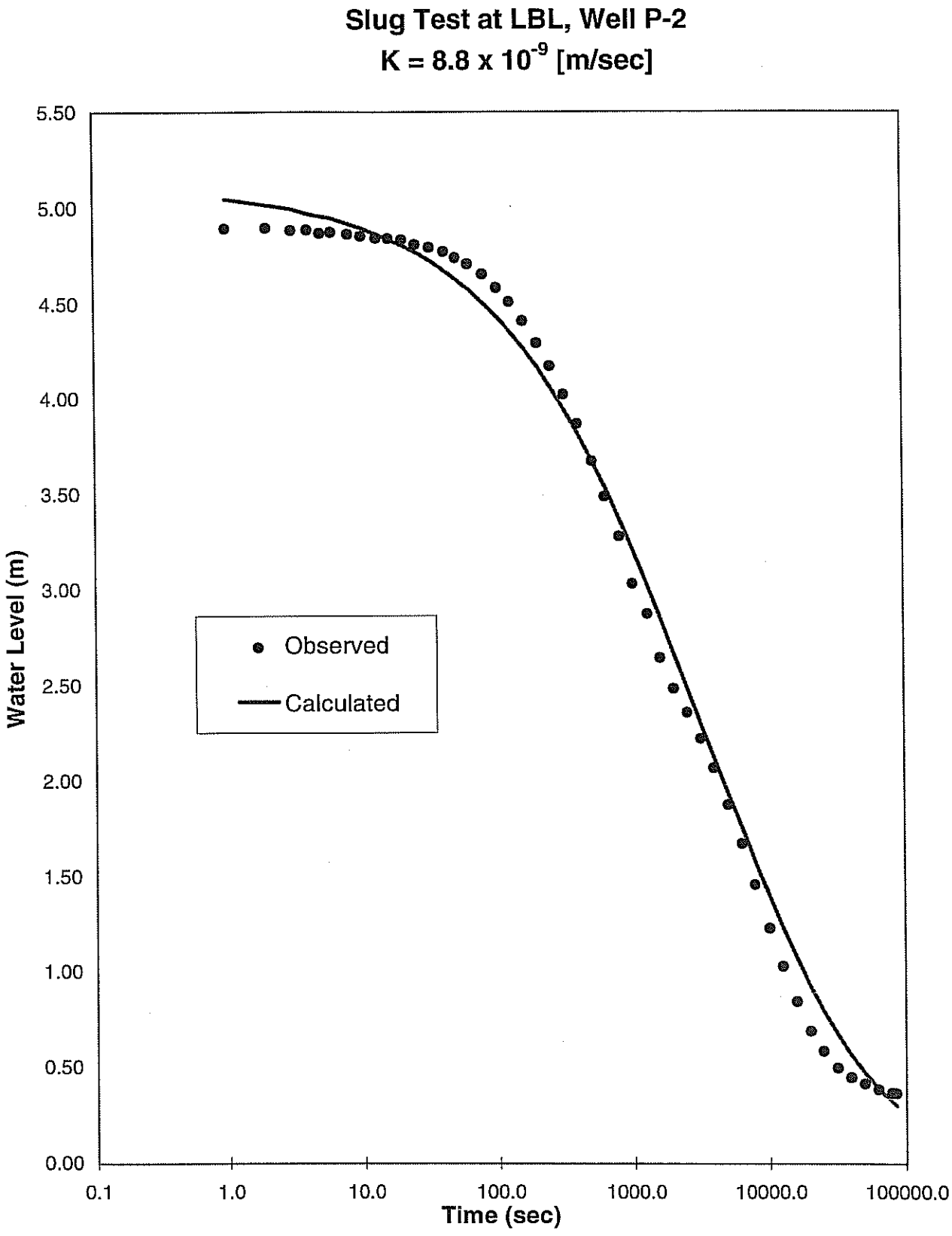

Slug Test at LBL, Well 91-5
K = 1.0 x 10^-9 [m/sec]
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

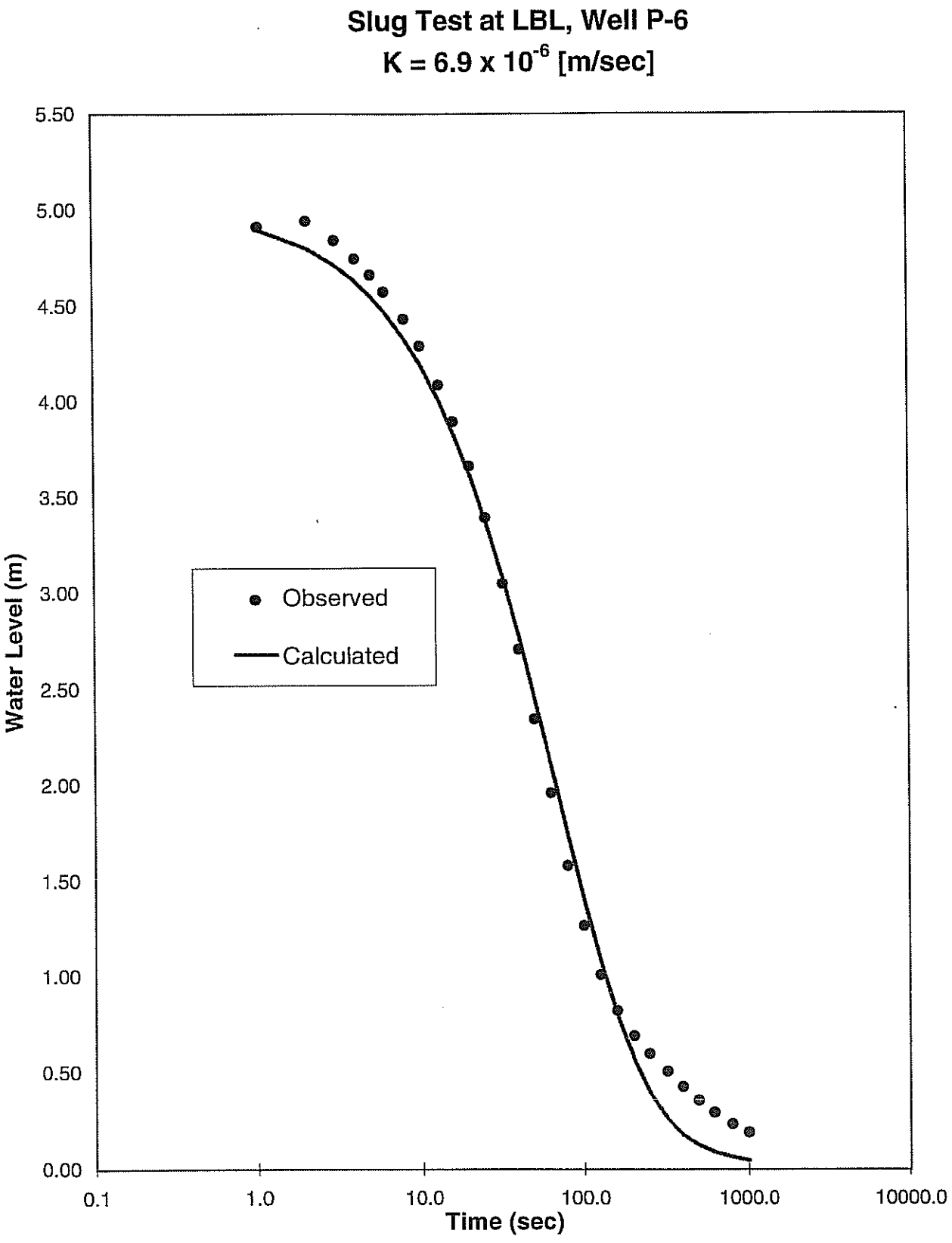

Slug Test at LBL, Well 91-6
K = 6.3 x 10^-6 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

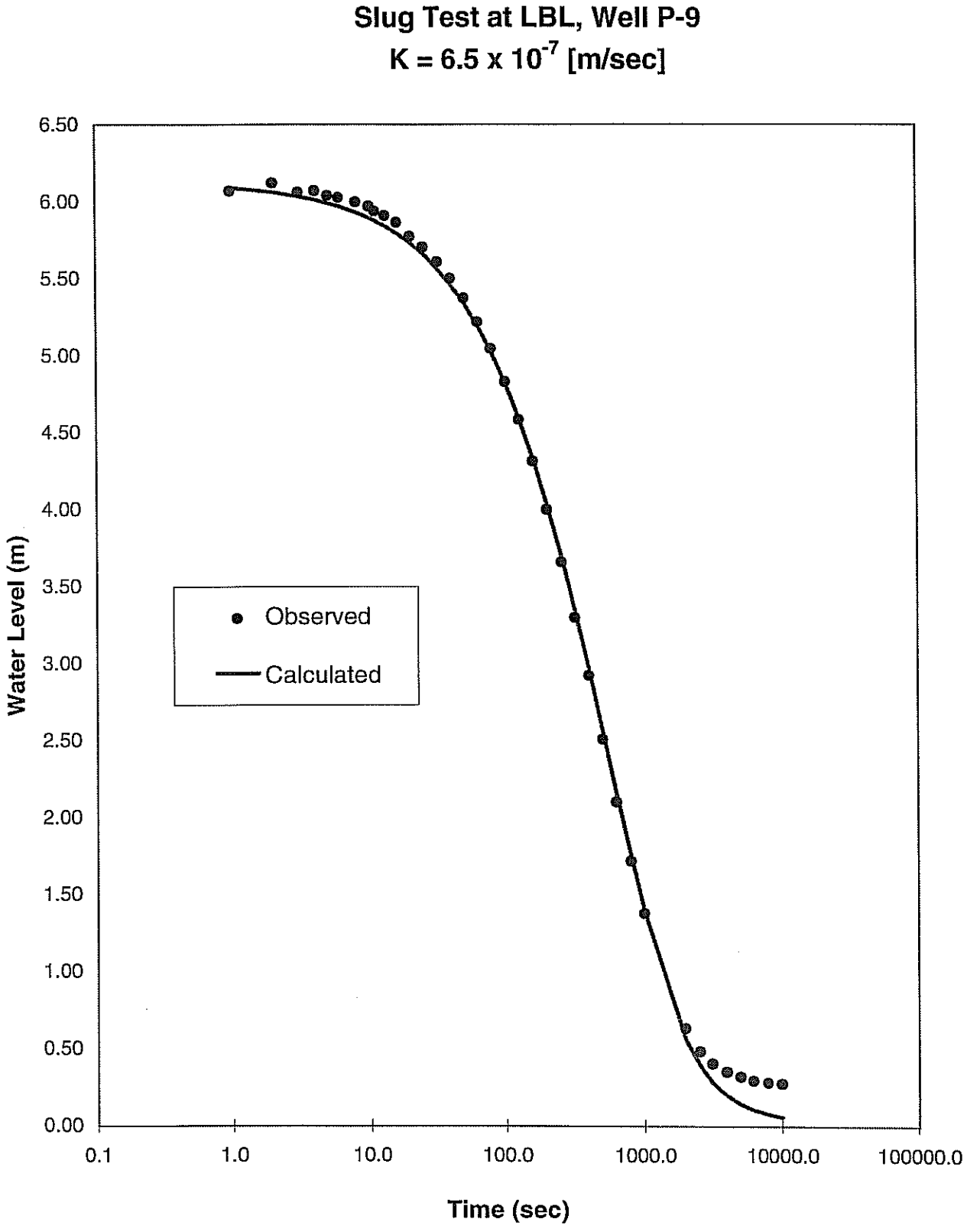

Slug Test at LBL, Well 91-7
K = 8.8 x 10^-7 [m/sec]
Water Level (m)
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)


Slug Test at LBL, Well 91-8
K = 3.3 x 10^-5 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

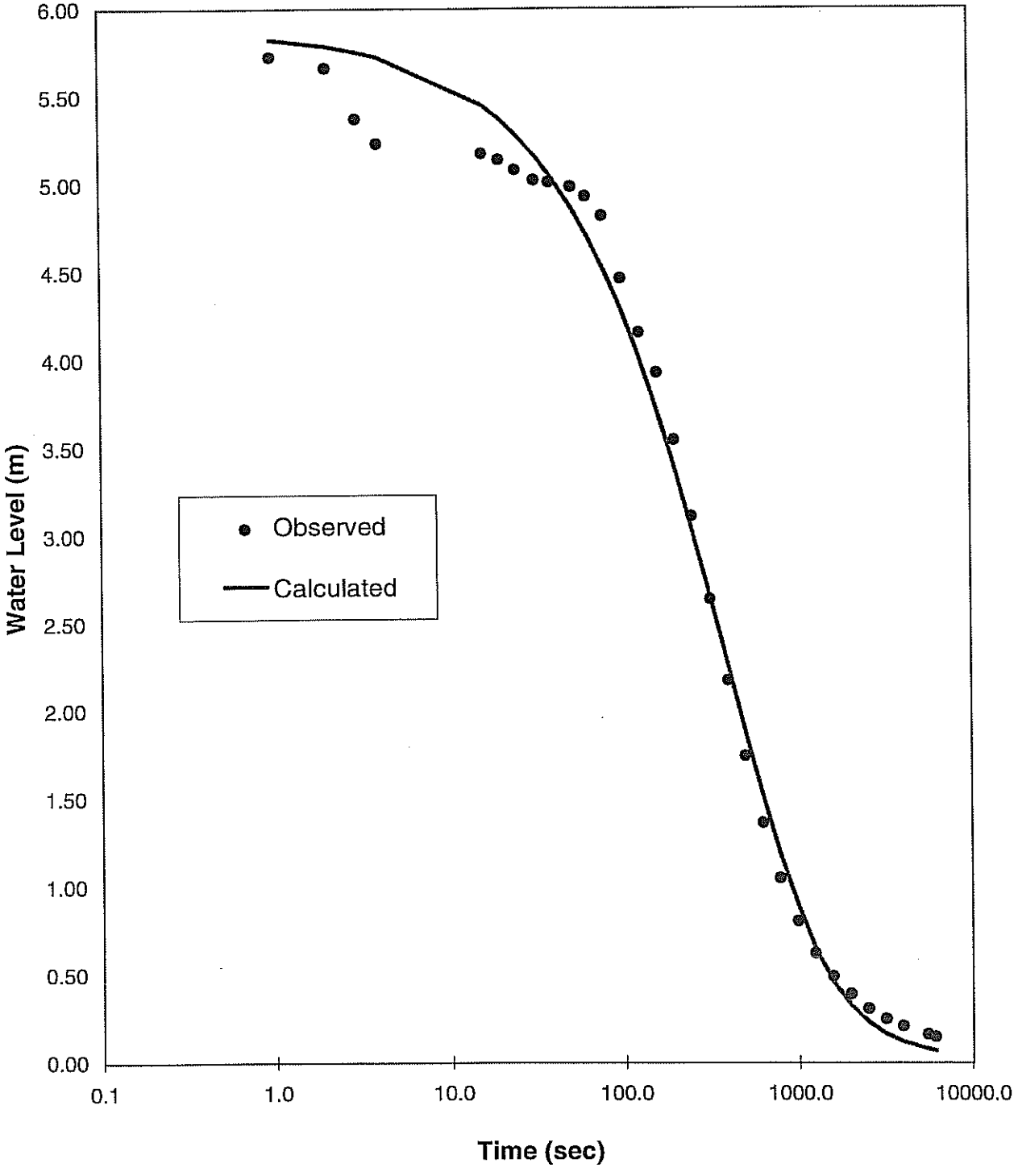

Slug Test at LBL, Well 91-9
K = 1.1 x 10^-4 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

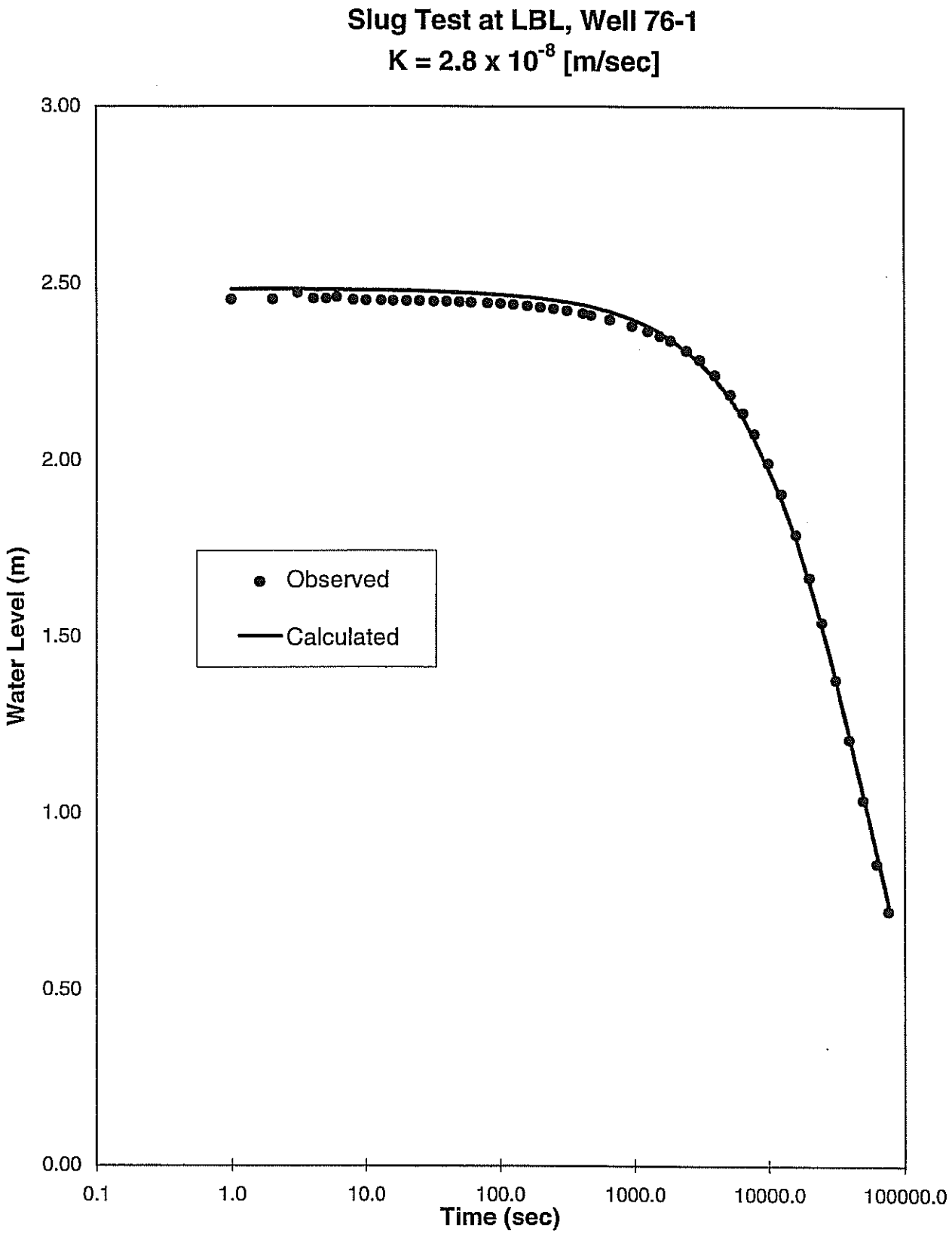

Slug Test at LBL, Well P-2
K = 8.8 x 10^-9 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

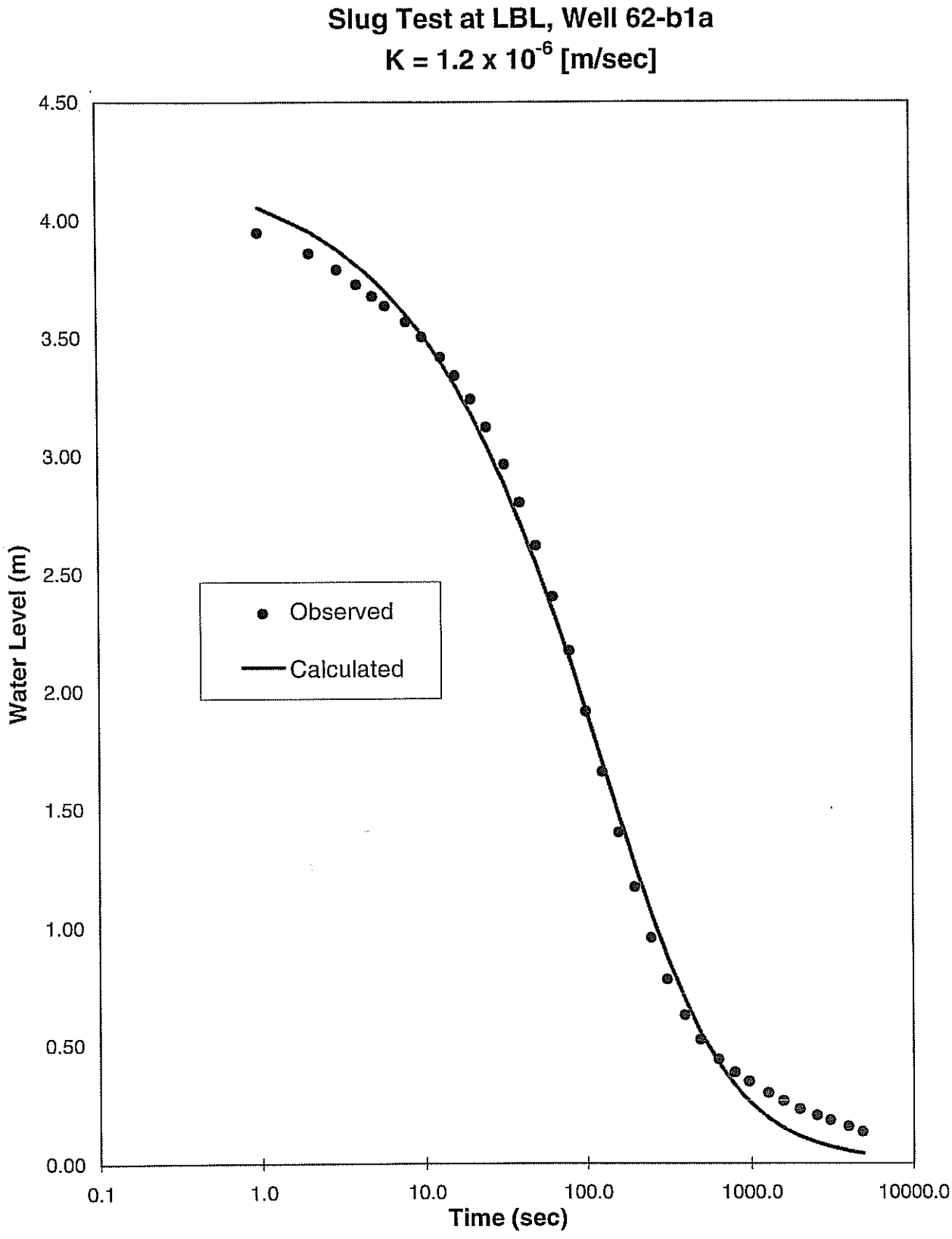

Slug Test at LBL, Well P-6
K = 6.9 x 10^-6 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

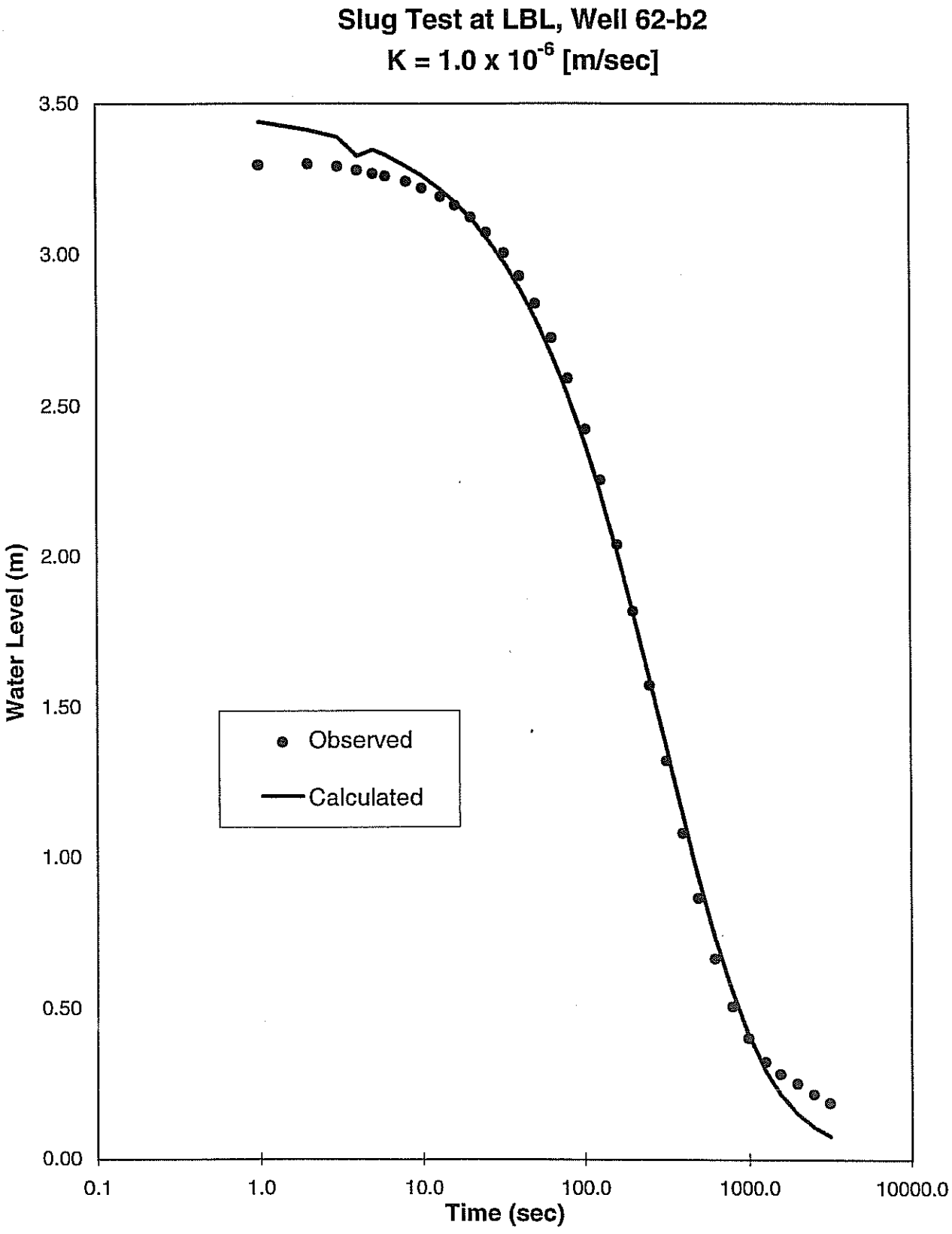

Slug Test at LBL, Well P-9
K = 6.5 x 10^-7 [m/sec]
Water Level (m)
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

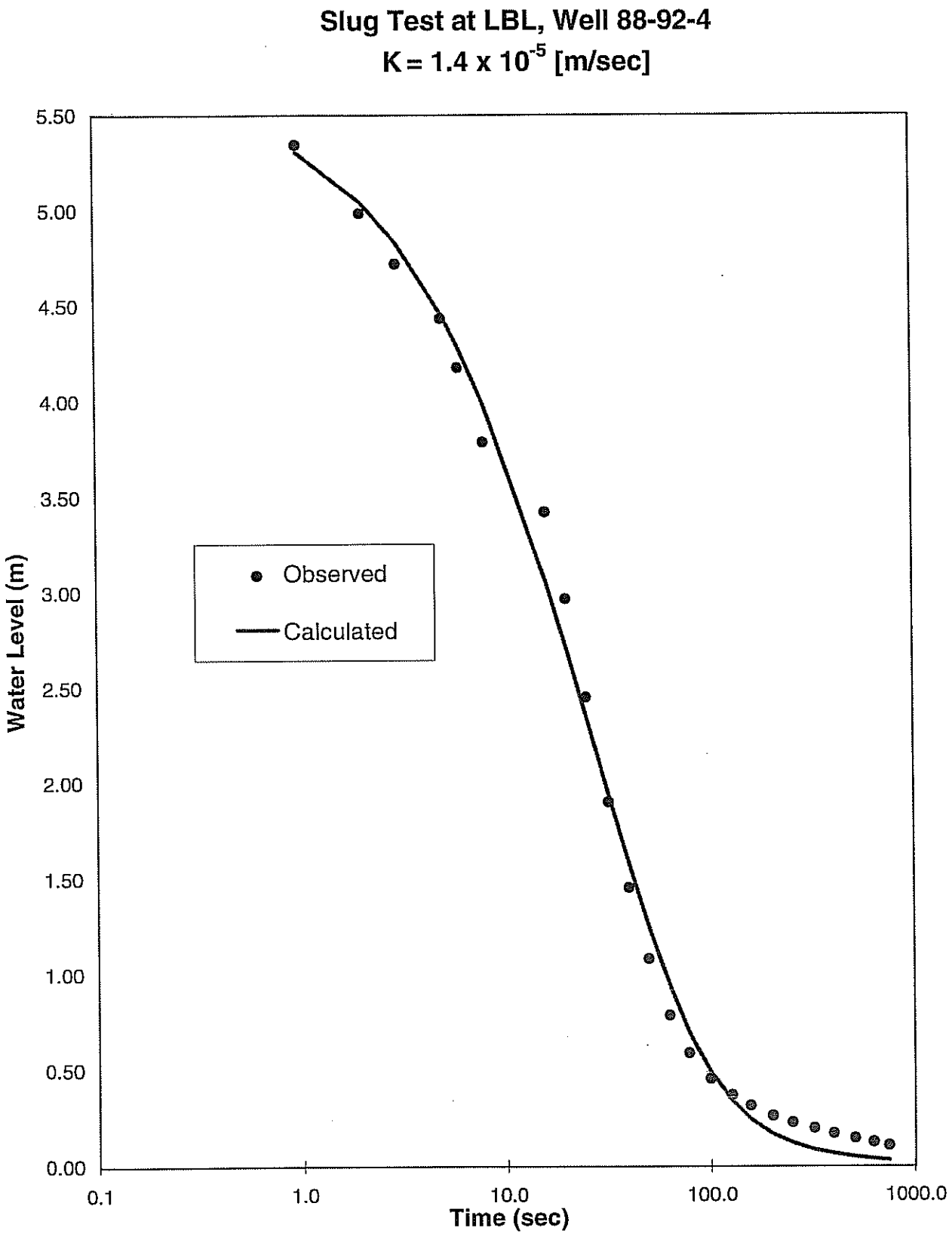
Slug Test at LBL, Well P-10
K = 9.0 x 10^{-7} [m/sec]

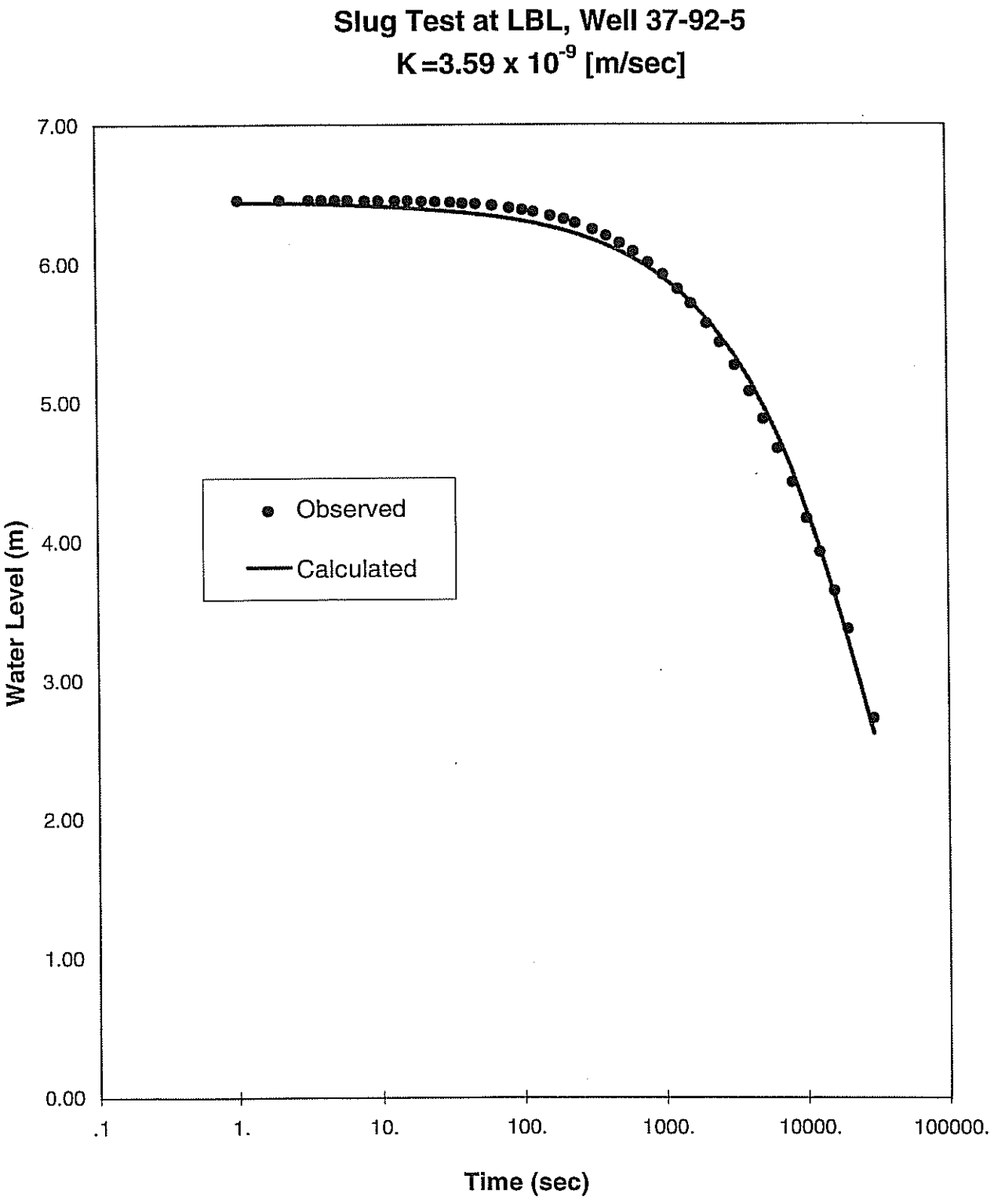


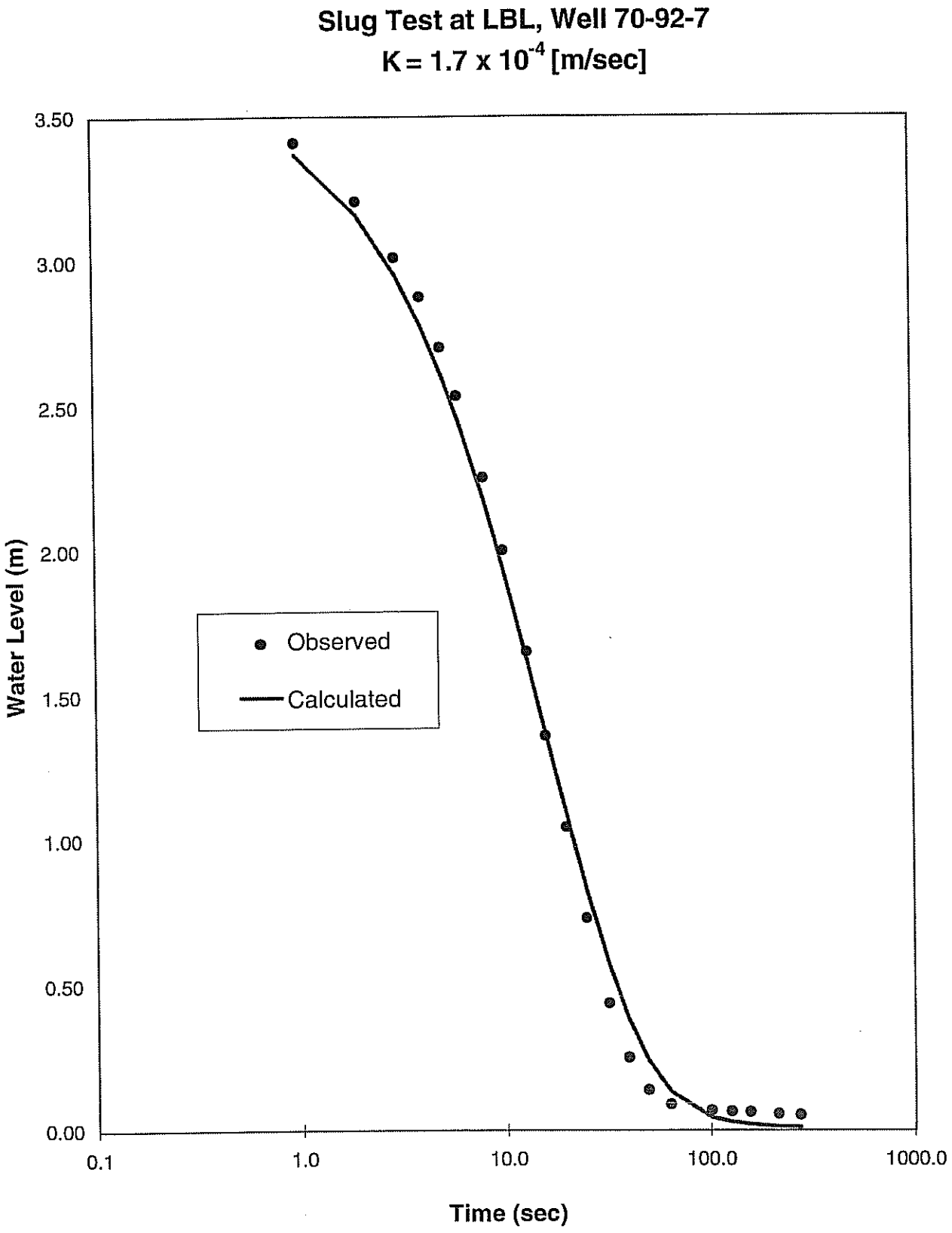

Slug Test at LBL, Well 76-1
K = 2.8 x 10^-8 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

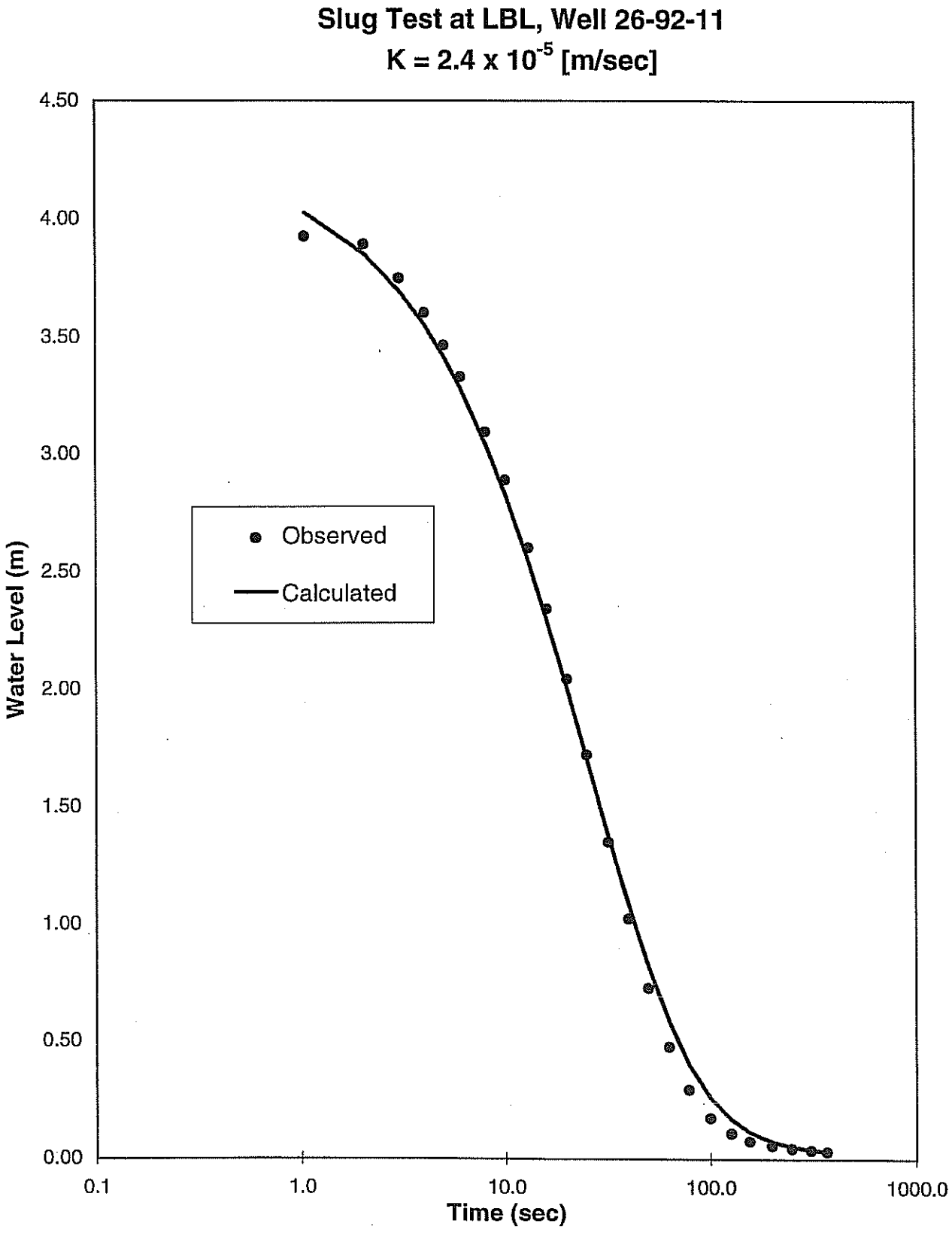

Slug Test at LBL, Well 62-b1a
K = 1.2 x 10^-6 [m/sec]
Water Level (m)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

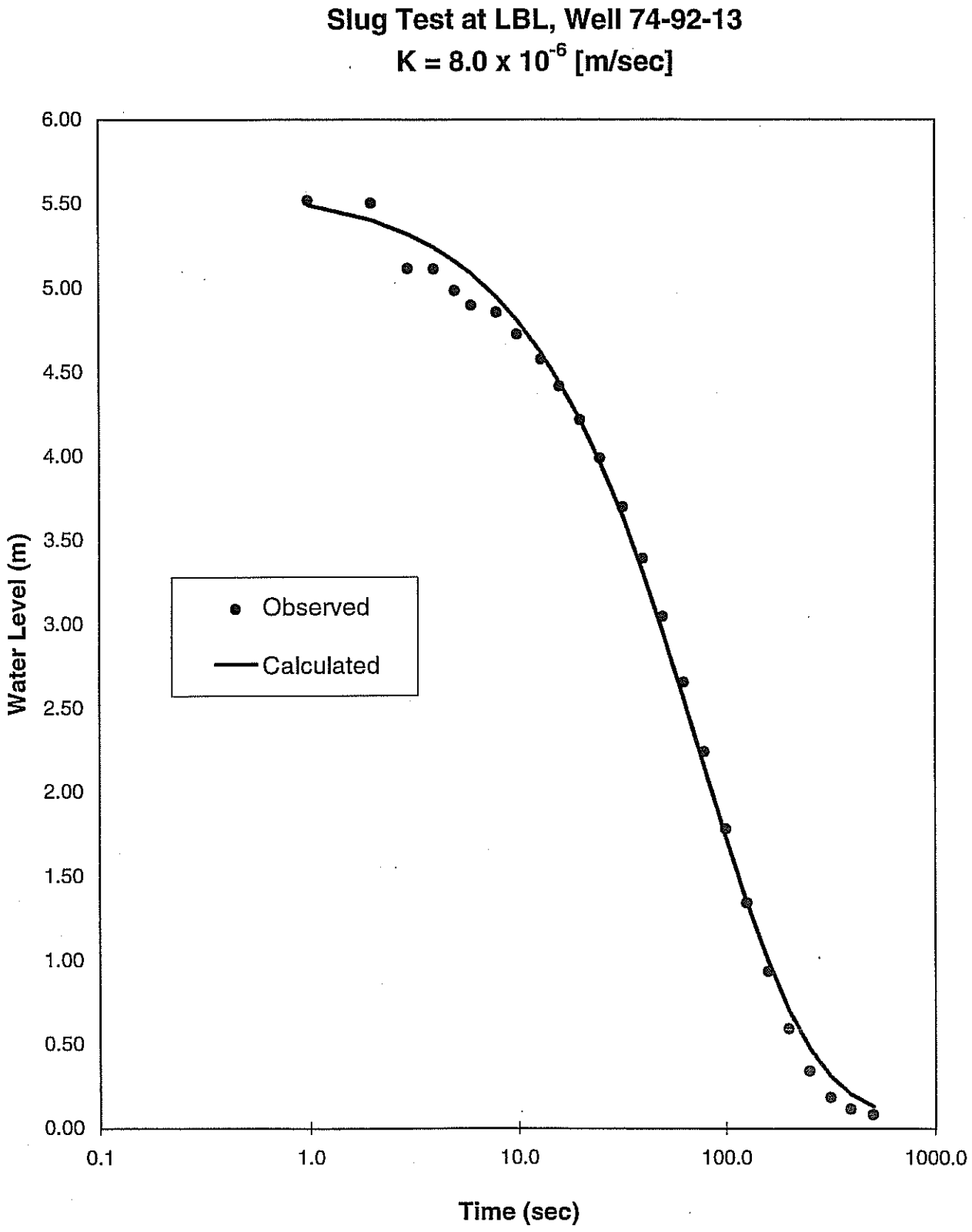

Slug Test at LBL, Well 62-b2
K = 1.0 x 10^-6 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

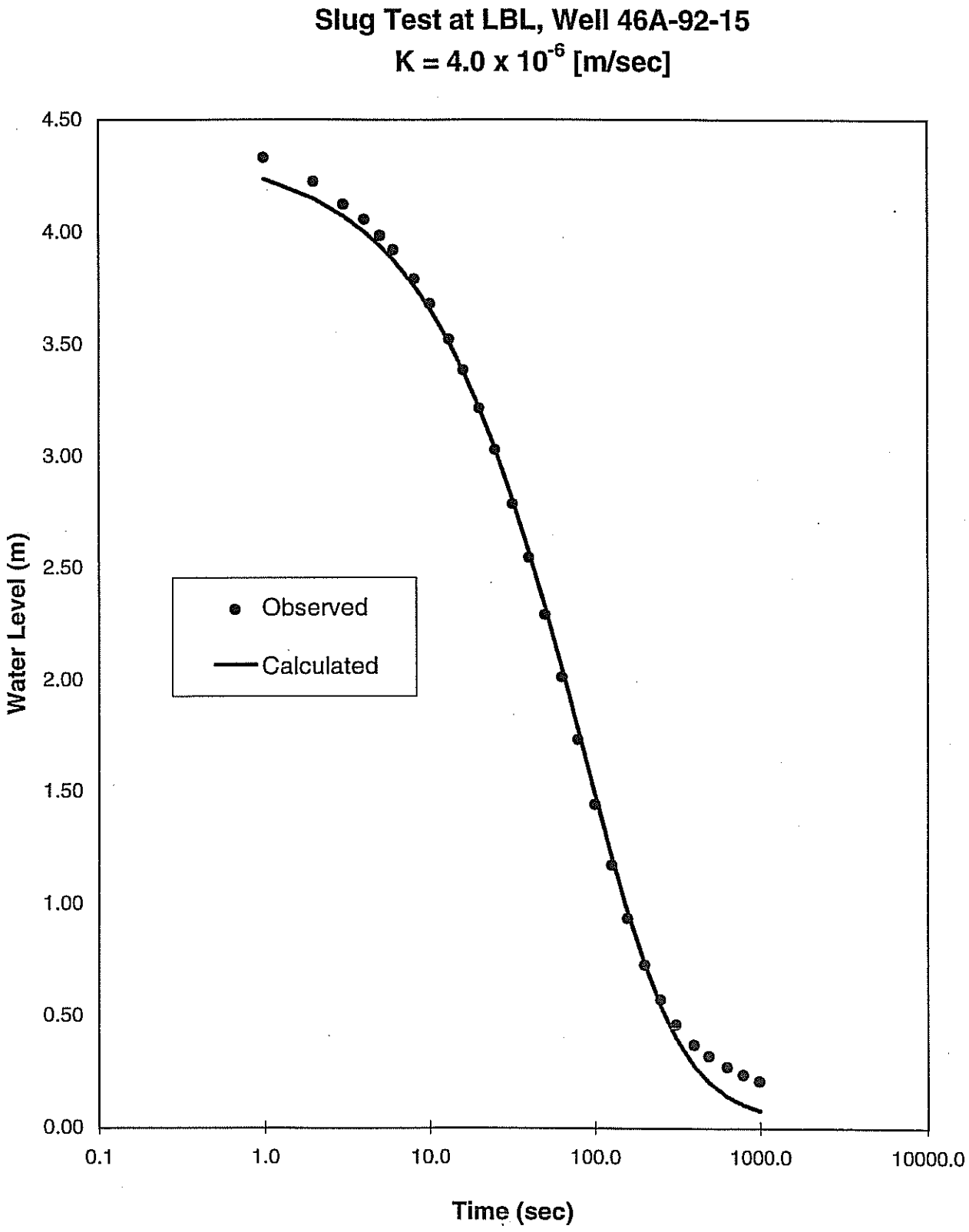

Slug Test at LBL, Well 88-92-4
K = 1.4 x 10^-5 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

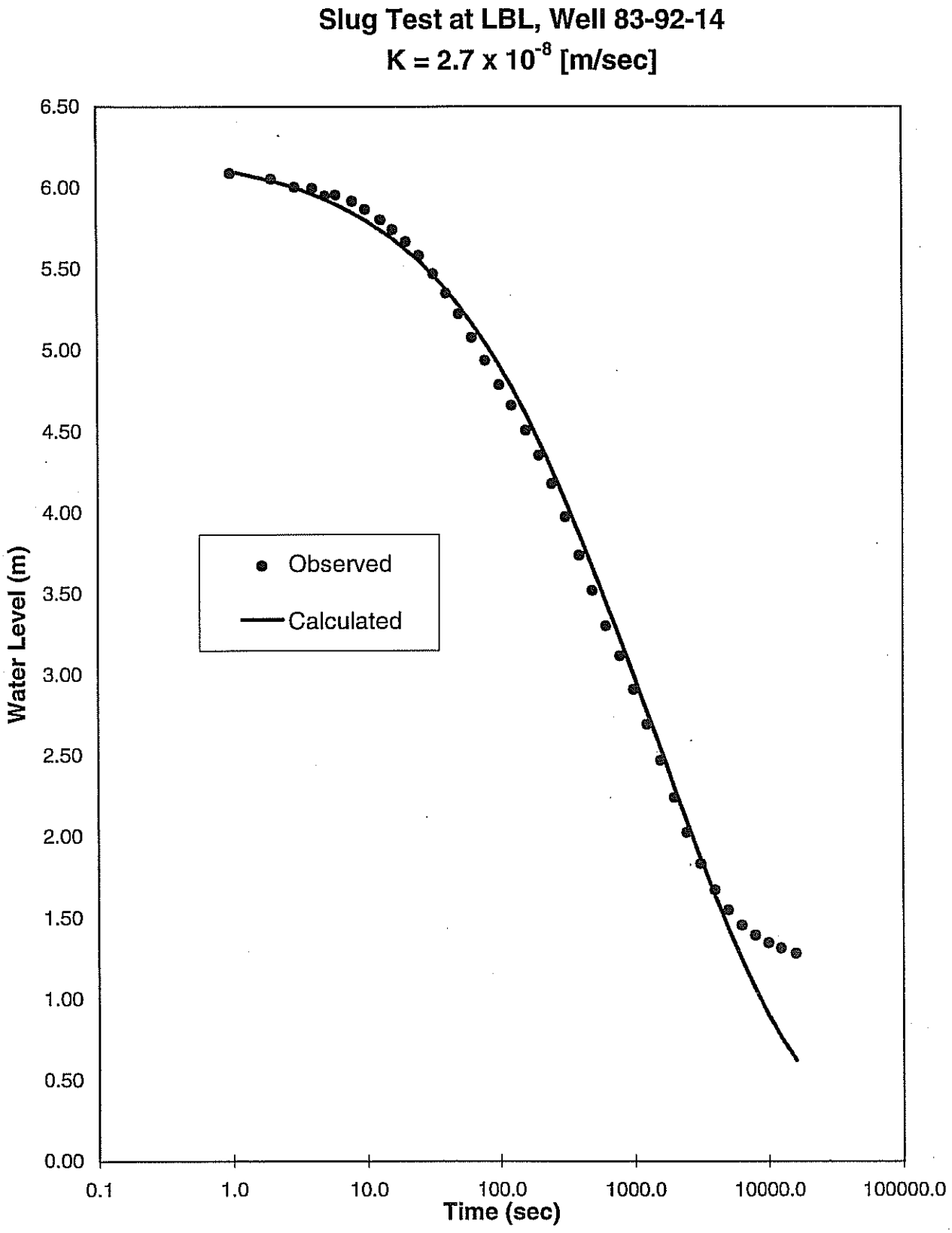

Slug Test at LBL, Well 37-92-5
K =3.59 x 10^-9 [m/sec]
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Water Level (m)
Observed
Calculated
.1
1.
10.
100.
1000.
10000.
100000.
Time (sec)

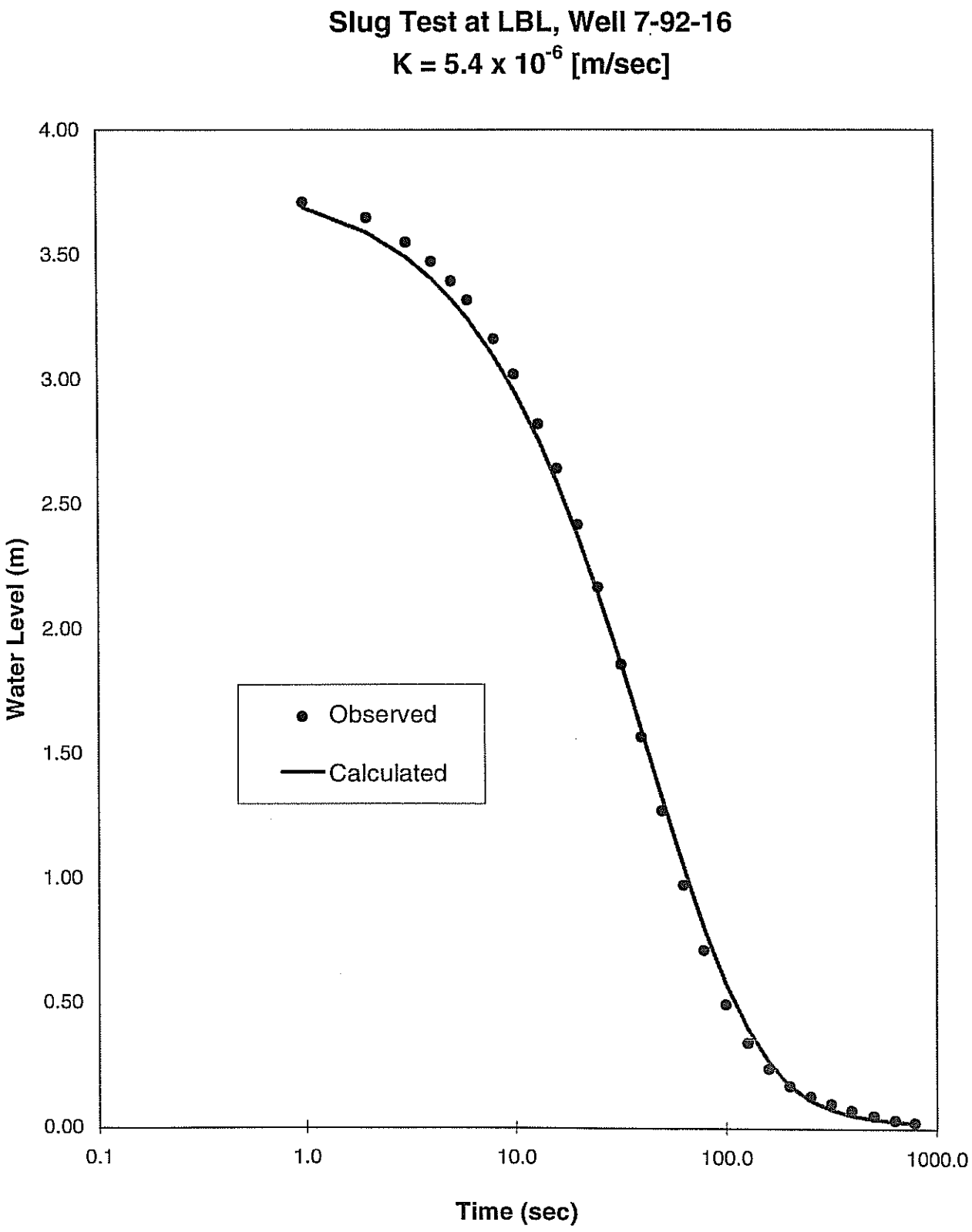

Slug Test at LBL, Well 70-92-7
K = 1.7 x 10^-4 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

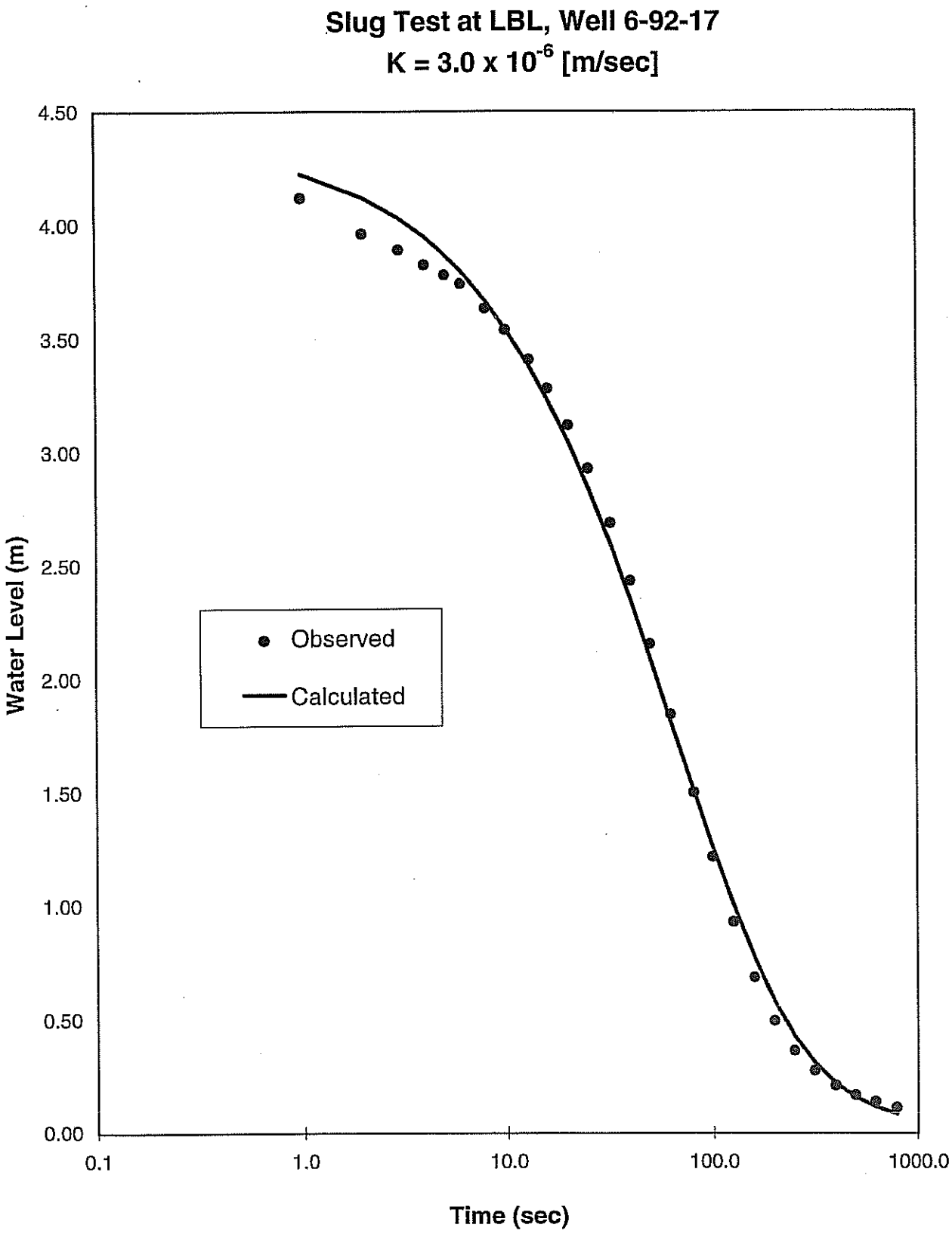

Slug Test at LBL, Well 26-92-11
K = 2.4 x 10^-5 [m/sec]
Water Level (m)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

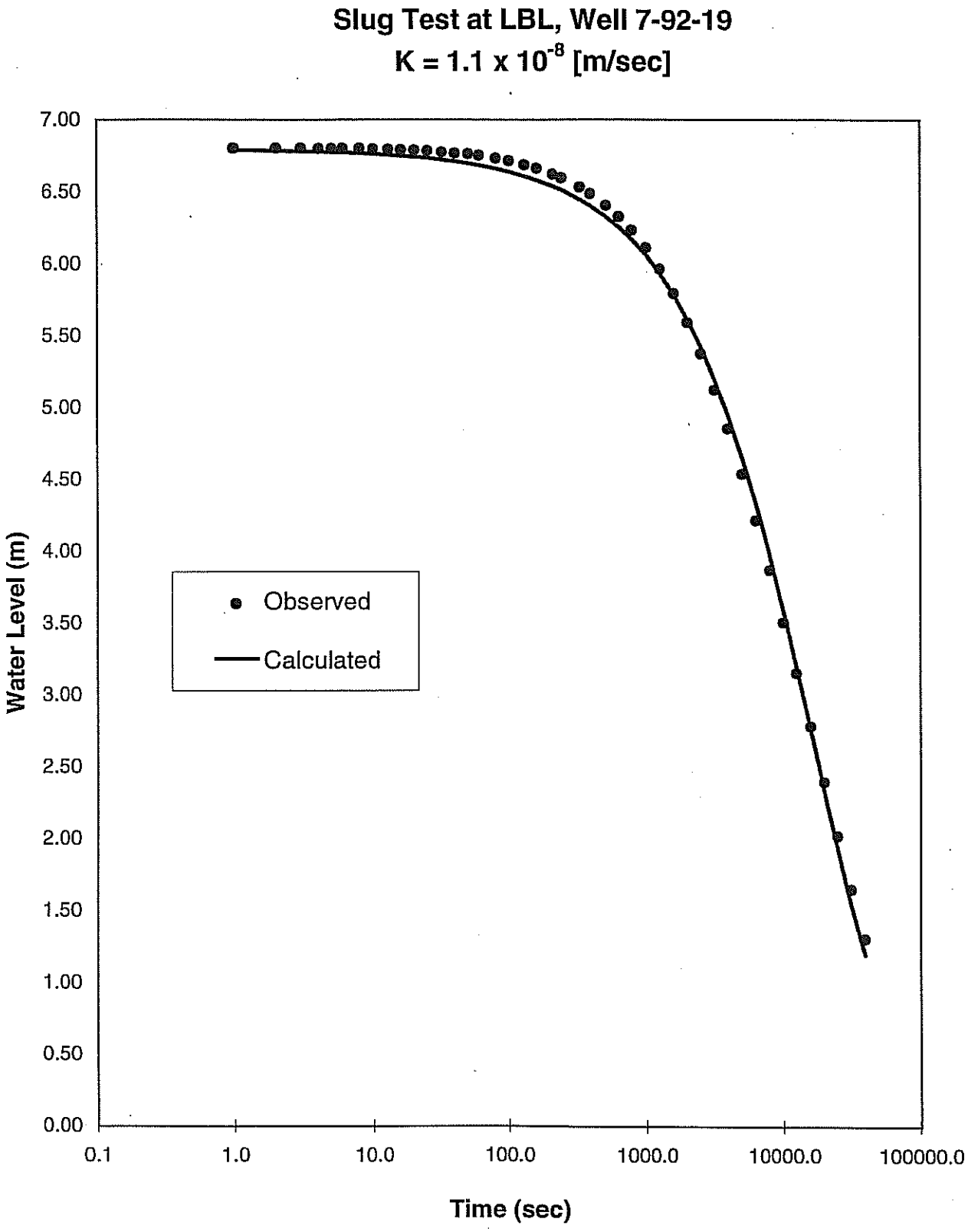

Slug Test at LBL, Well 74-92-13
K = 8.0 x 10^-6 [m/sec]
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

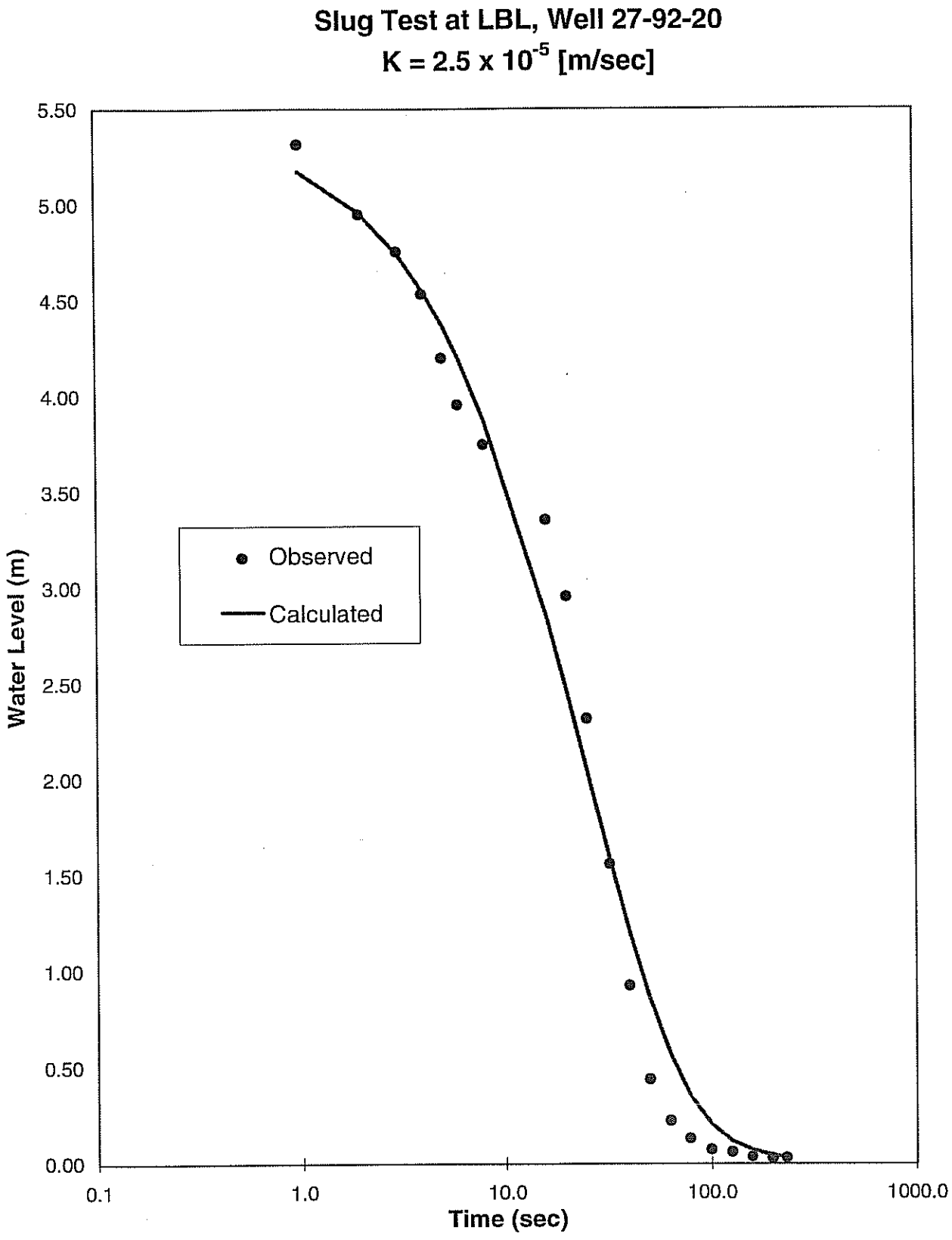

Slug Test at LBL, Well 46A-92-15
K = 4.0 x 10^-6 [m/sec]
Water Level (m)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

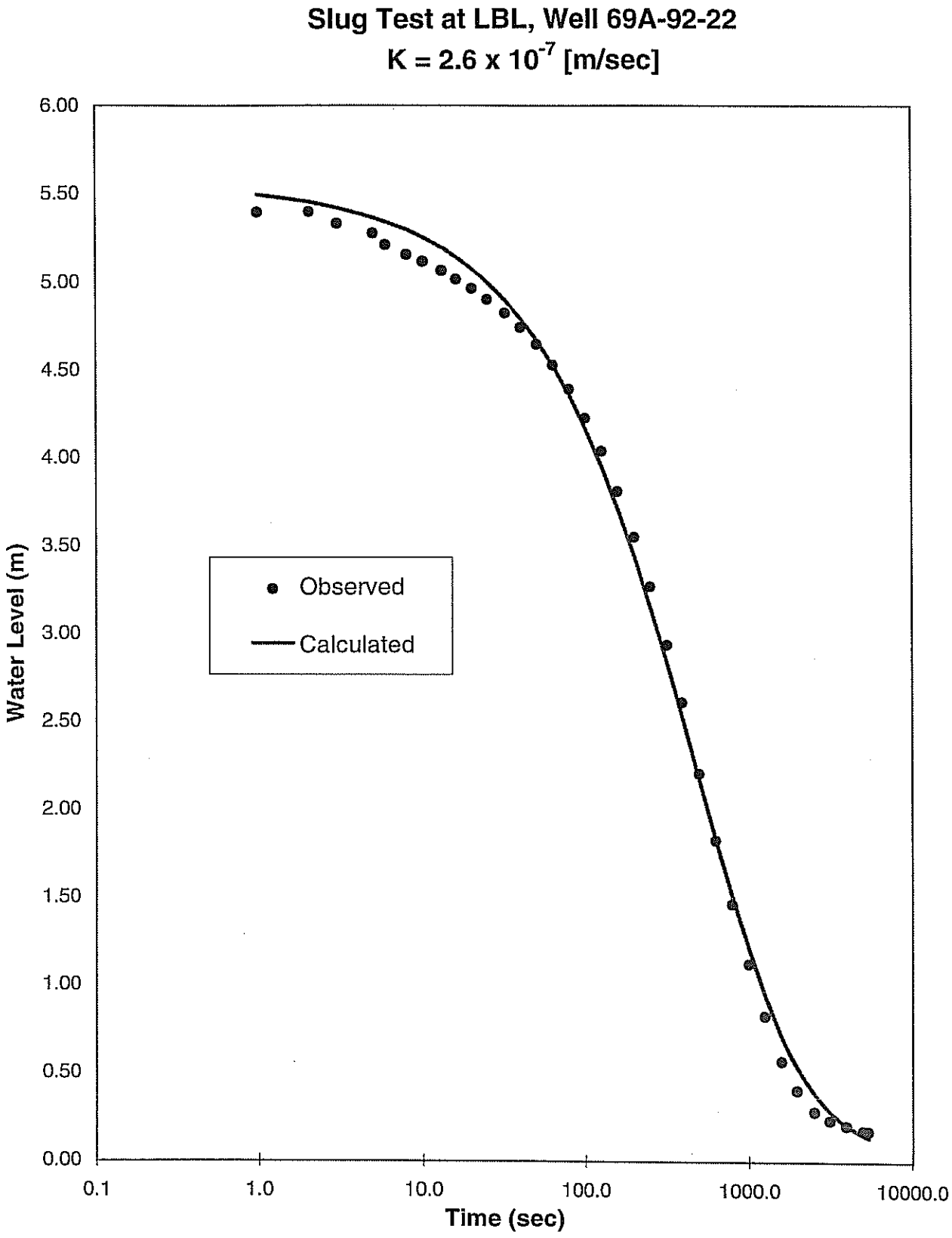

Slug Test at LBL, Well 83-92-14
K = 2.7 x 10^-8 [m/sec]
Water Level (m)
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

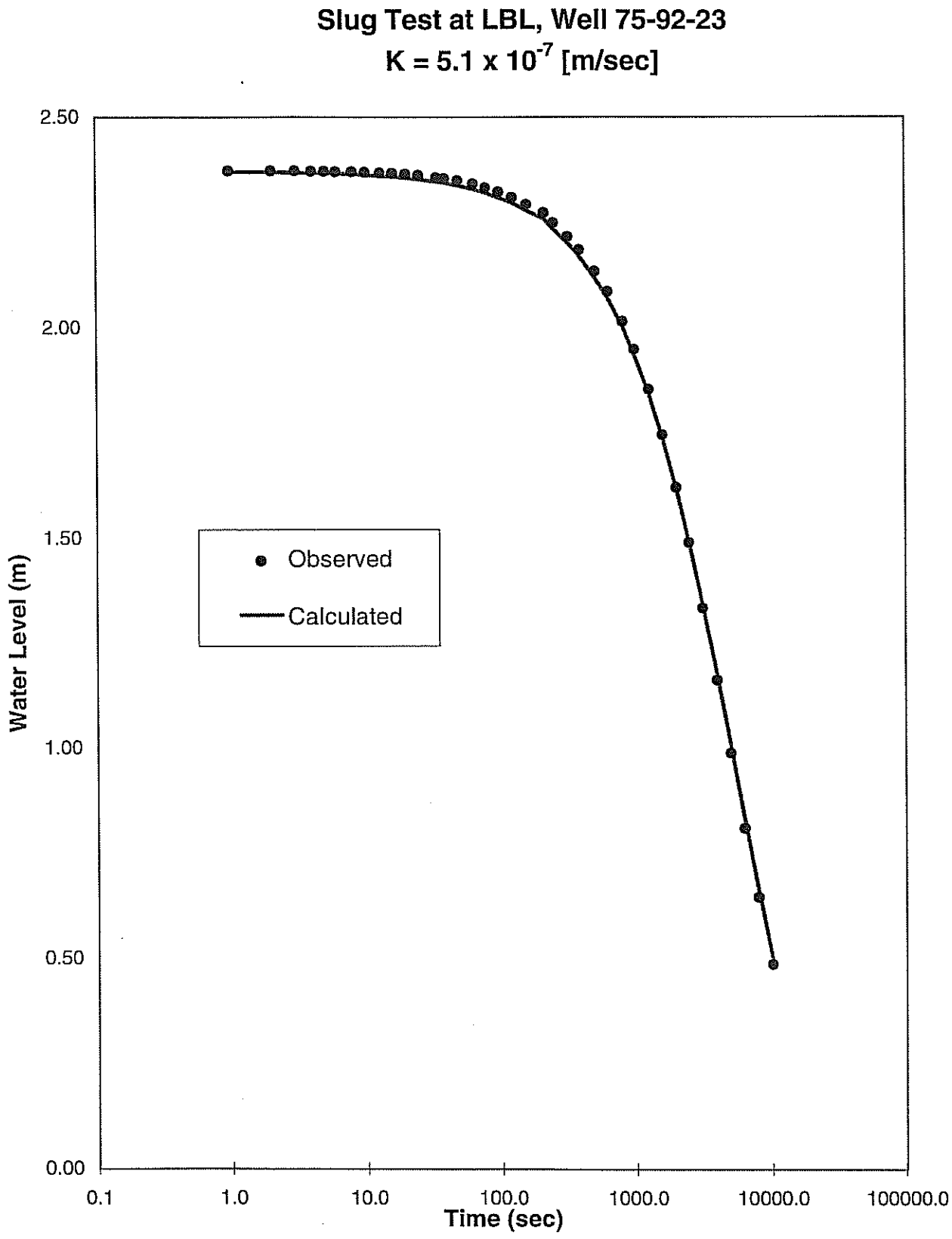

Slug Test at LBL, Well 7-92-16
K = 5.4 x 10^-6 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

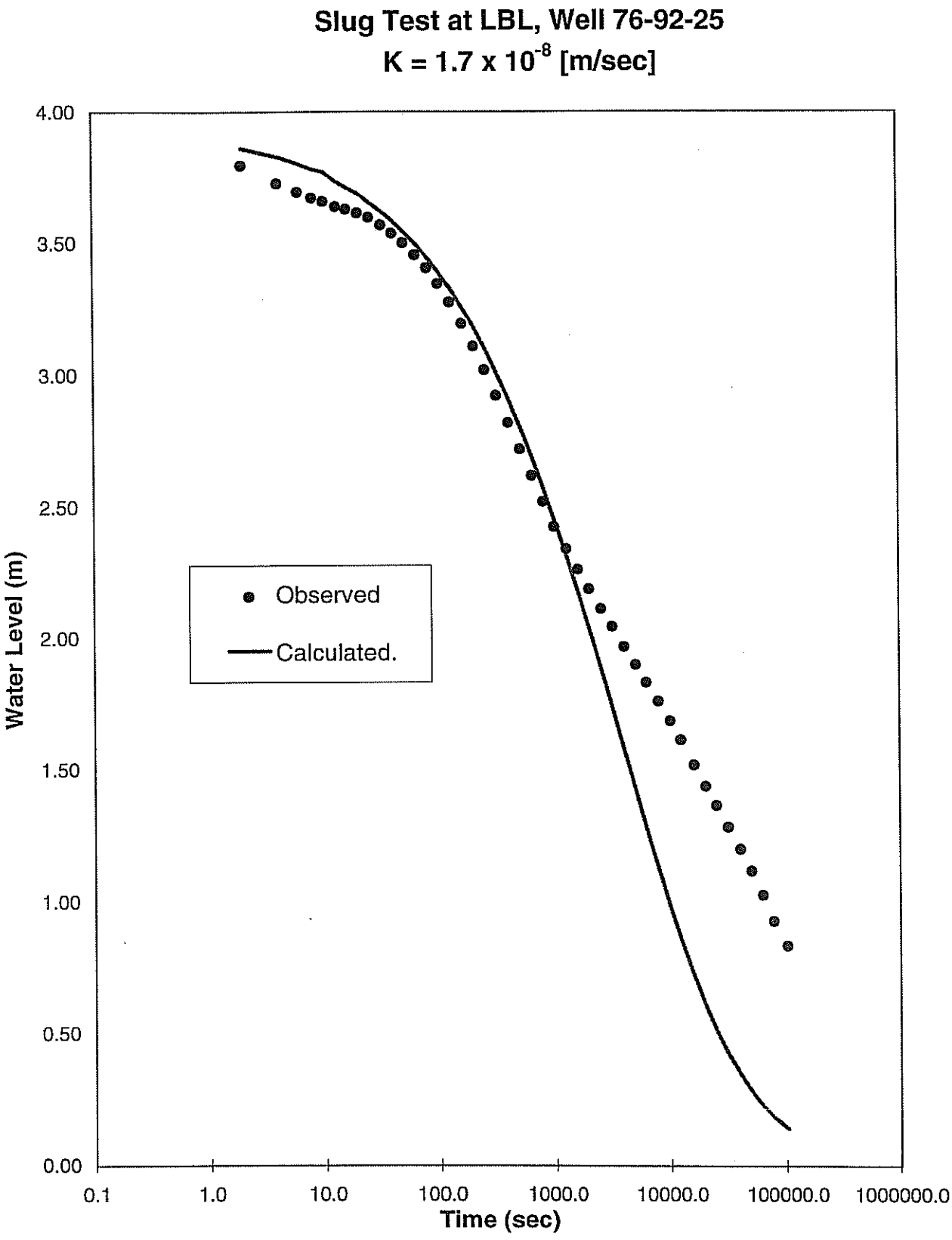

Slug Test at LBL, Well 6-92-17
K = 3.0 x 10^-6 [m/sec]
Water Level (m)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
Time (sec)
Observed
Calculated


Slug Test at LBL, Well 7-92-19
K = 1.1 x 10^-8 [m/sec]
Water Level (m)
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

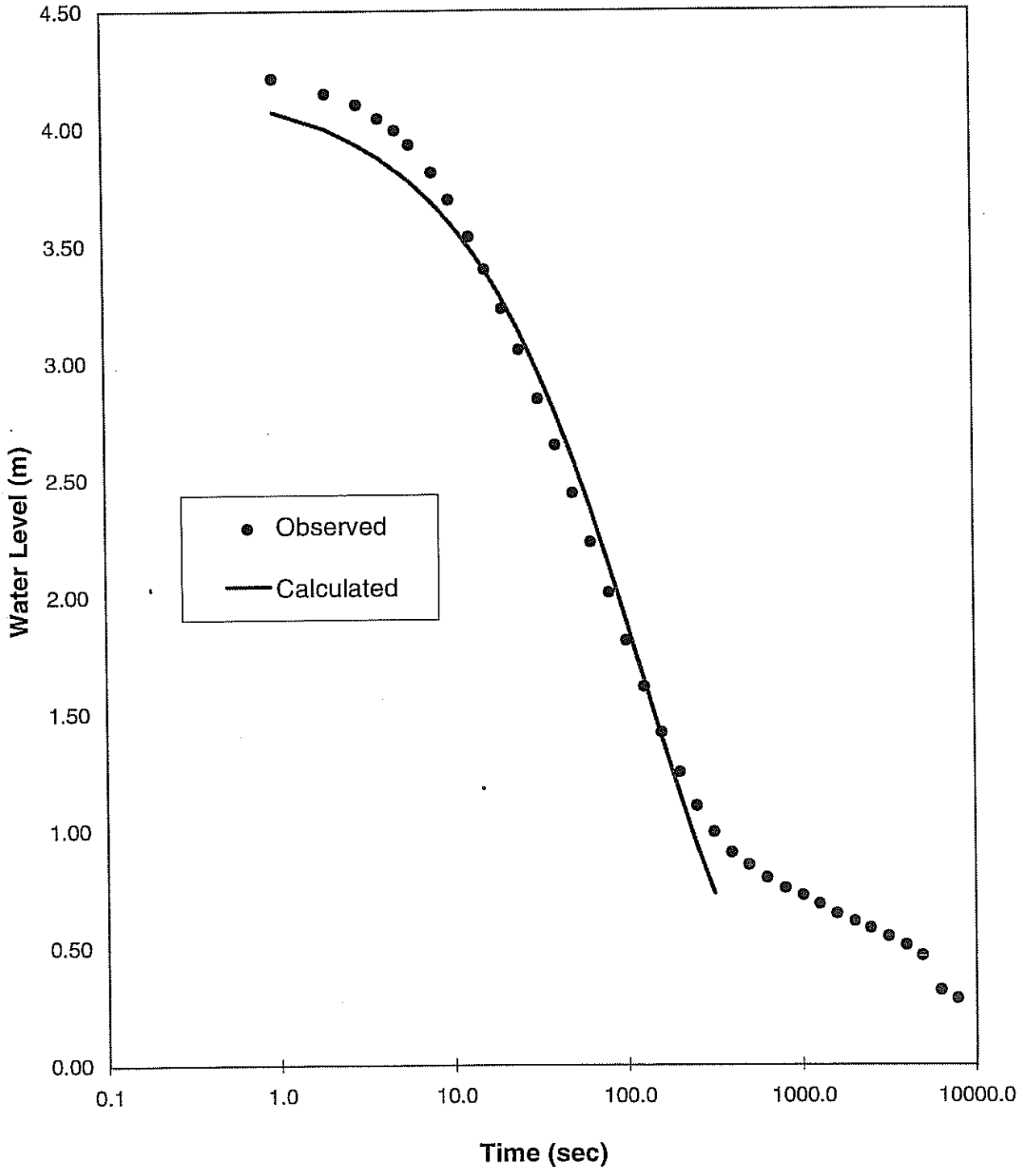

Slug Test at LBL, Well 27-92-20
K = 2.5 x 10^-5 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

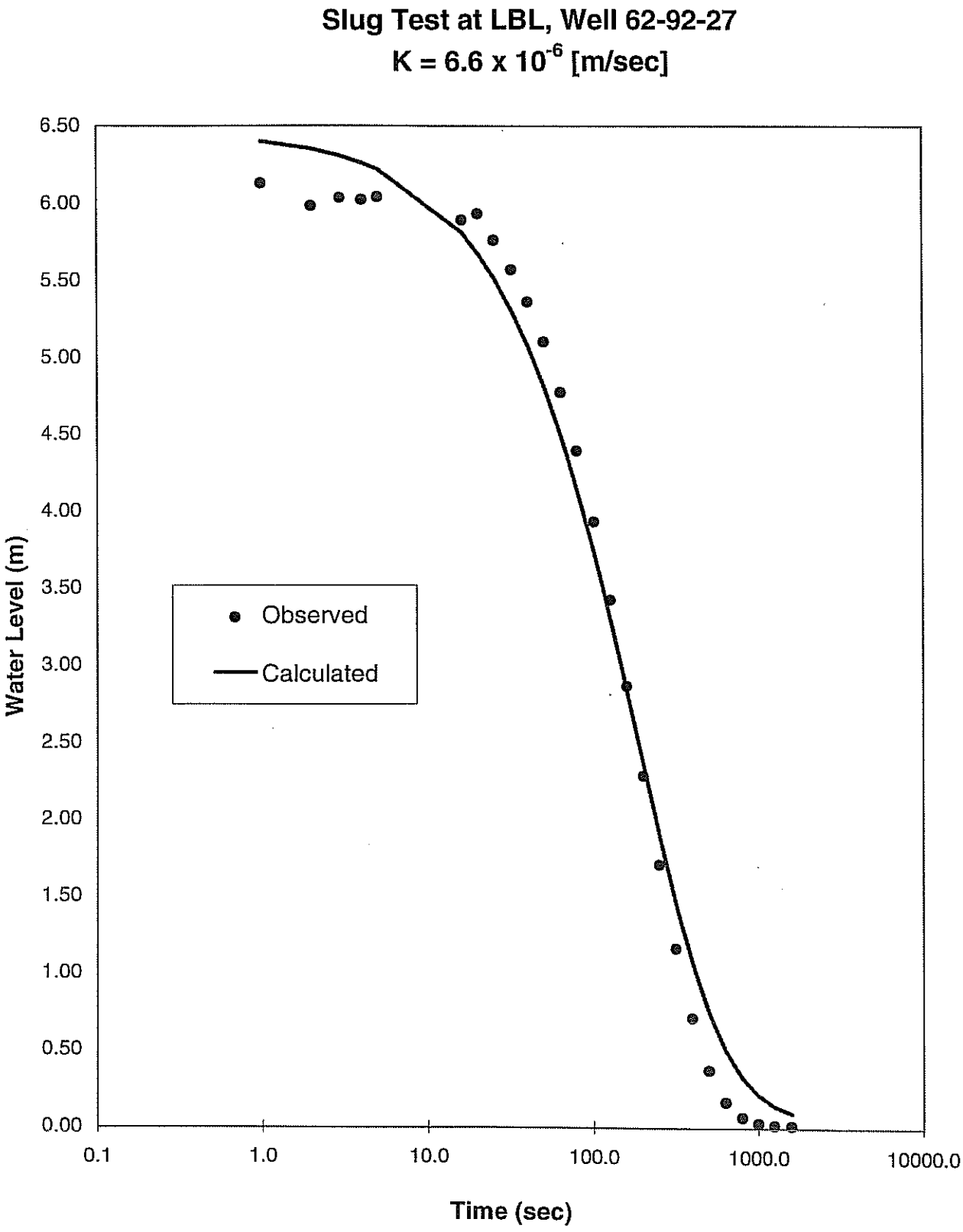

Slug Test at LBL, Well 69A-92-22
K = 2.6 x 10^-7 [m/sec]
Water Level (m)
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)


Slug Test at LBL, Well 75-92-23
K = 5.1 x 10^-7 [m/sec]
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

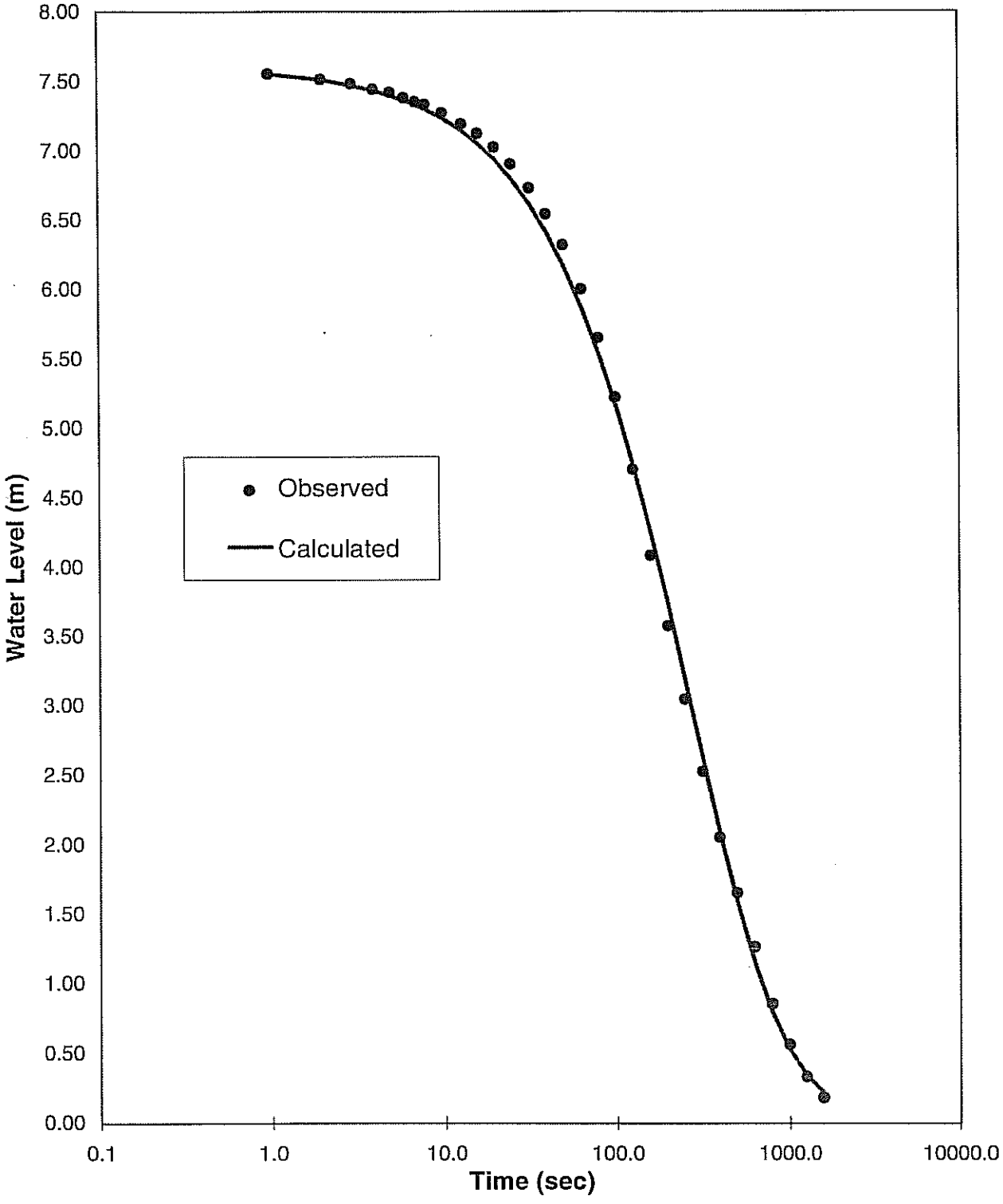

Slug Test at LBL, Well 76-92-25
K = 1.7 x 10^-8 [m/sec]
Water Level (m)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated.
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

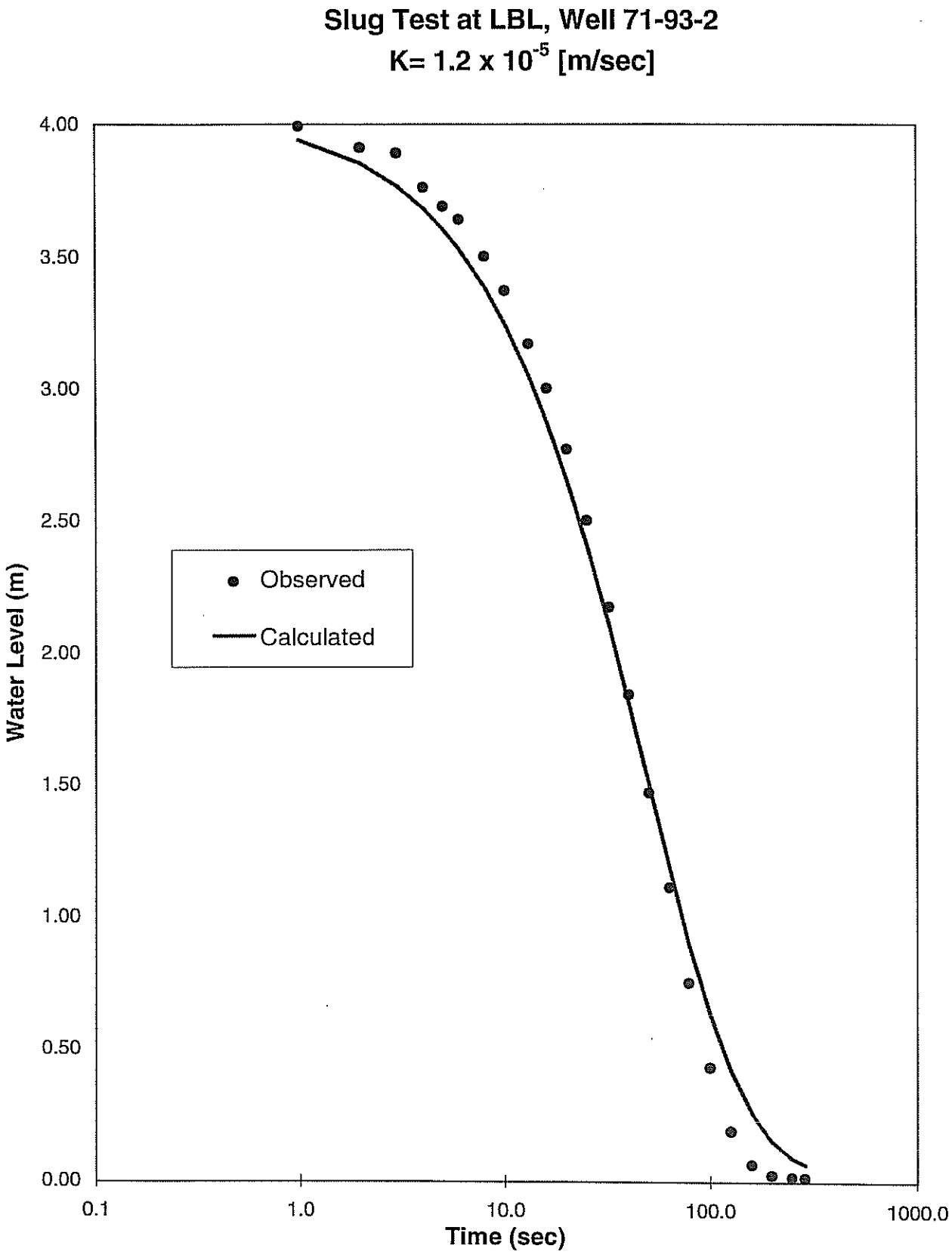
Slug Test at LBL, Well 62-92-26
K = 2.0 x 10^{-6} [m/sec]

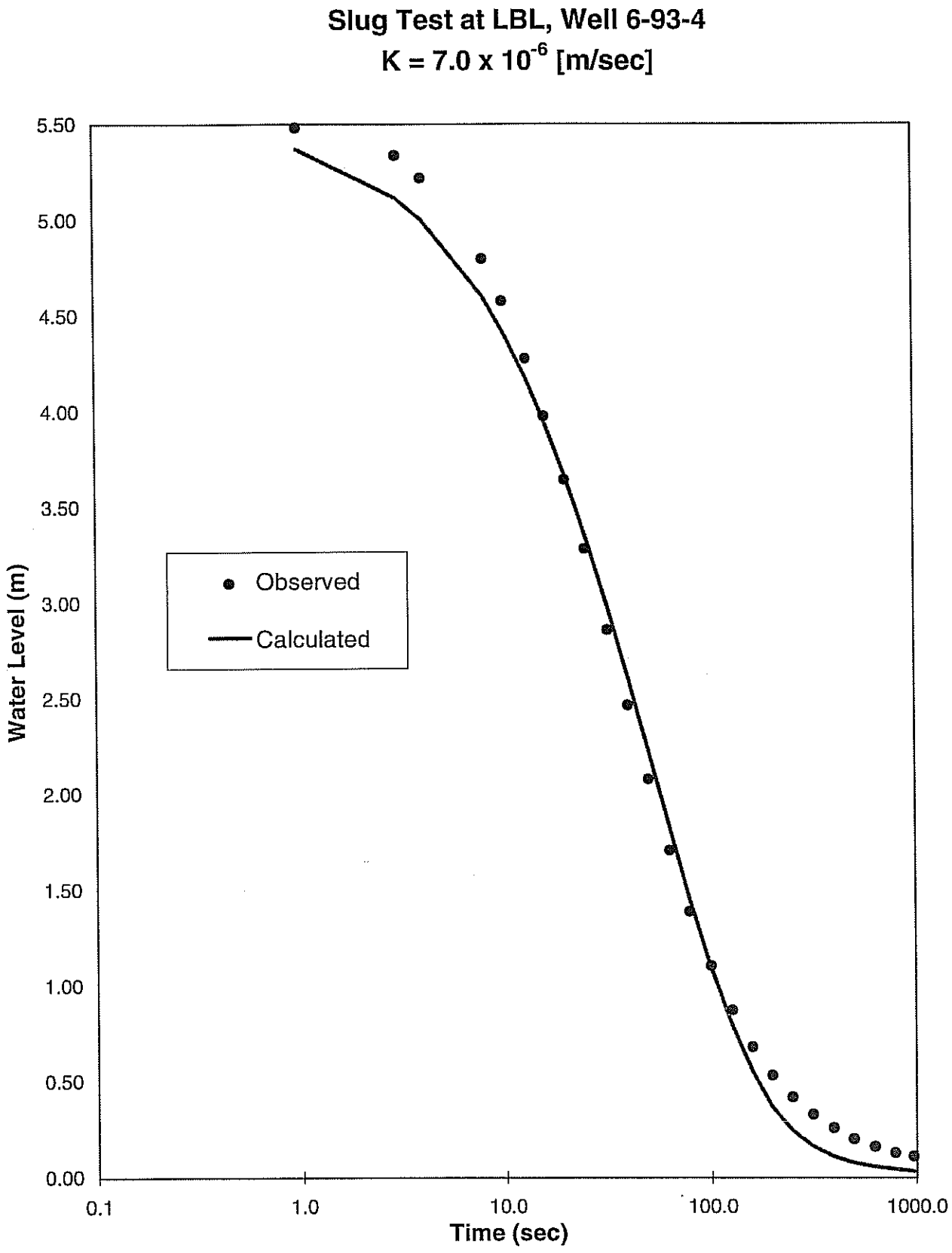



Slug Test at LBL, Well 62-92-27
K = 6.6 x 10^-6 [m/sec]
Water Level (m)
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

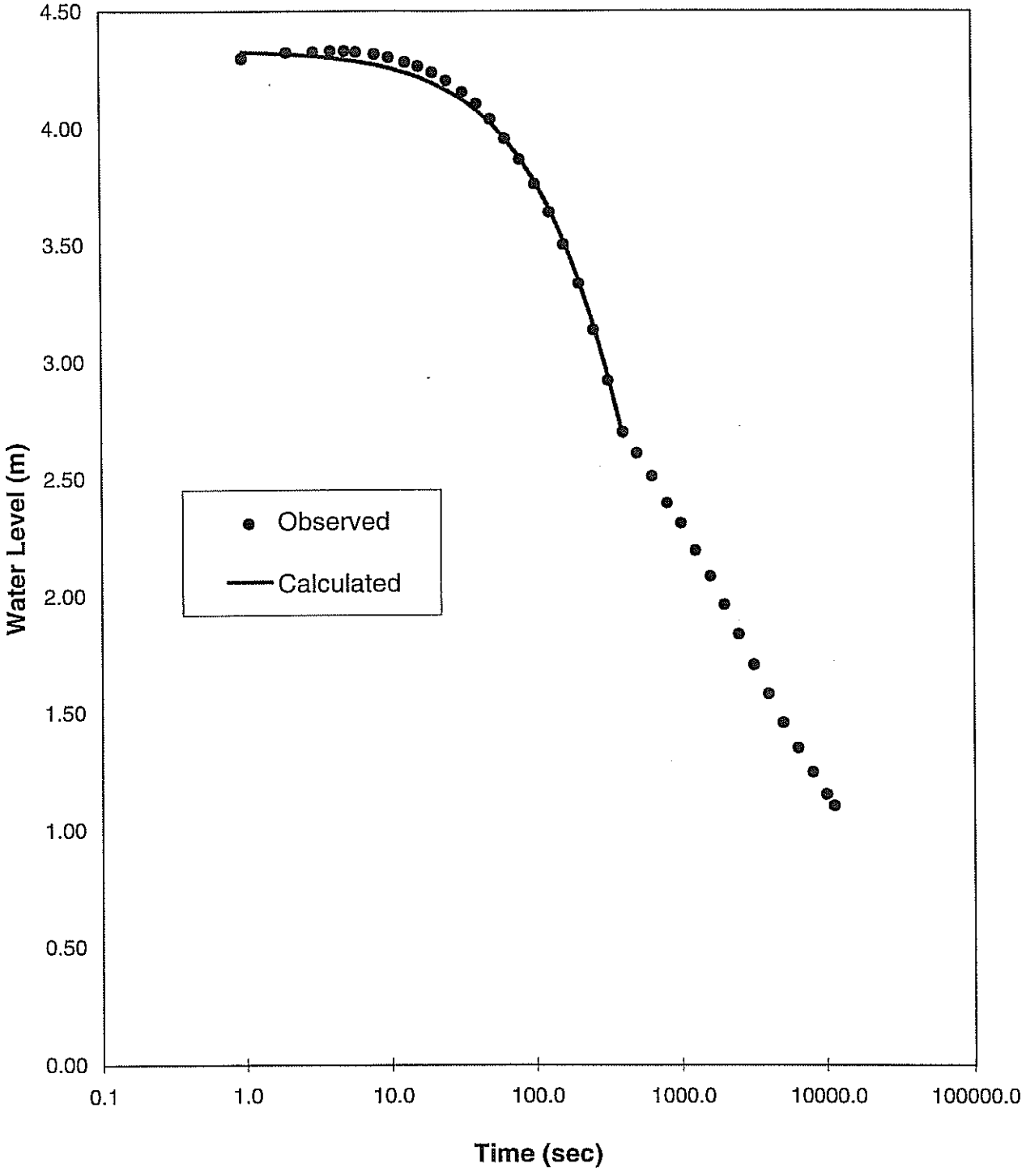
Slug Test at LBL, Well 71-93-1
K = 1.1 x 10^{-6} [m/sec]

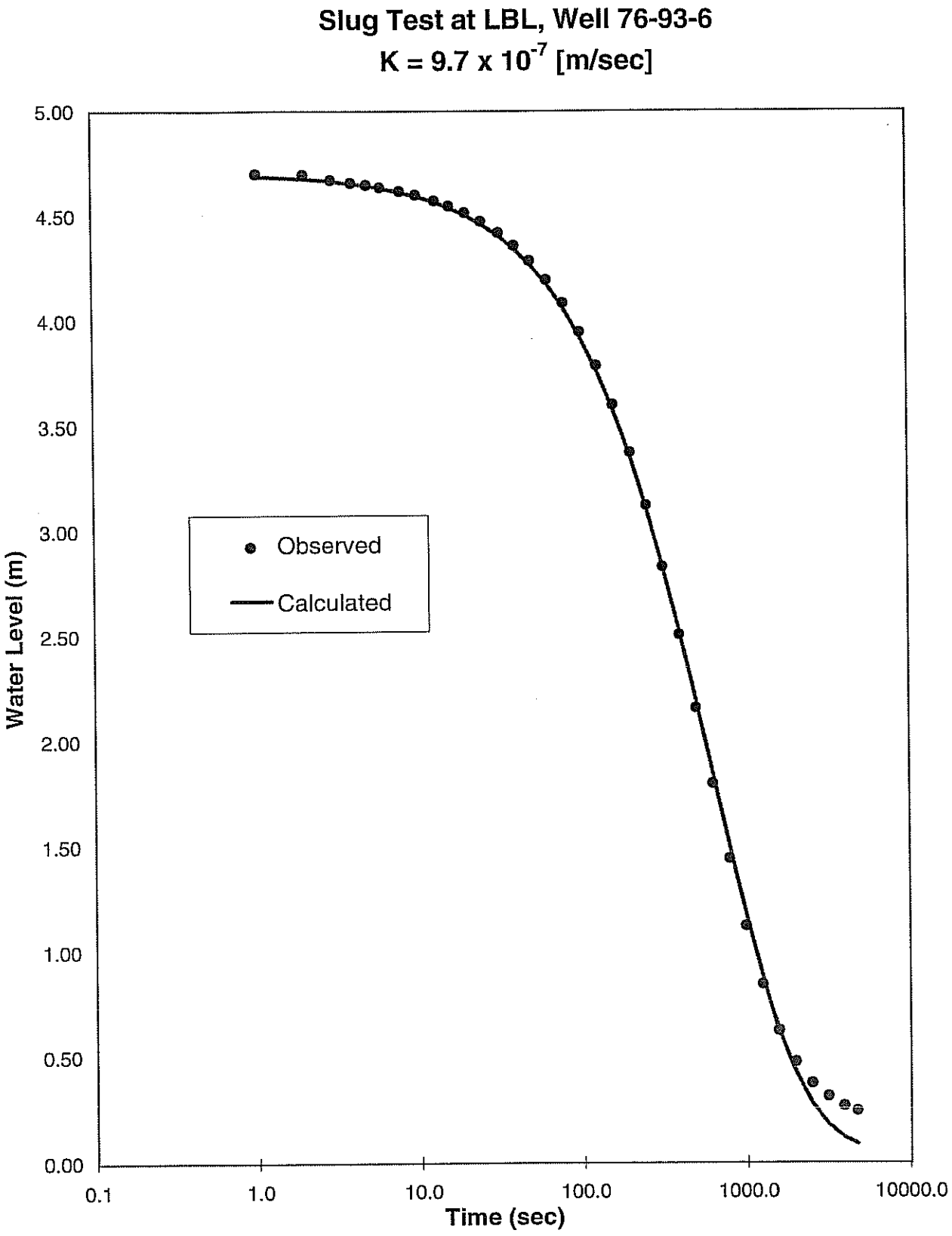


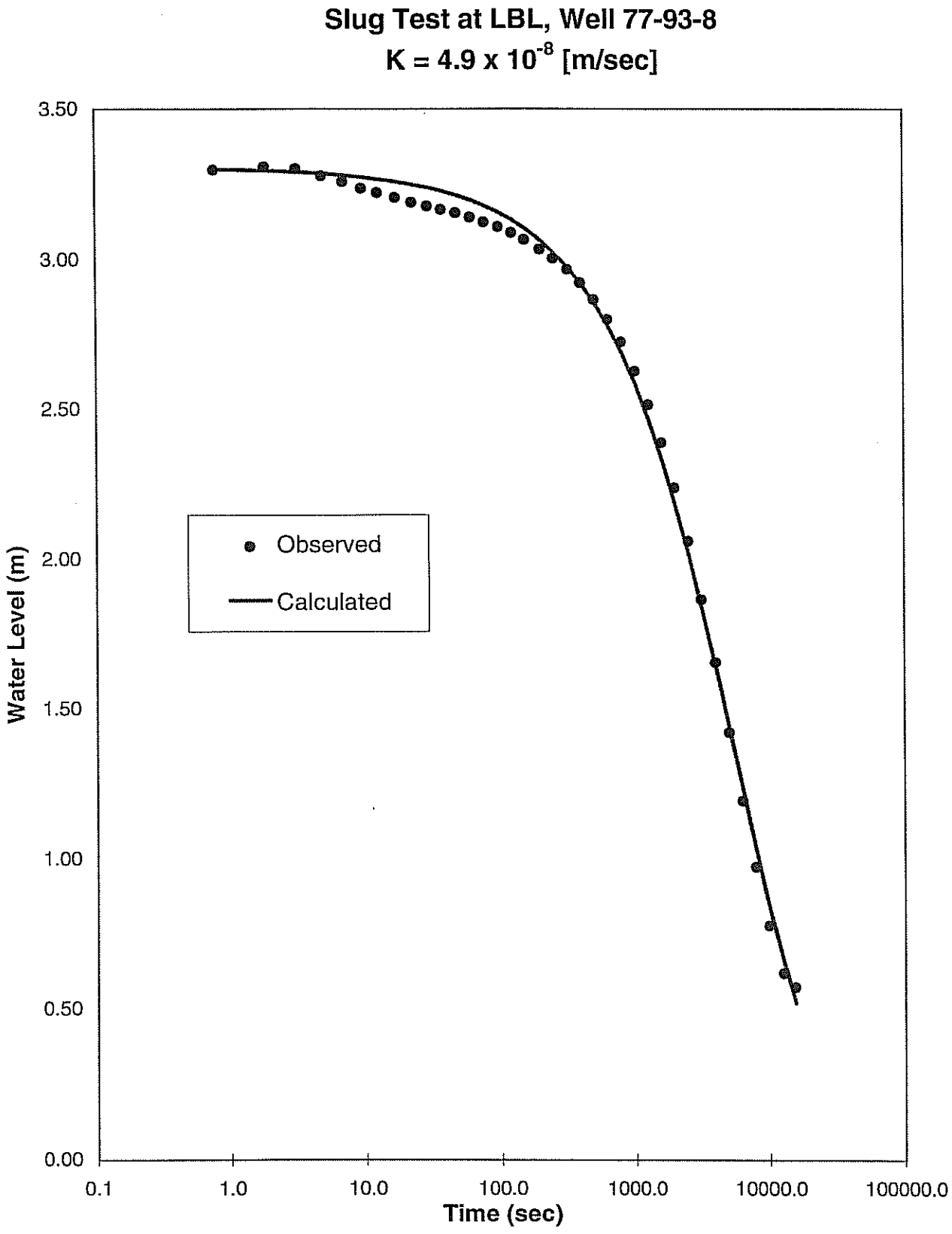

Slug Test at LBL, Well 71-93-2
K= 1.2 x 10^-5 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

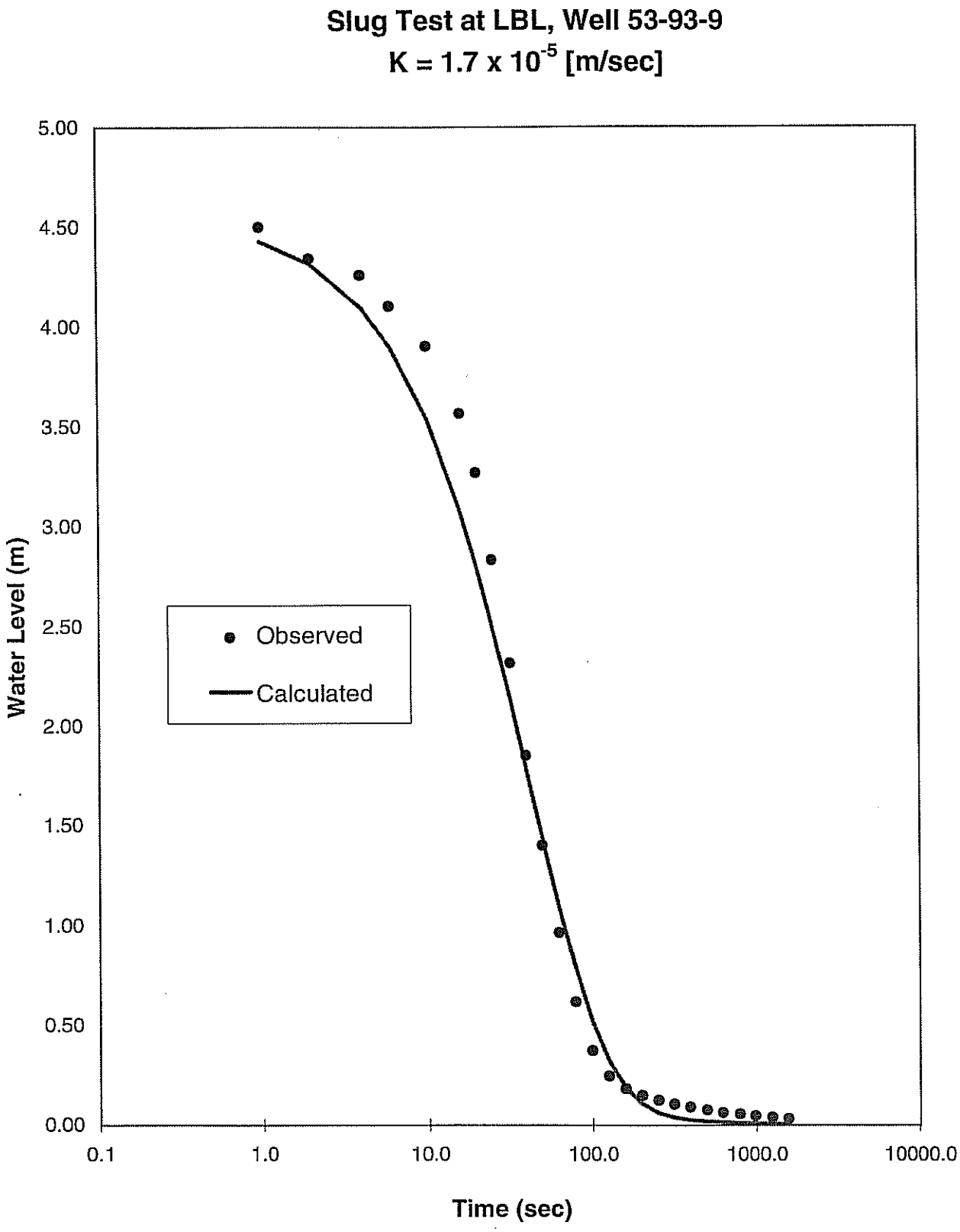

Slug Test at LBL, Well 6-93-4
K = 7.0 x 10^-6 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

Slug Test at LBL, Well 37-93-5
$K = 7.2 \times 10^{-7}$ [m/sec]

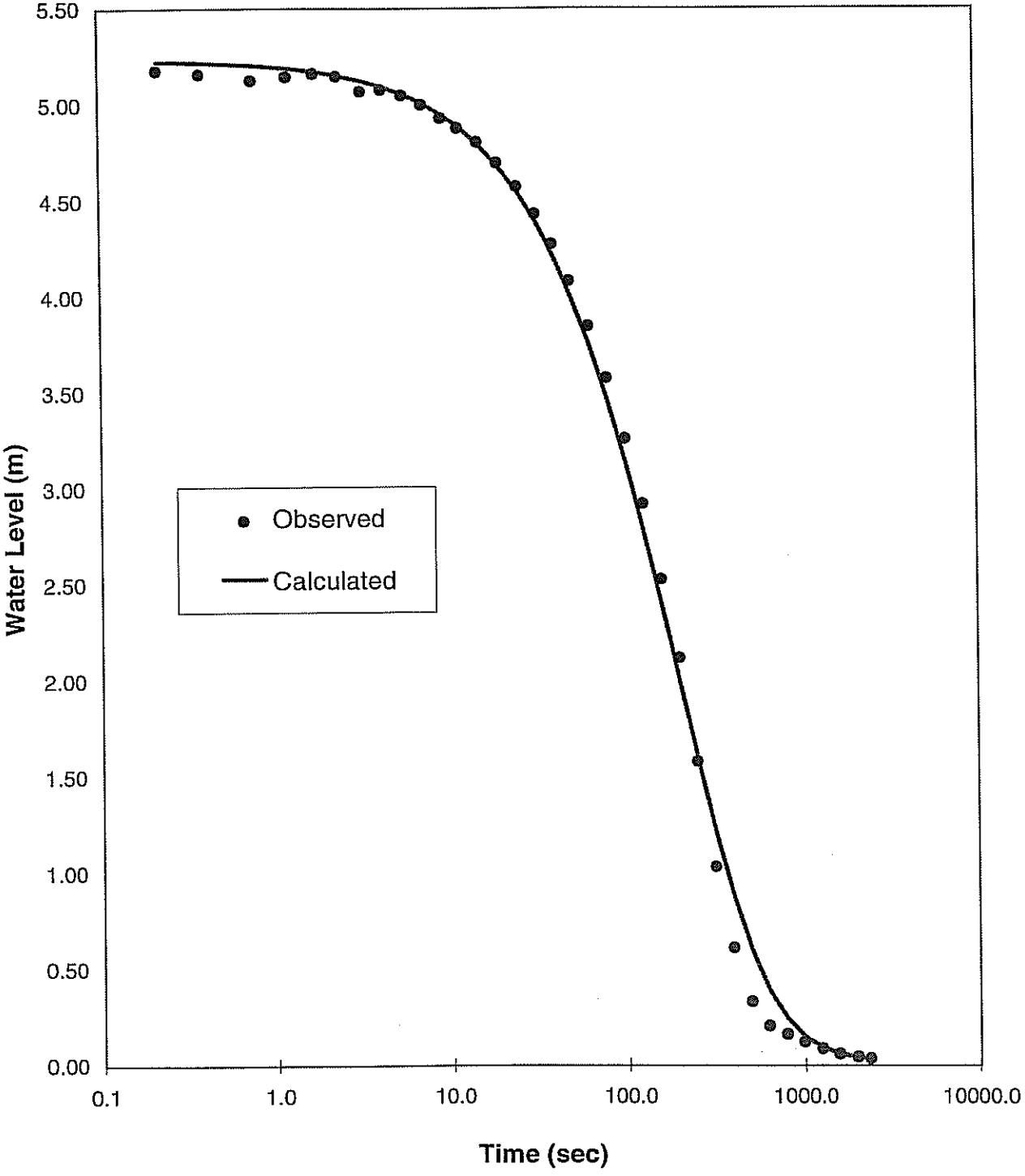



Slug Test at LBL, Well 76-93-6
K = 9.7 x 10^-7 [m/sec]
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

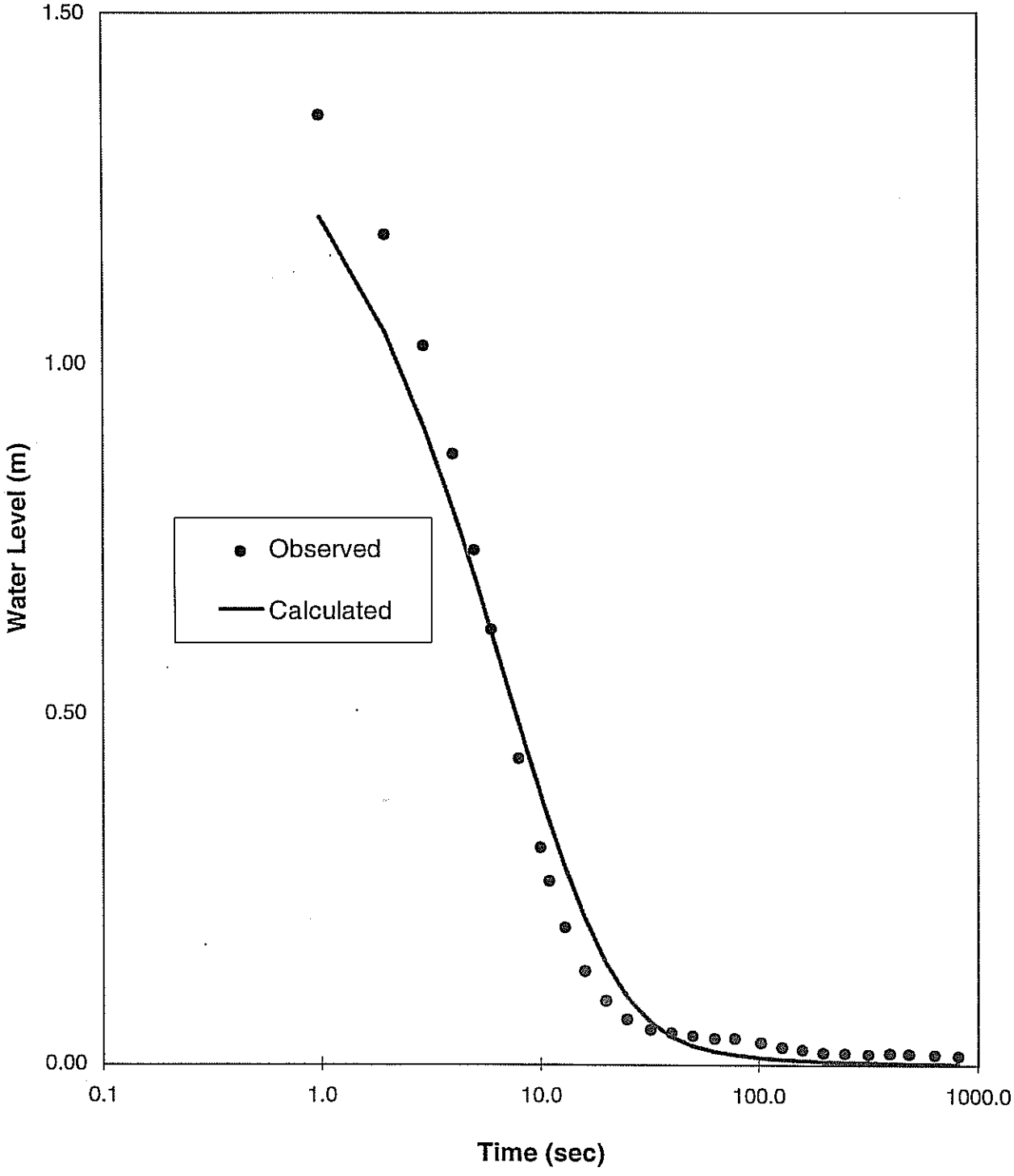

Slug Test at LBL, Well 77-93-8
K = 4.9 x 10^-8 [m/sec]
Water Level (m)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

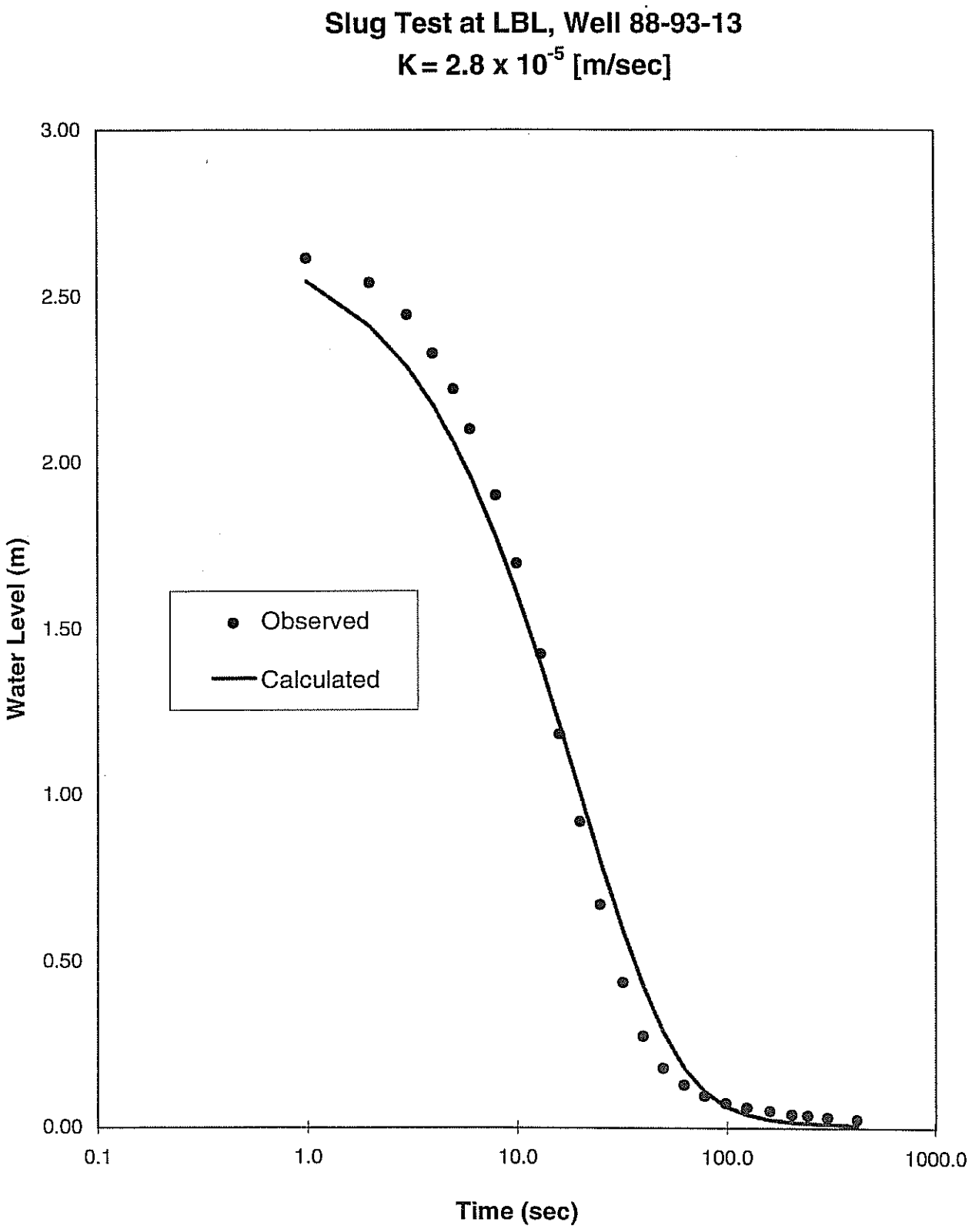

Slug Test at LBL, Well 53-93-9
K = 1.7 x 10^-5 [m/sec]
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

Slug Test at LBL, Well 5-93-10
K = 2.9 x 10^{-6} [m/sec]

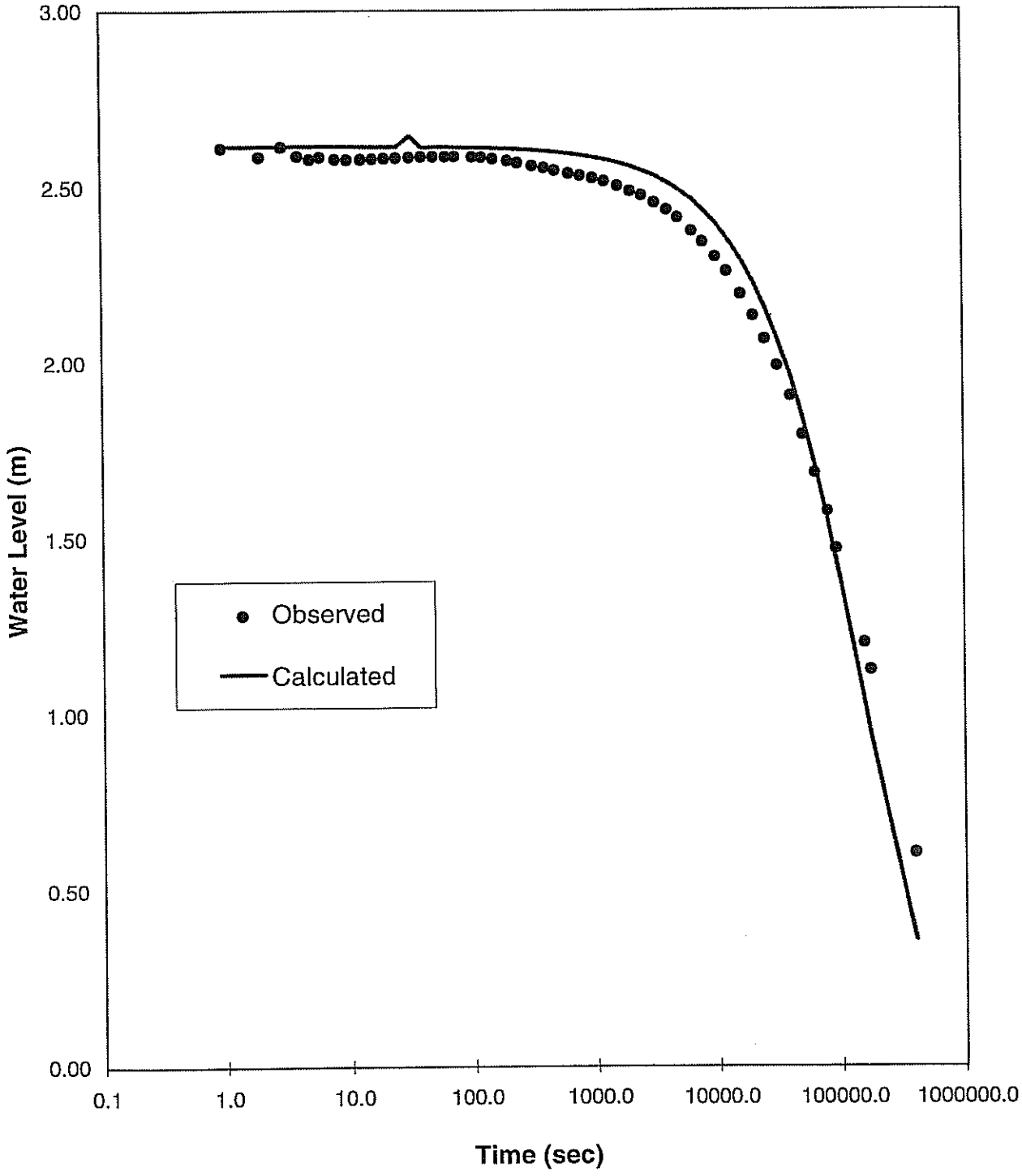


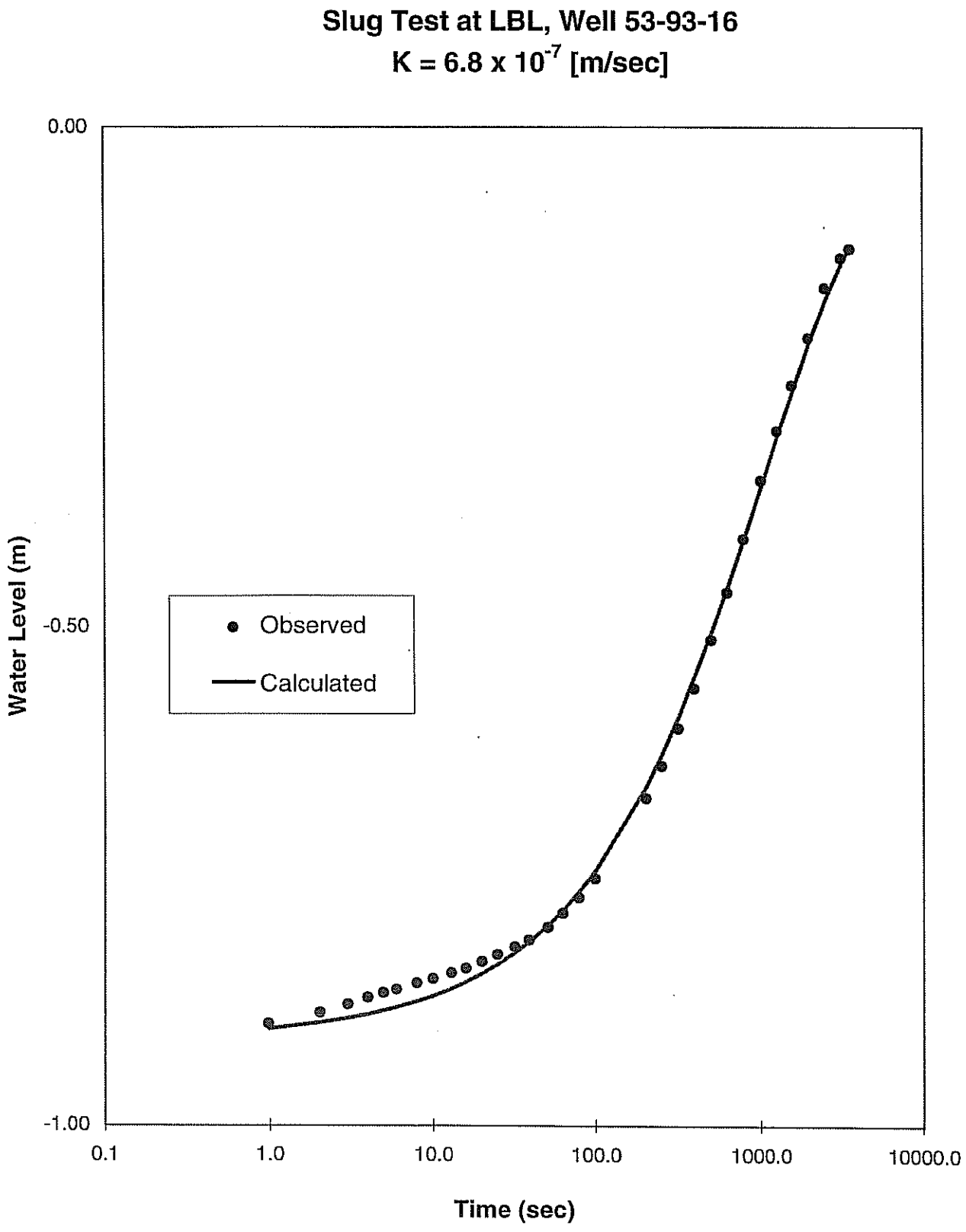
Slug Test at LBL, Well 46-93-12
K = 3.6 x 10^{-4} [m/sec]



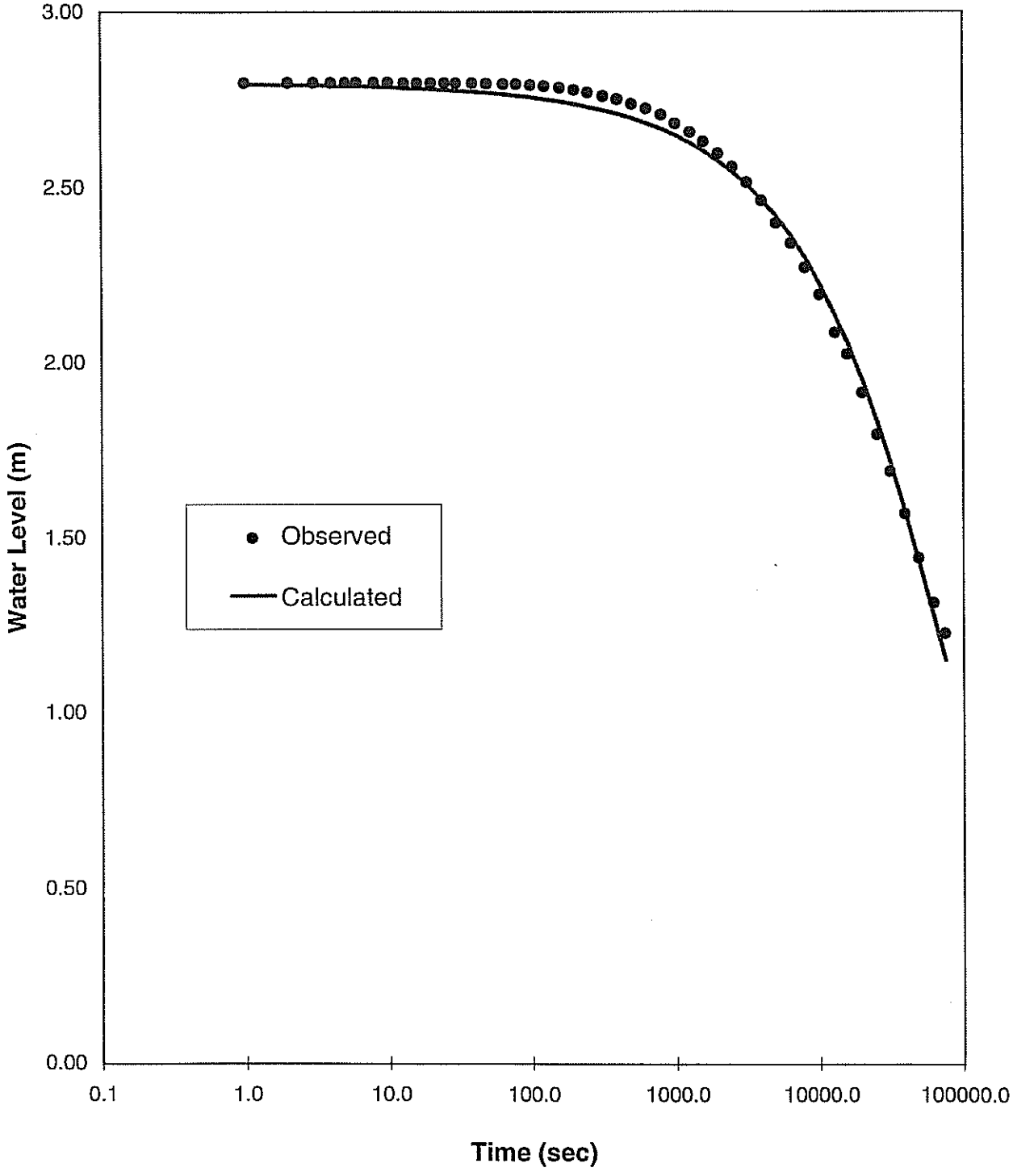

Slug Test at LBL, Well 88-93-13
K = 2.8 x 10^-5 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

Slug Test at LBL, Well 25-93-15
K = 2.7 x 10^{-8} [m/sec]

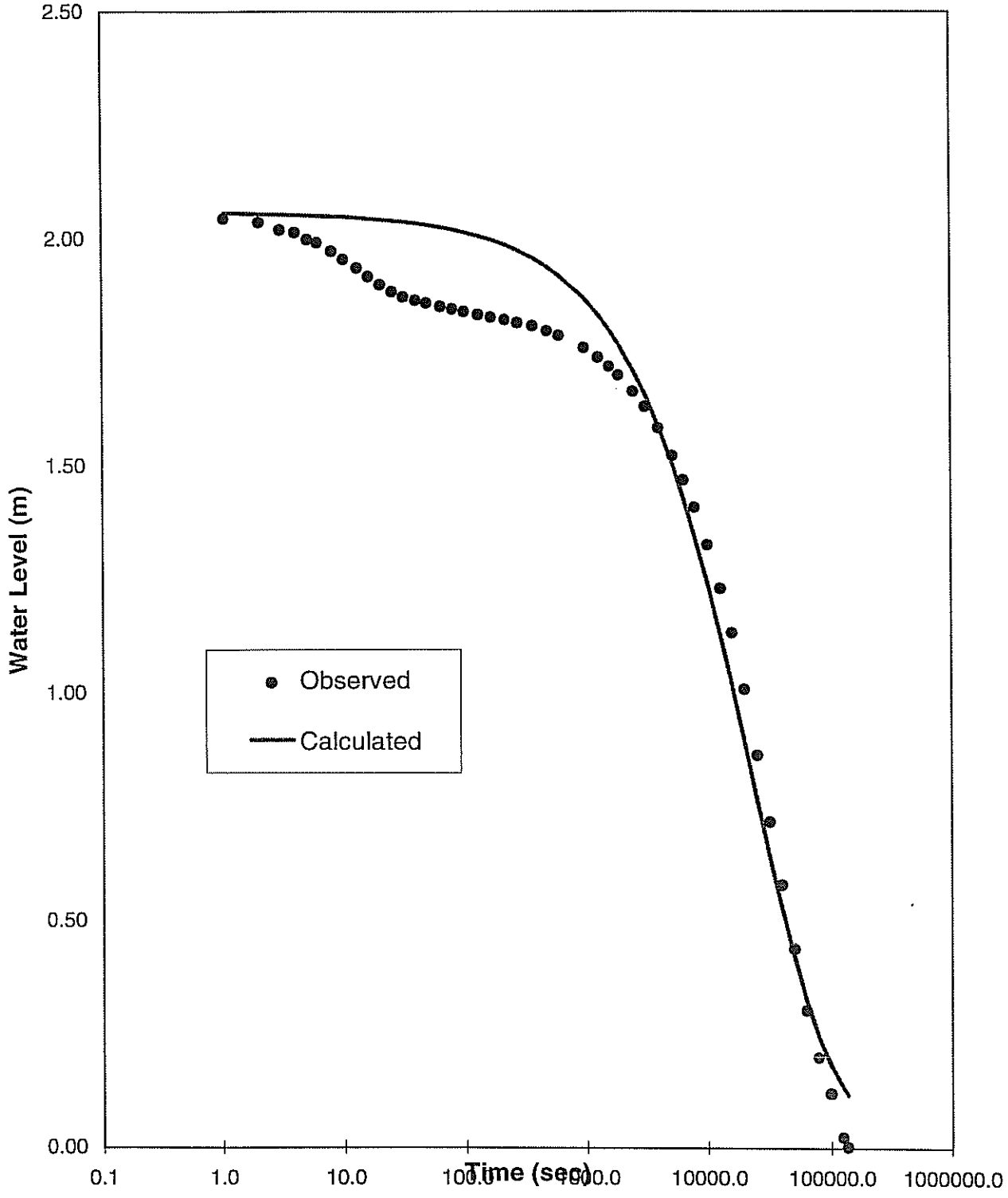


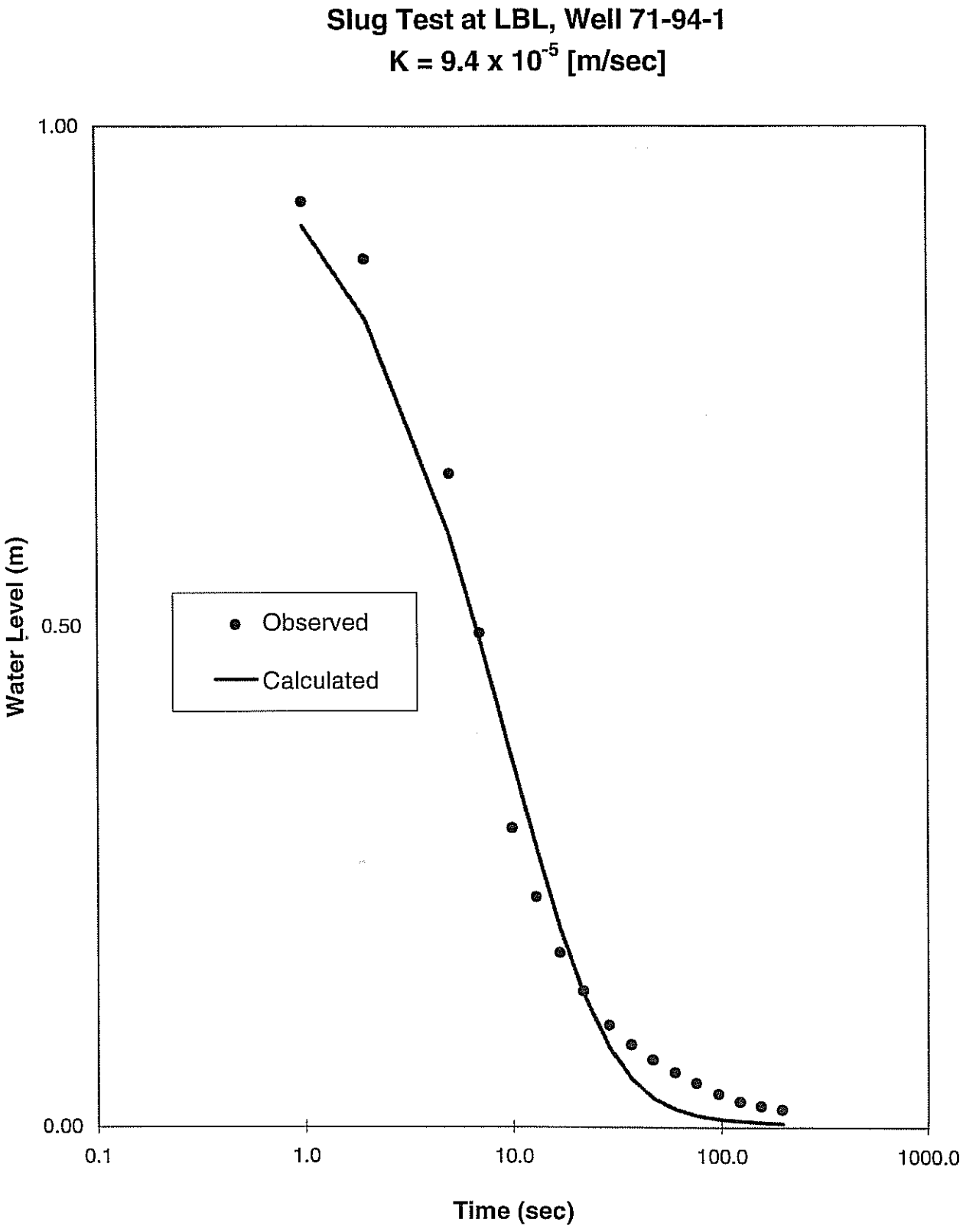

Slug Test at LBL, Well 53-93-16
K = 6.8 x 10^-7 [m/sec]
0.00
-0.50
-1.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

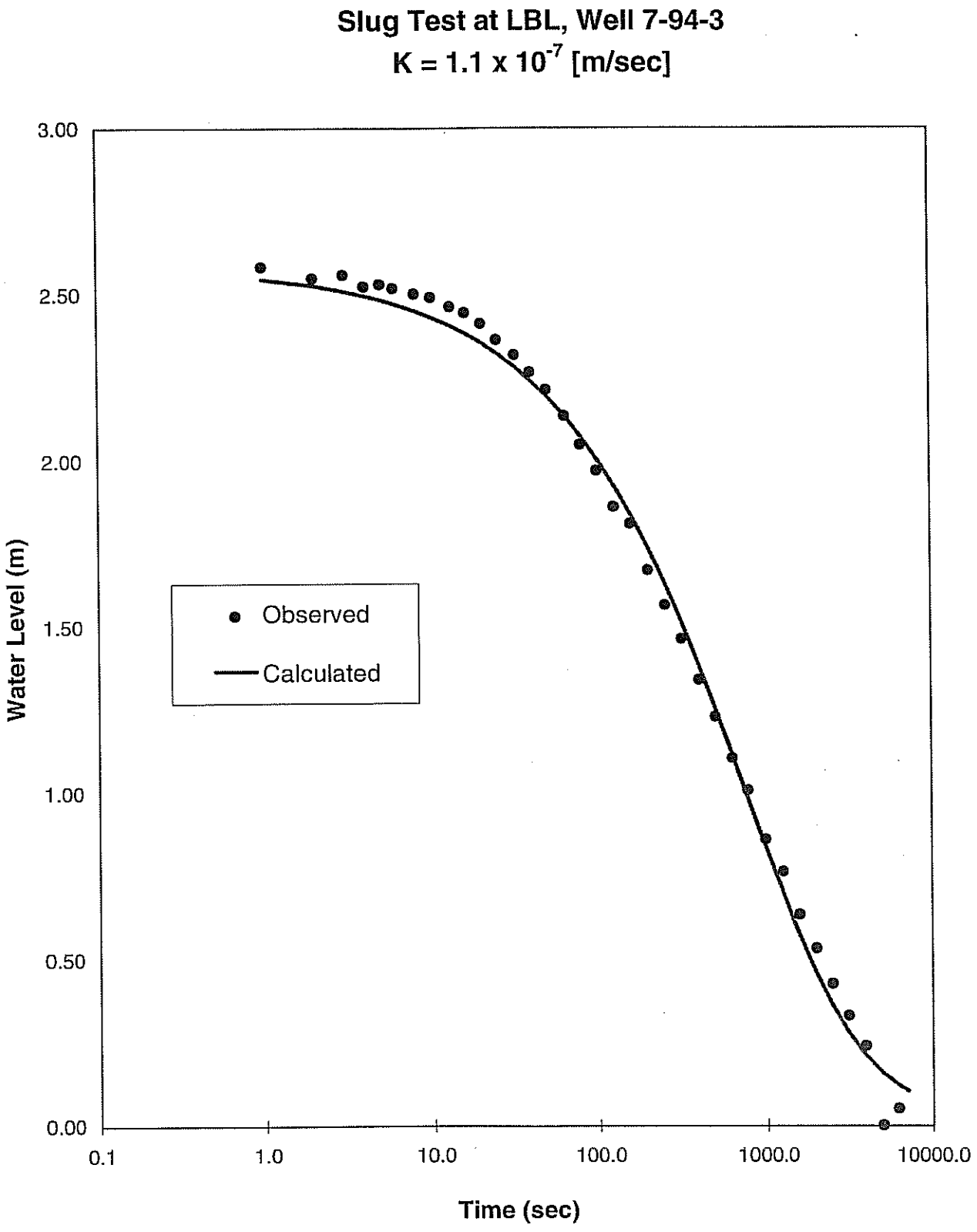
Slug Test at LBL, Well 53-93-17
$K = 1.5 \times 10^{-9}$ [m/sec]

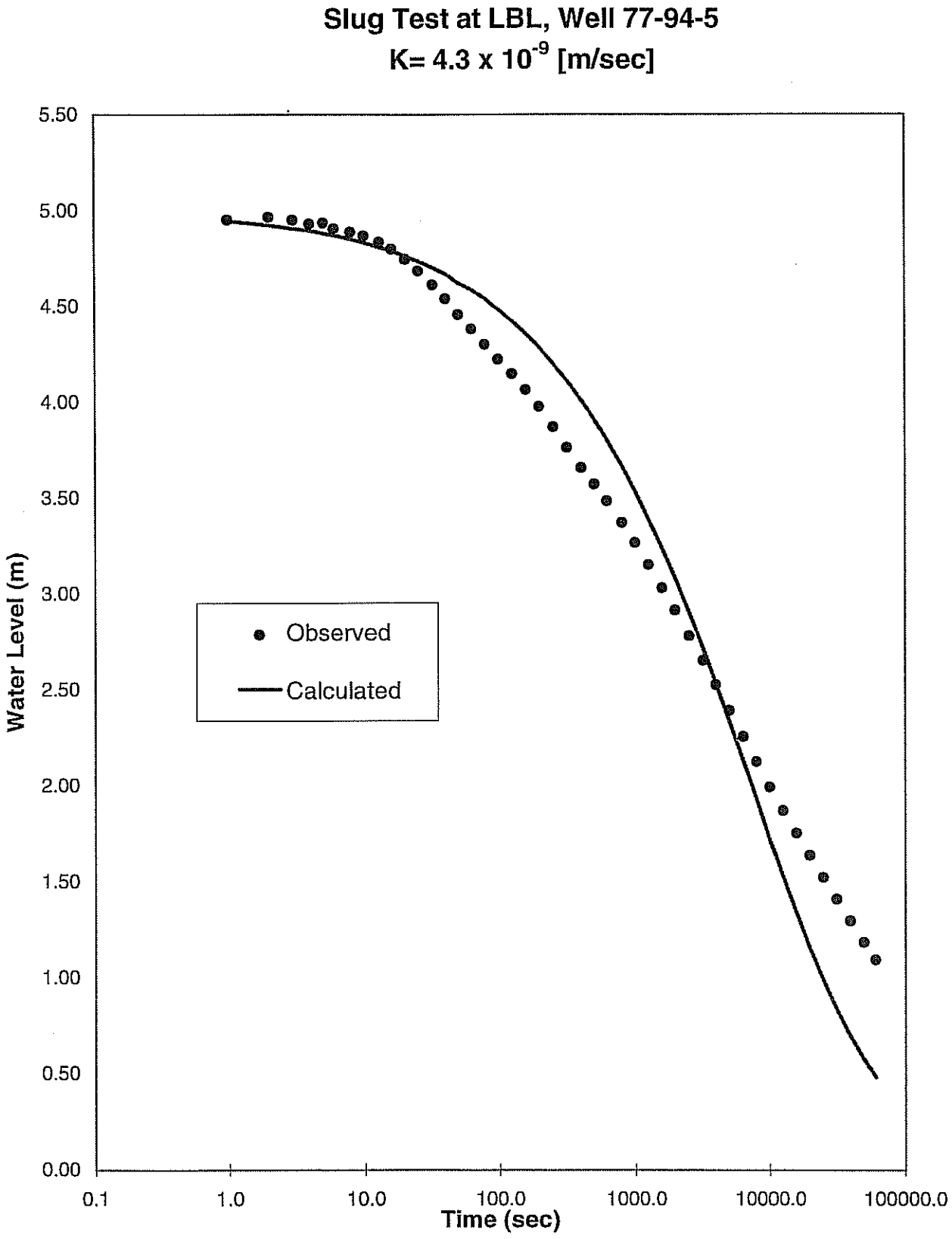


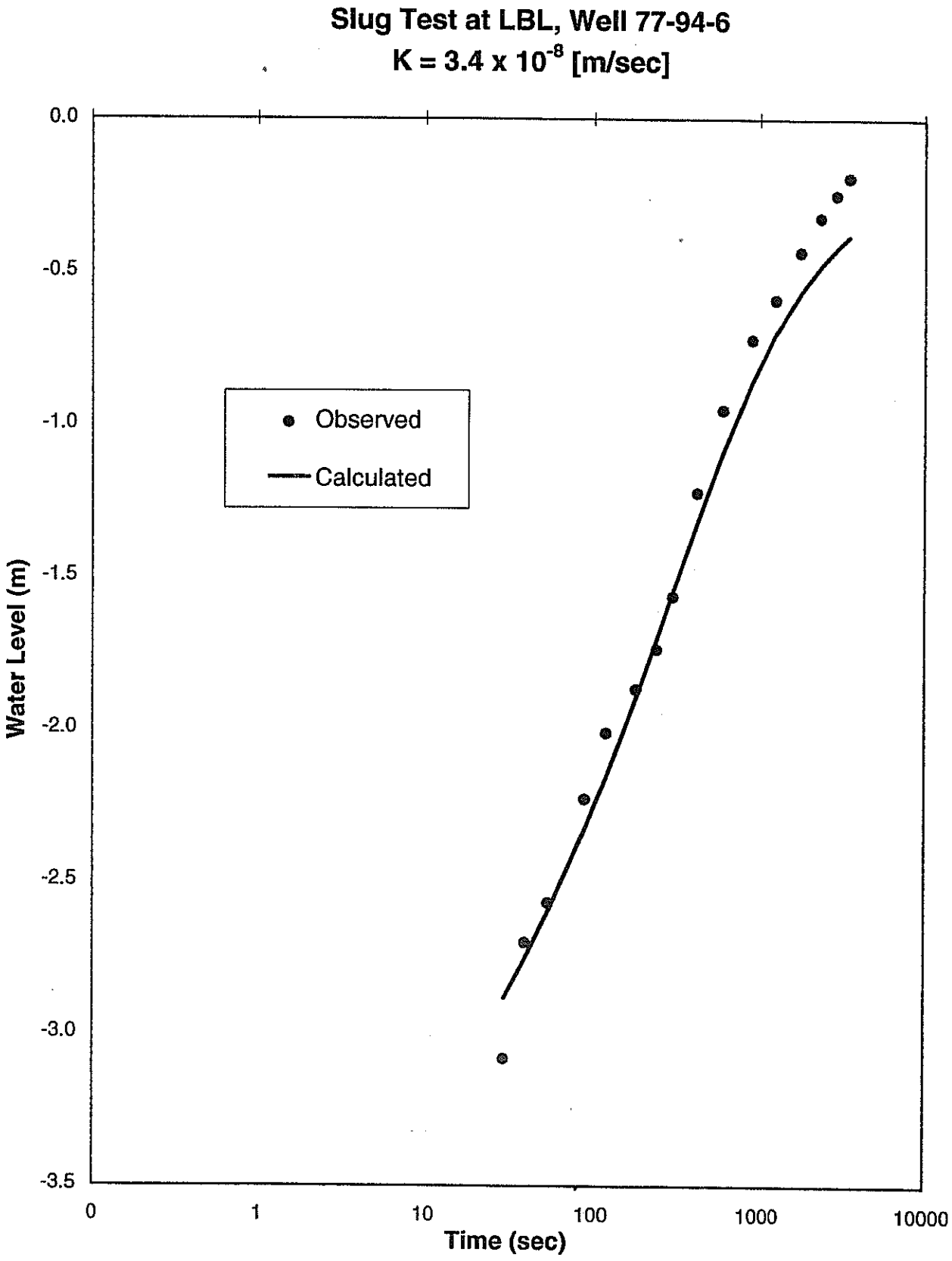
Slug Test at LBL, Well 51B-93-18b
$K = 5.5 \times 10^{-9}$ [m/sec]



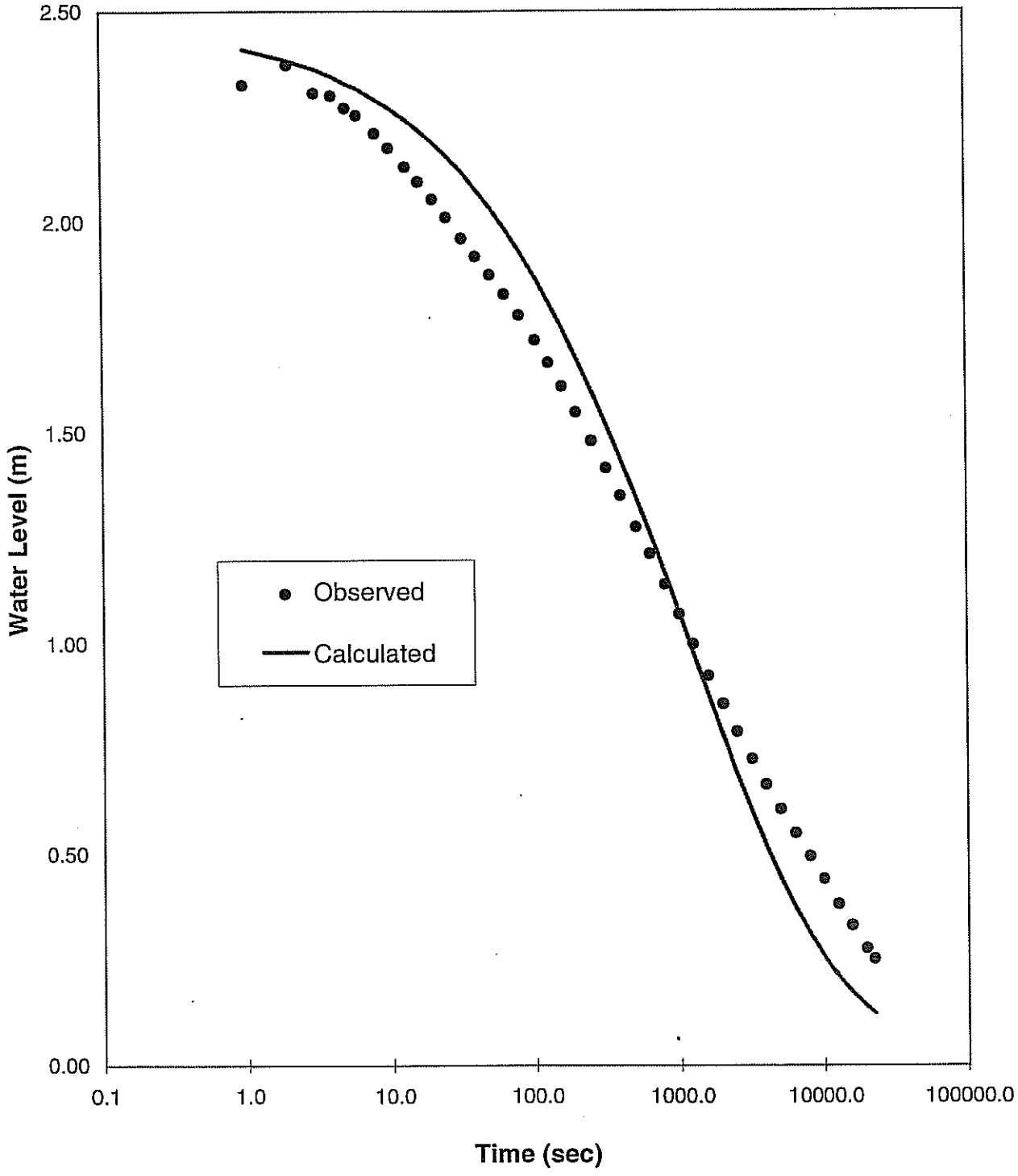

Slug Test at LBL, Well 71-94-1
K = 9.4 x 10^-5 [m/sec]
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

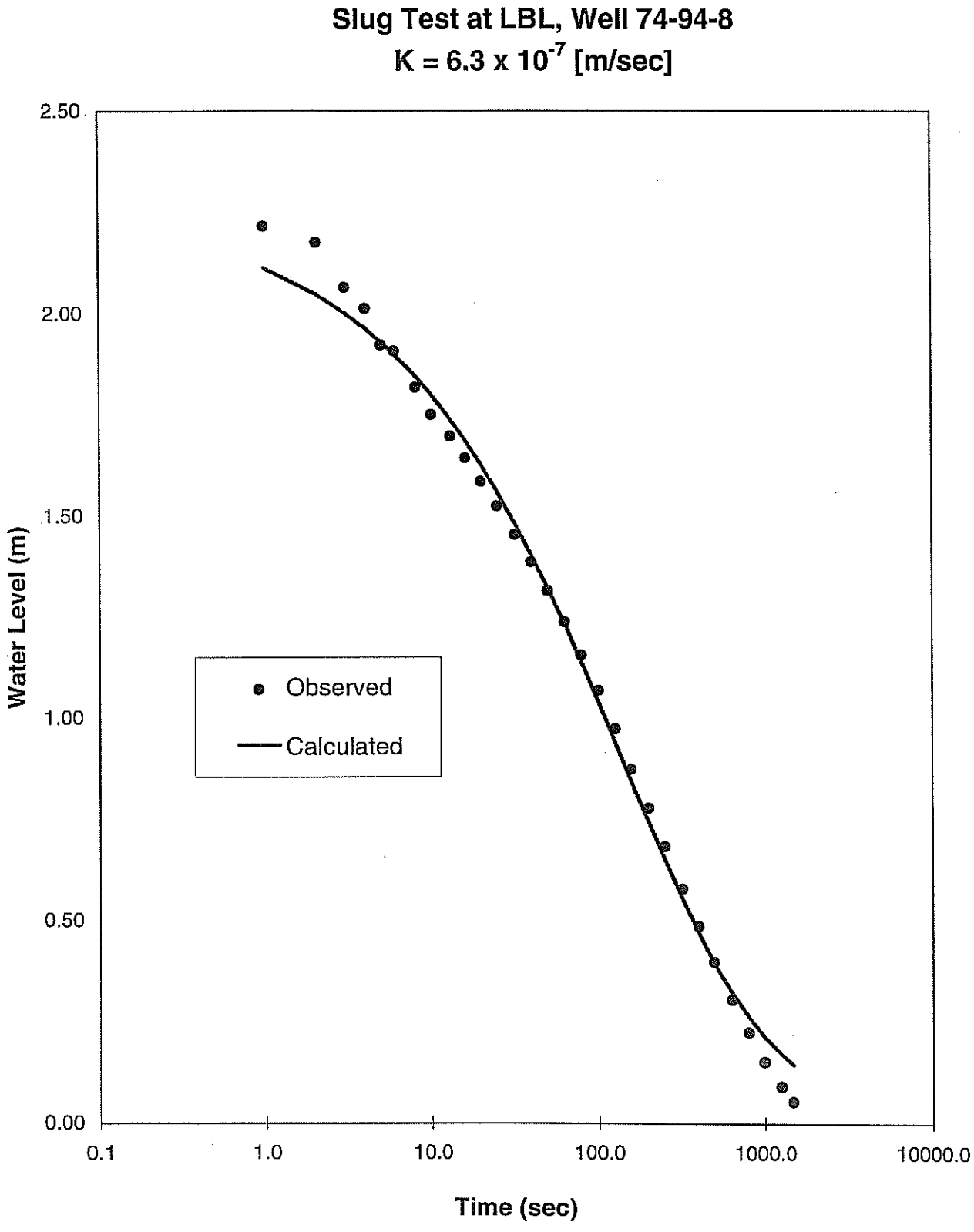

Slug Test at LBL, Well 7-94-3
K = 1.1 x 10^-7 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

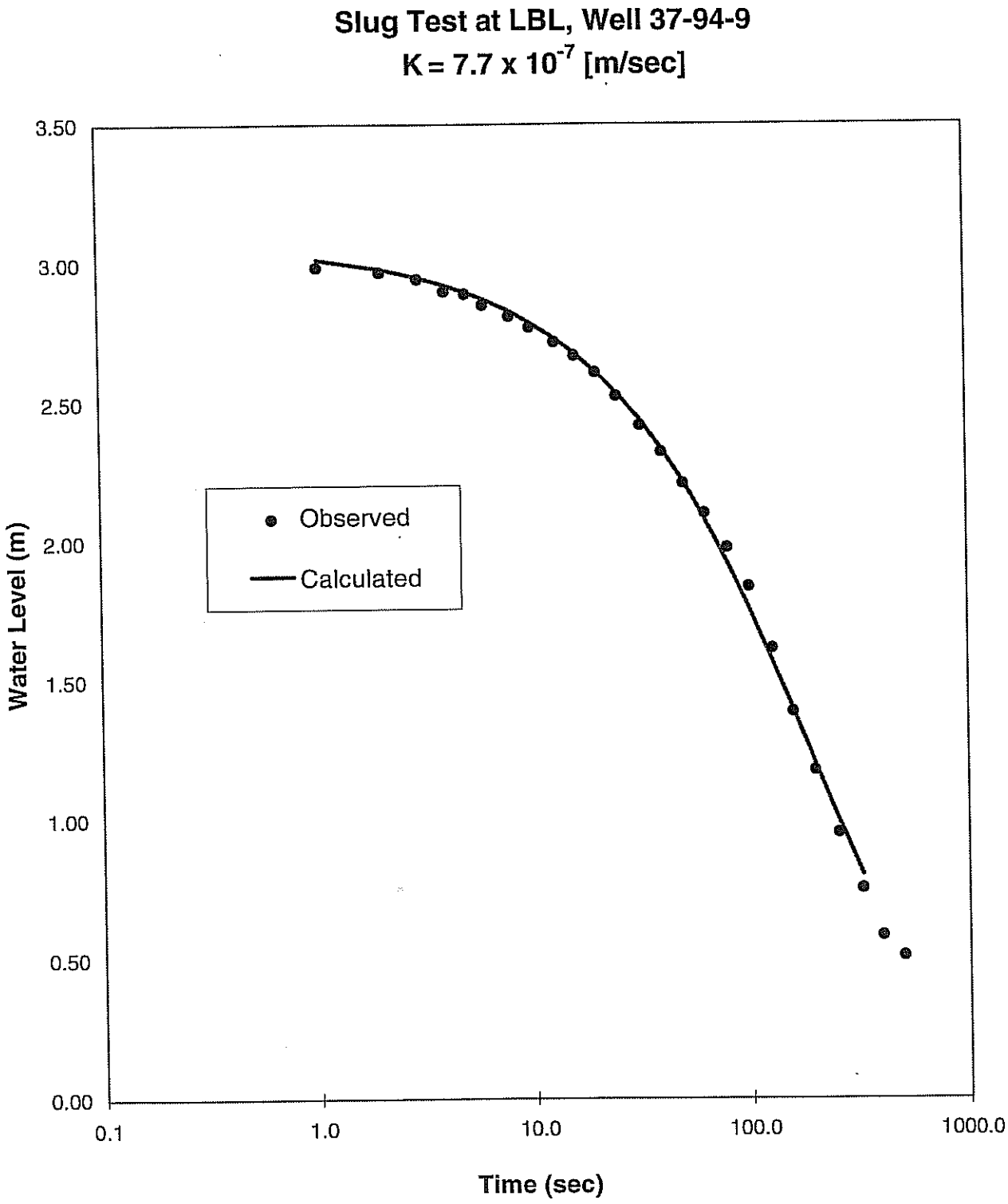

Slug Test at LBL, Well 77-94-5
K= 4.3 x 10^-9 [m/sec]
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)
Observed
Calculated

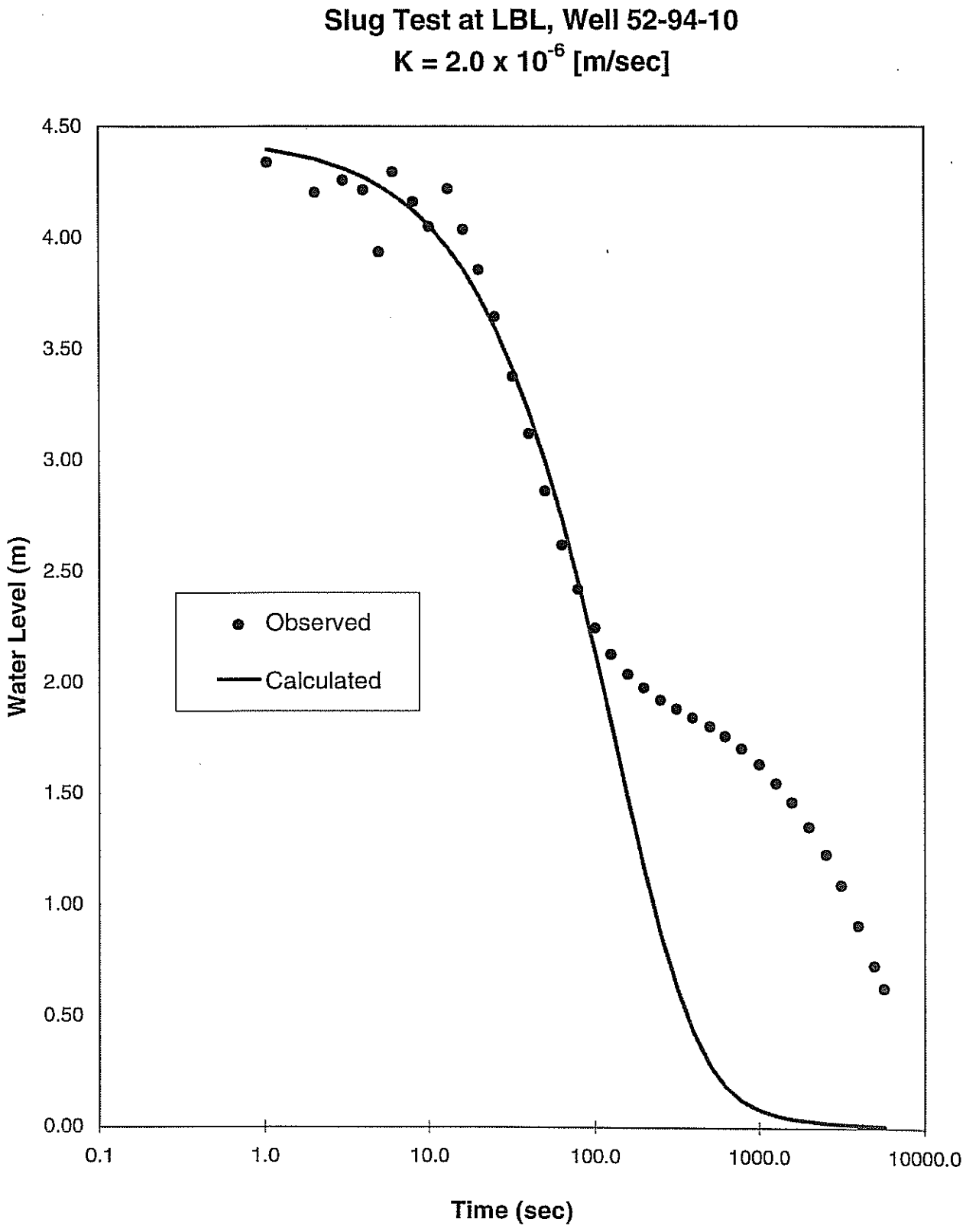

Slug Test at LBL, Well 77-94-6
K = 3.4 x 10^-8 [m/sec]
Observed
Calculated
Water Level (m)
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
0
1
10
100
1000
10000
Time (sec)

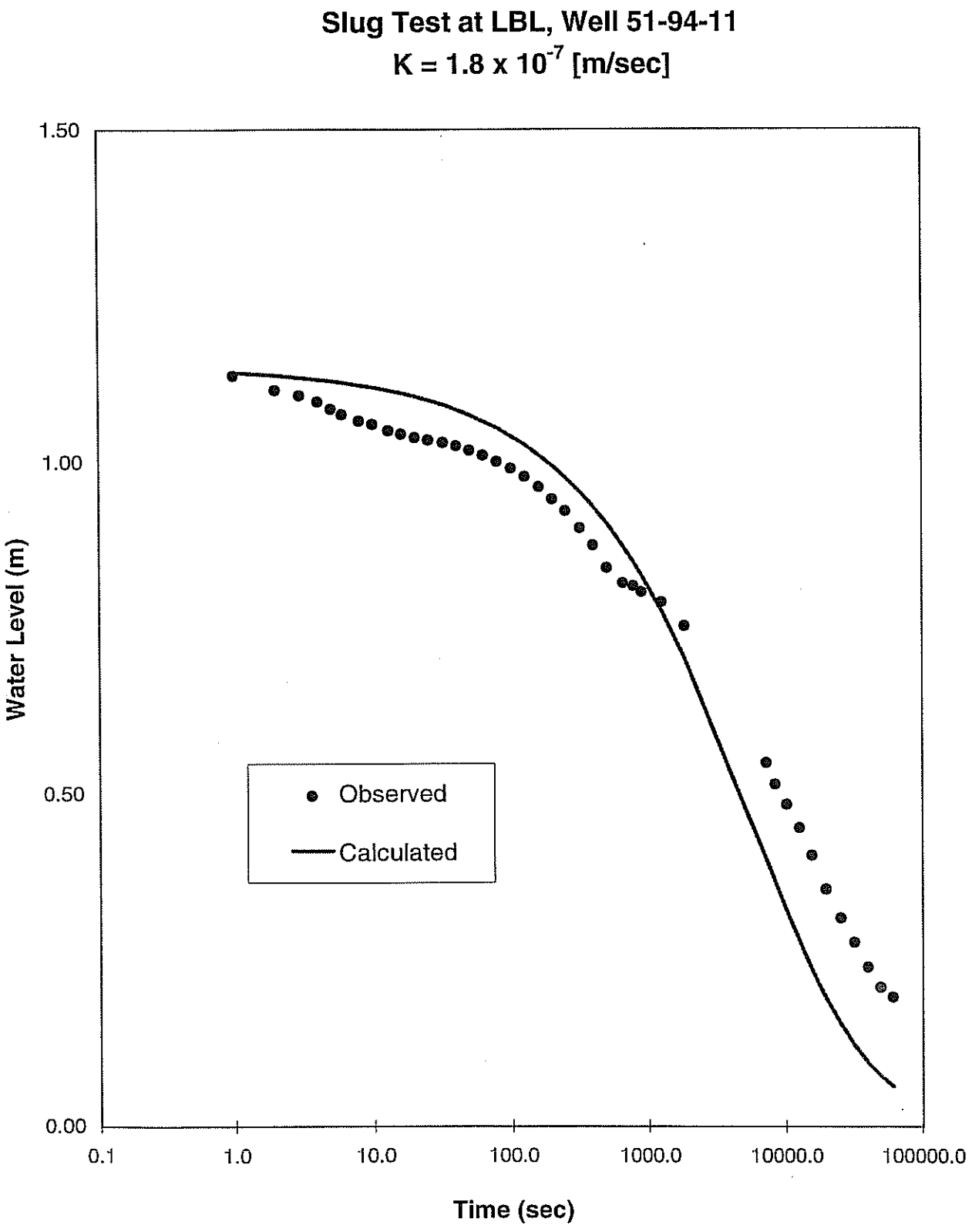
Slug Test at LBL, Well 74-94-7
$K = 4.6 \times 10^{-8}$ [m/sec]

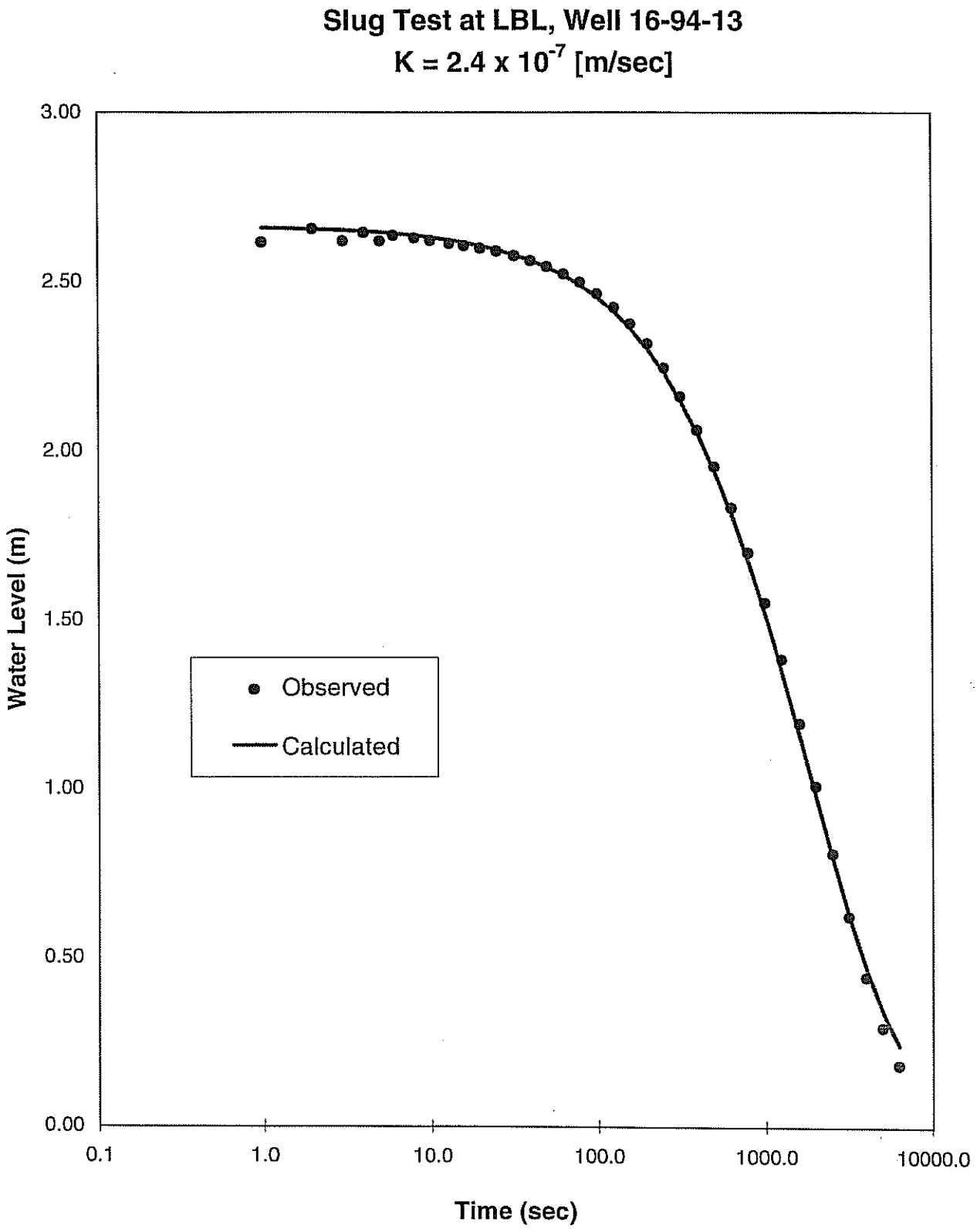


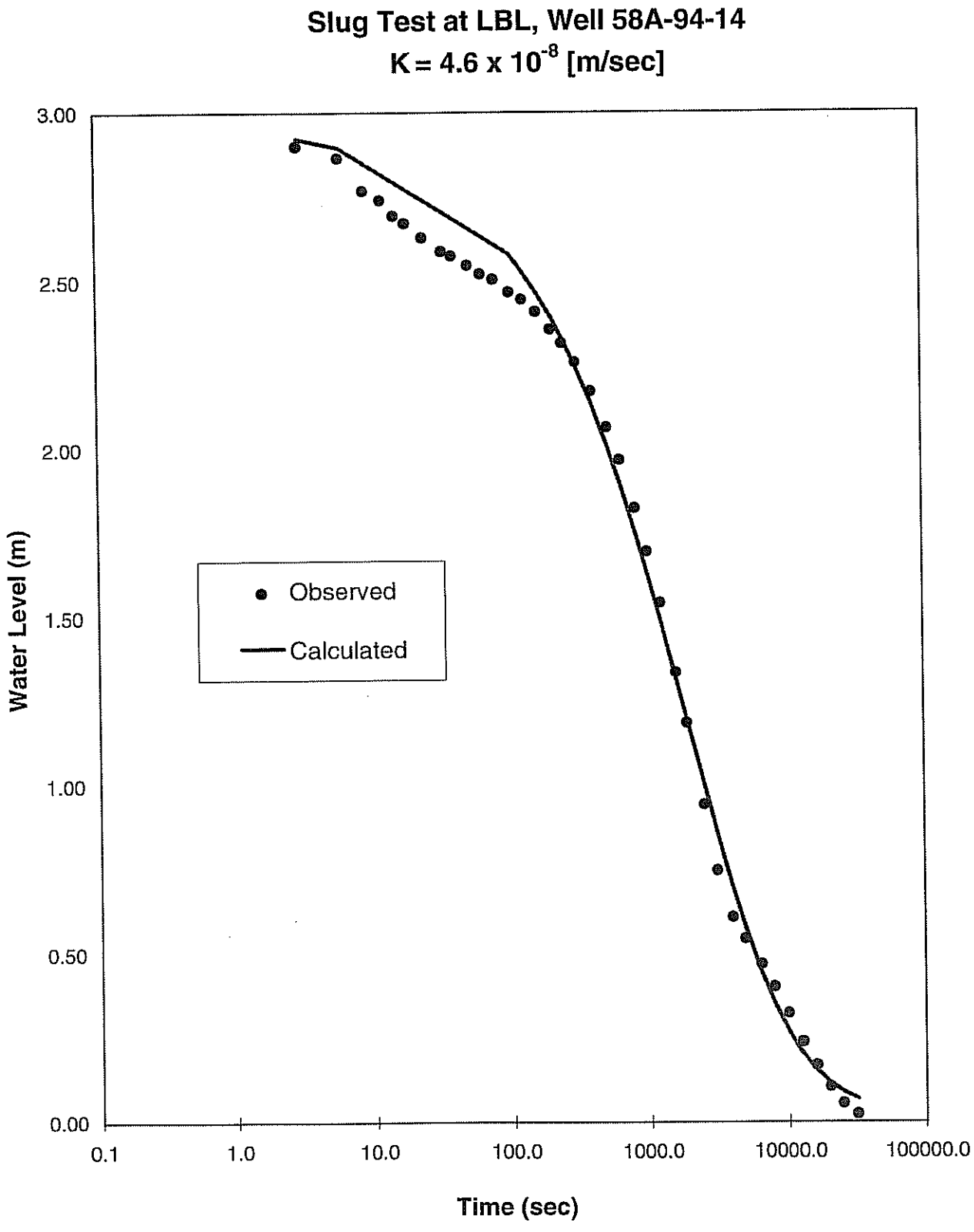

Slug Test at LBL, Well 74-94-8
K = 6.3 x 10^-7 [m/sec]
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

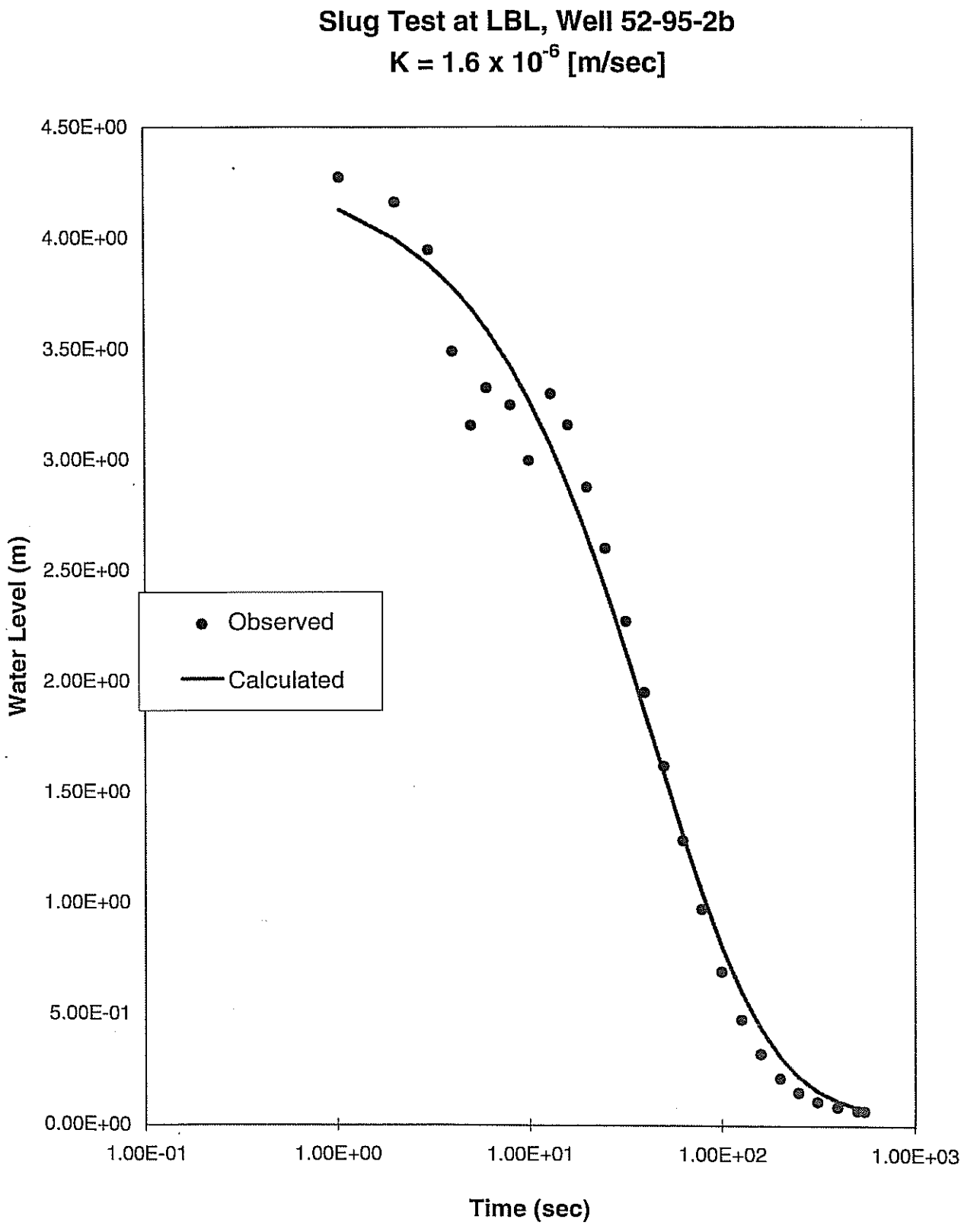

Slug Test at LBL, Well 37-94-9
K = 7.7 x 10^-7 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

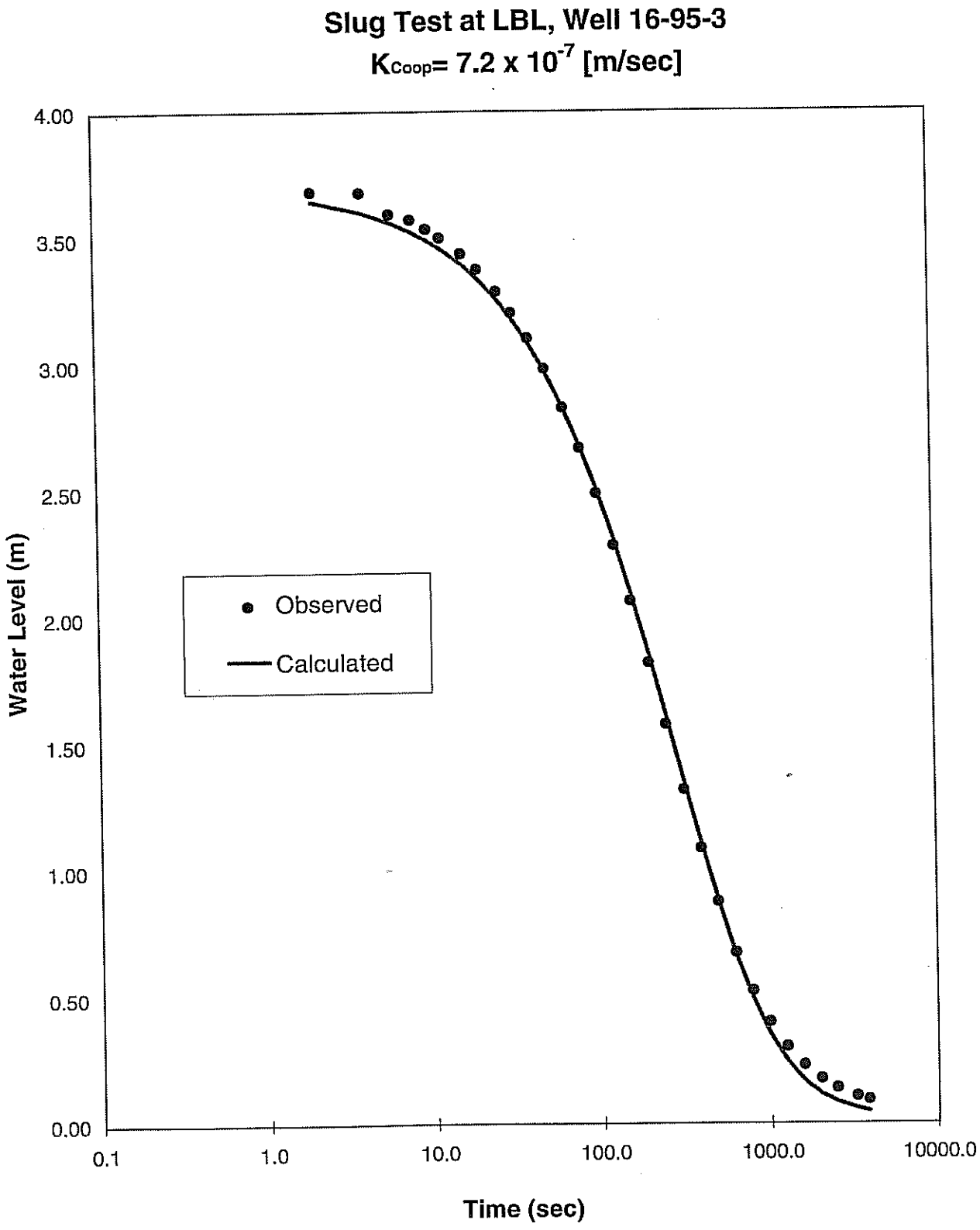

Slug Test at LBL, Well 52-94-10
K = 2.0 x 10^-6 [m/sec]
Water Level (m)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

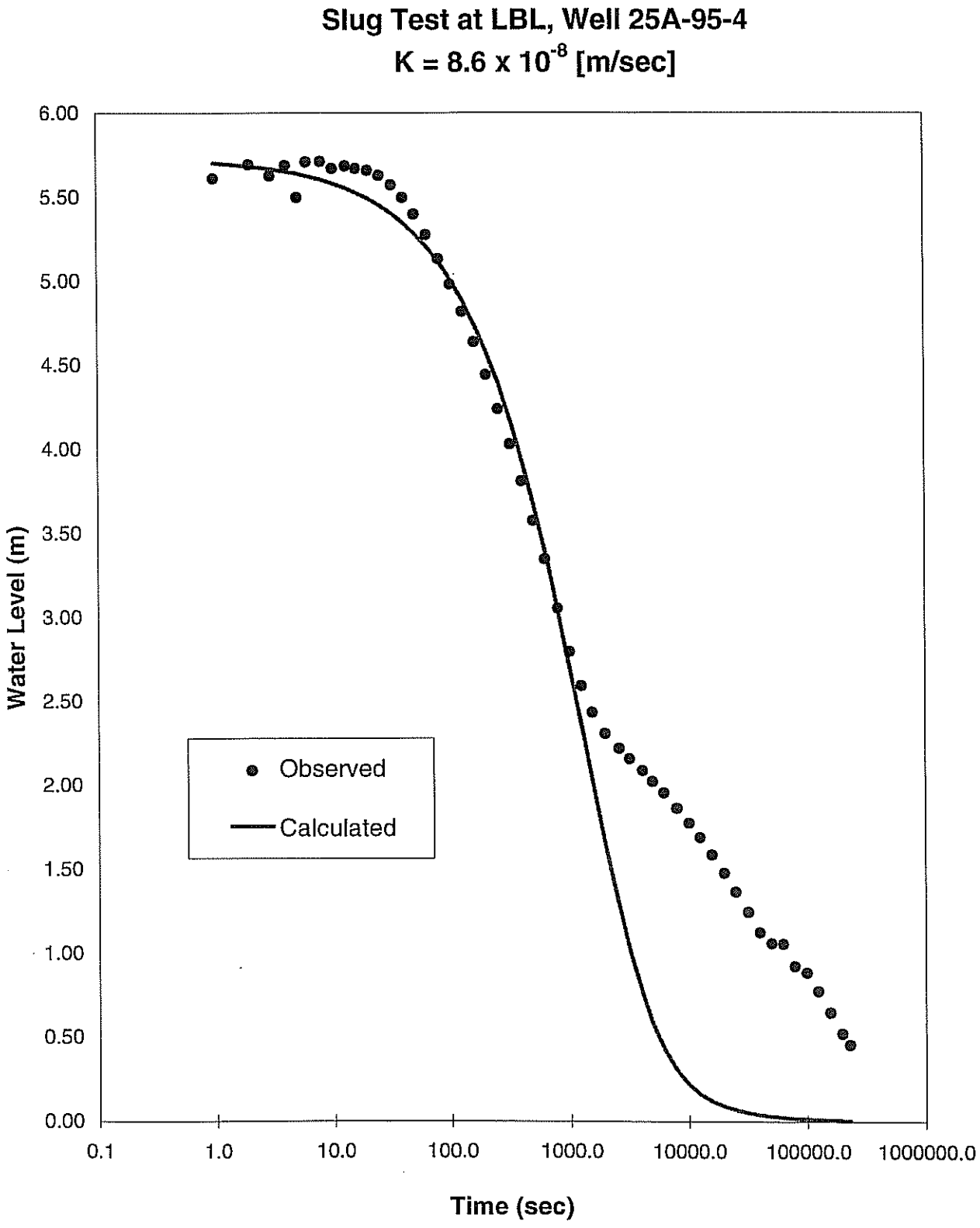

Slug Test at LBL, Well 51-94-11
K = 1.8 x 10^-7 [m/sec]
1.50
1.00
0.50
0.00
Water Level (m)
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)
Observed
Calculated

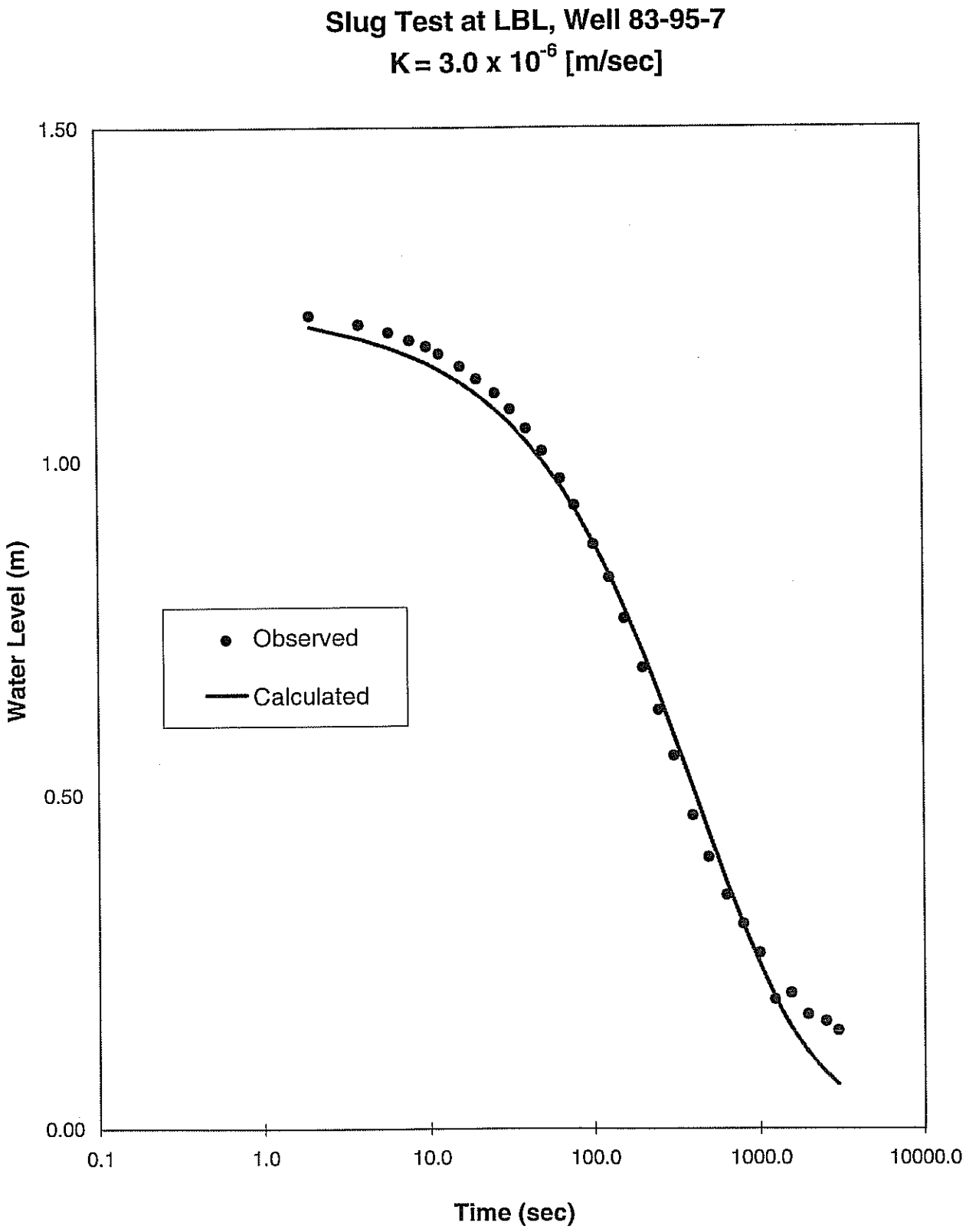

Slug Test at LBL, Well 16-94-13
K = 2.4 x 10^-7 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

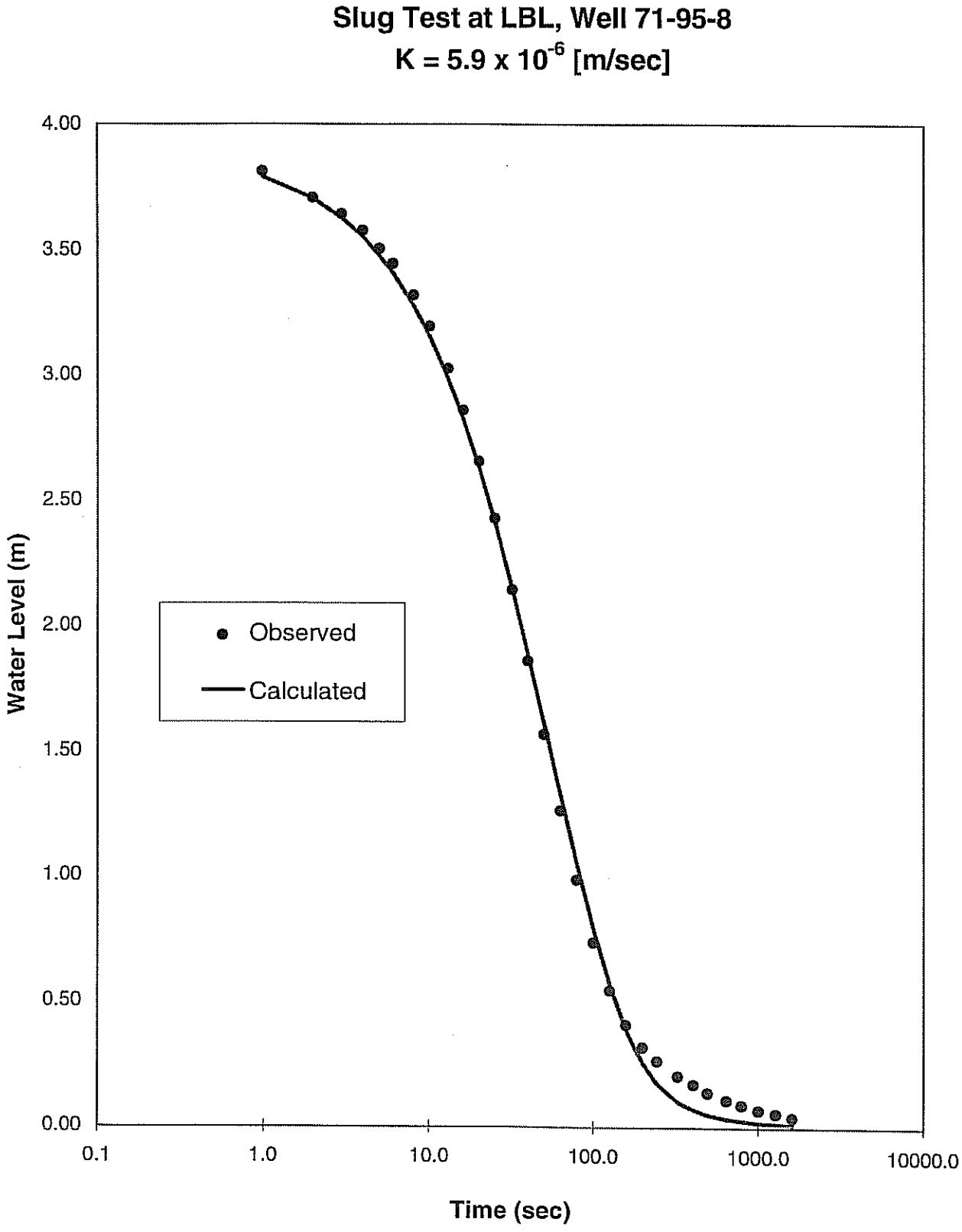

Slug Test at LBL, Well 58A-94-14
K = 4.6 x 10^-8 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

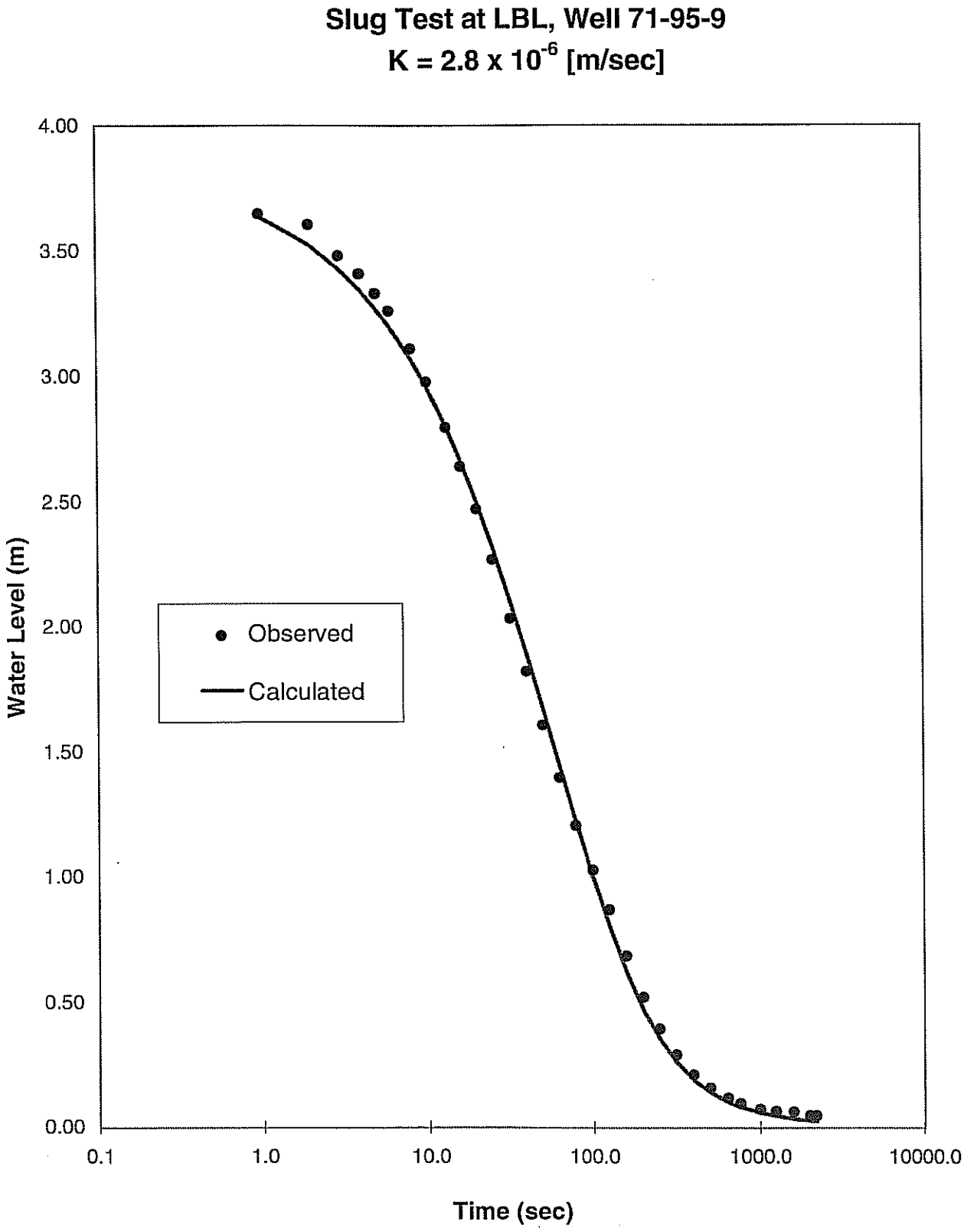

Slug Test at LBL, Well 52-95-2b
K = 1.6 x 10^-6 [m/sec]
4.50E+00
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Water Level (m)
Observed
Calculated
1.00E-01
1.00E+00
1.00E+01
1.00E+02
1.00E+03
Time (sec)

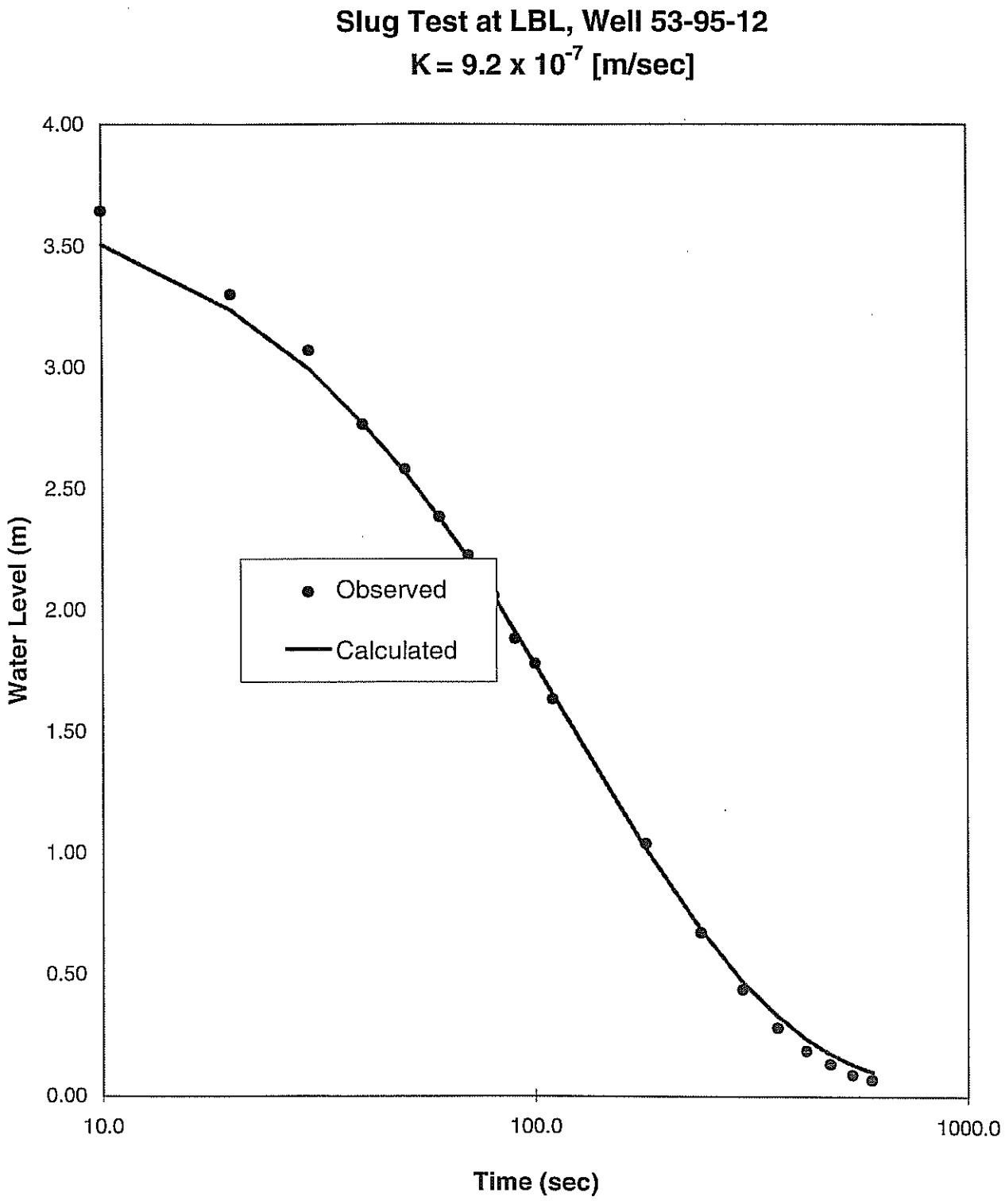

Slug Test at LBL, Well 16-95-3
Kcoop= 7.2 x 10-7 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

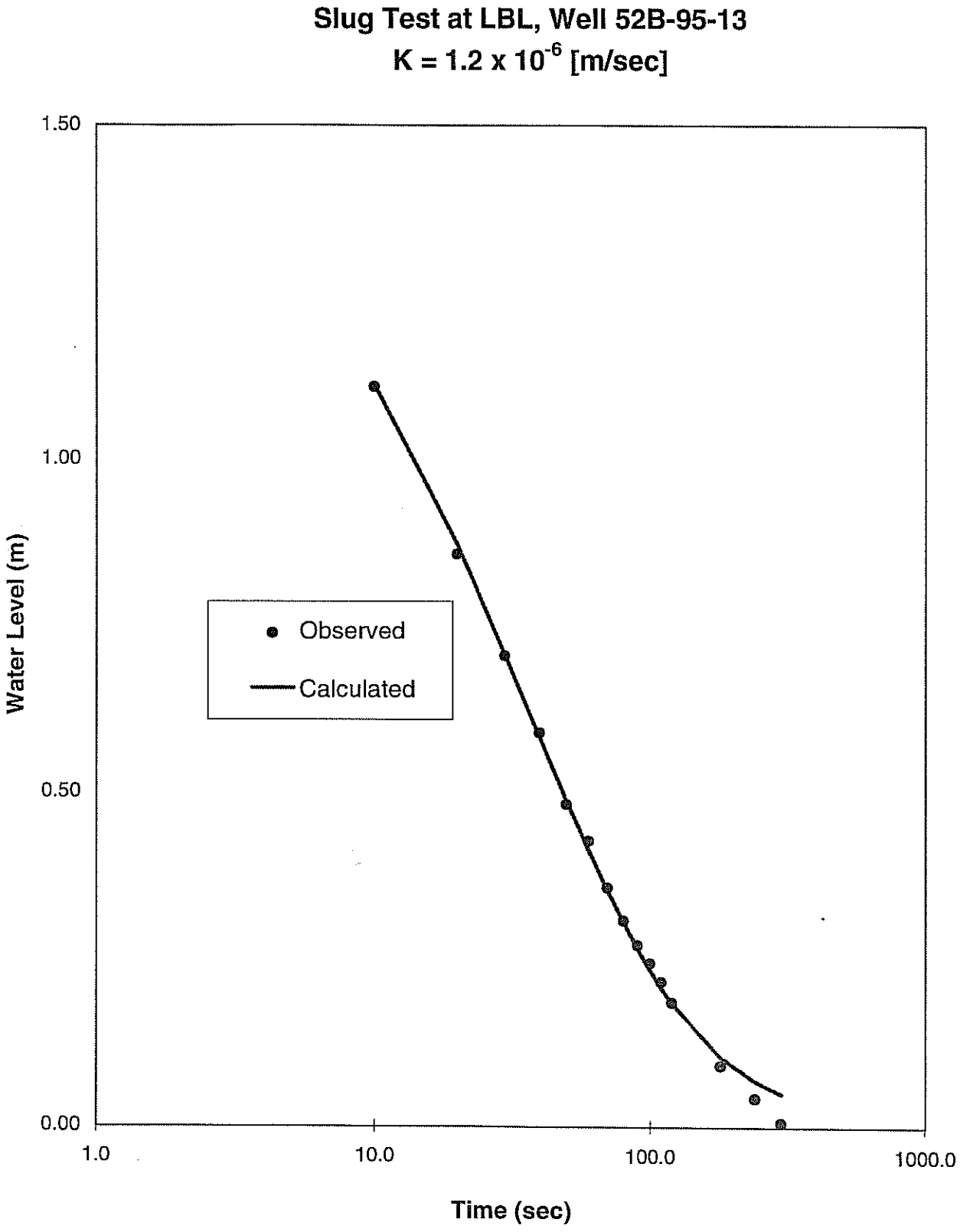

Slug Test at LBL, Well 25A-95-4
K = 8.6 x 10^-8 [m/sec]
Water Level (m)
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)
Observed
Calculated

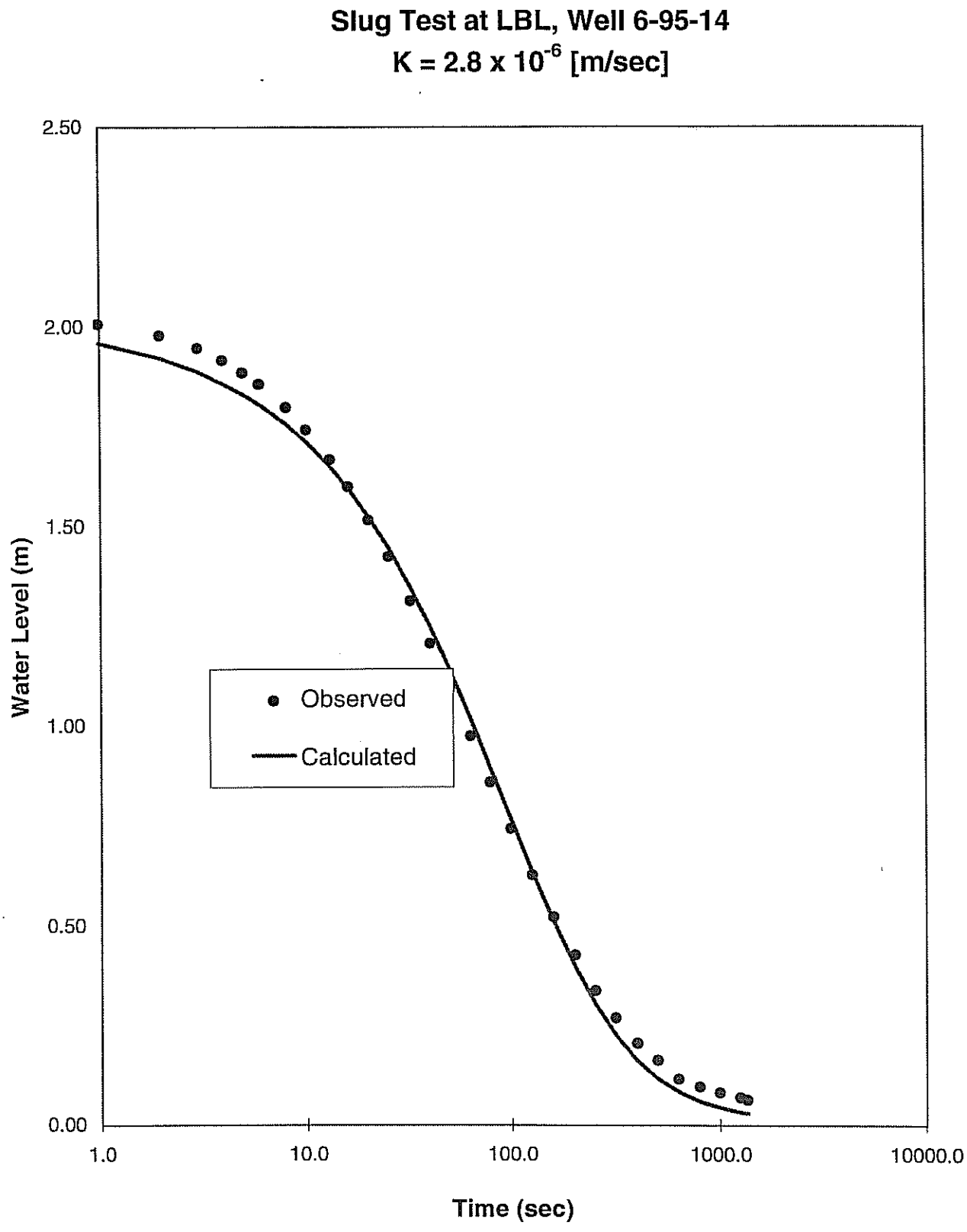

Slug Test at LBL, Well 83-95-7
K = 3.0 x 10^-6 [m/sec]
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

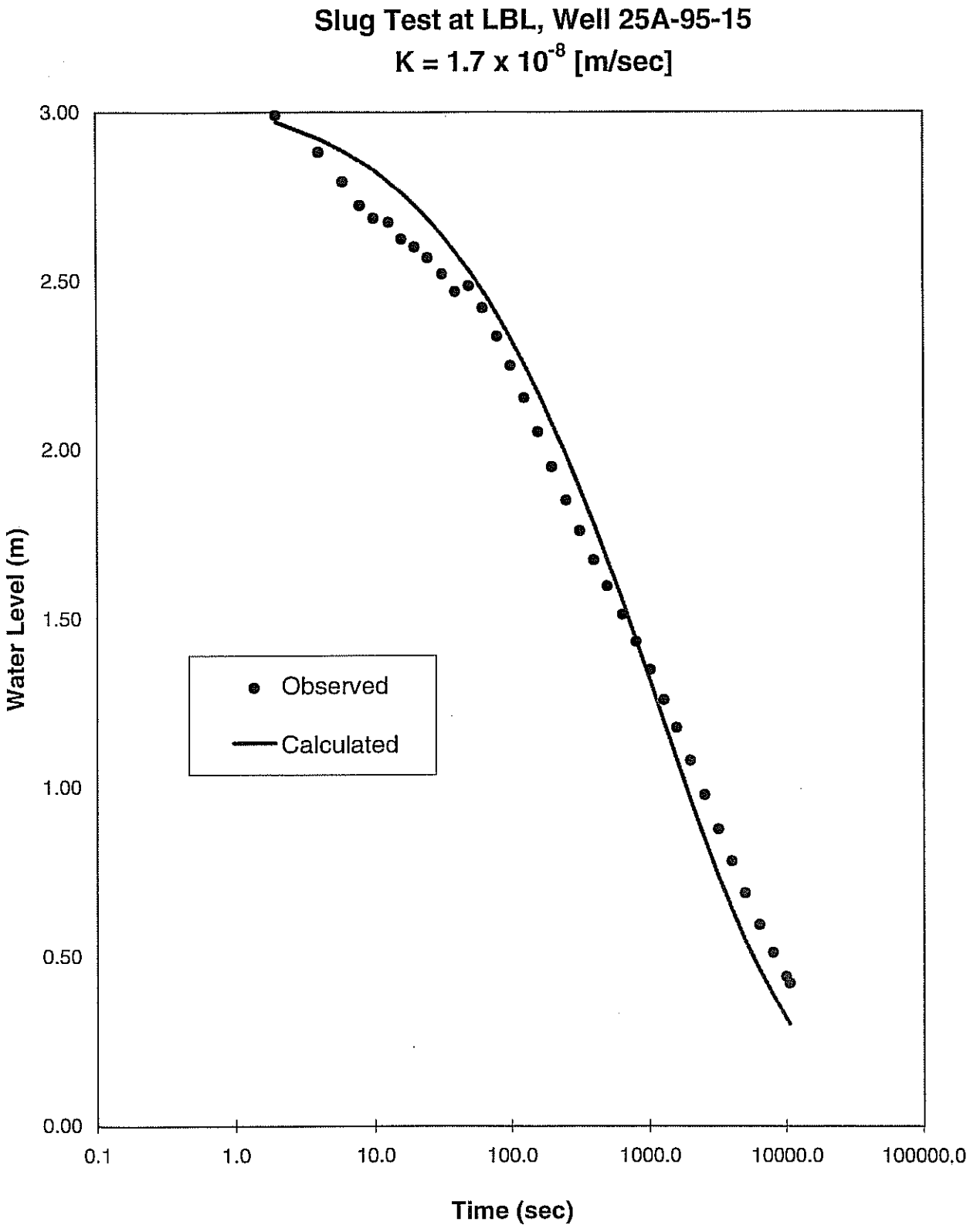

Slug Test at LBL, Well 71-95-8
K = 5.9 x 10^-6 [m/sec]
Water Level (m)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

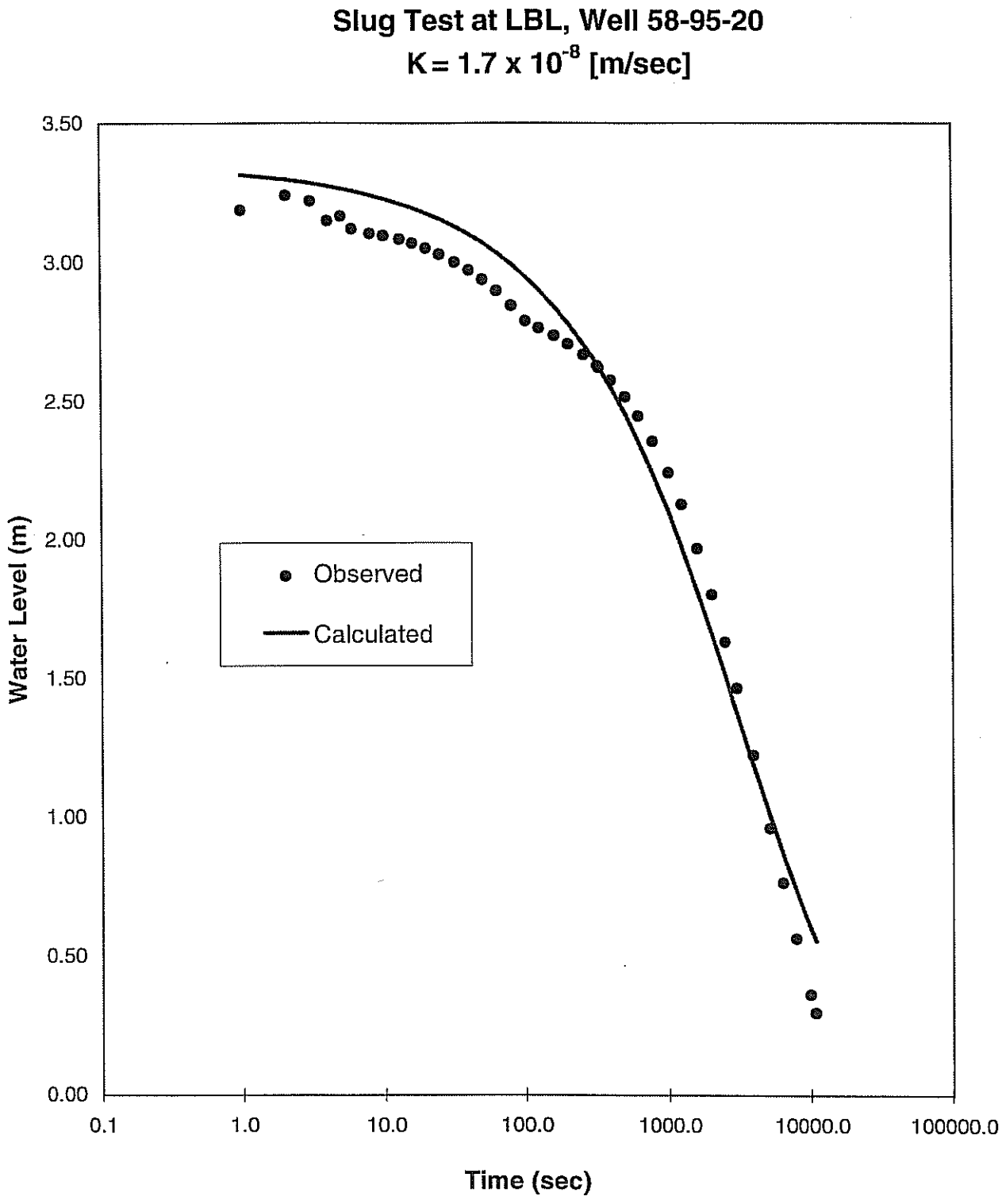

Slug Test at LBL, Well 71-95-9
K = 2.8 x 10^-6 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

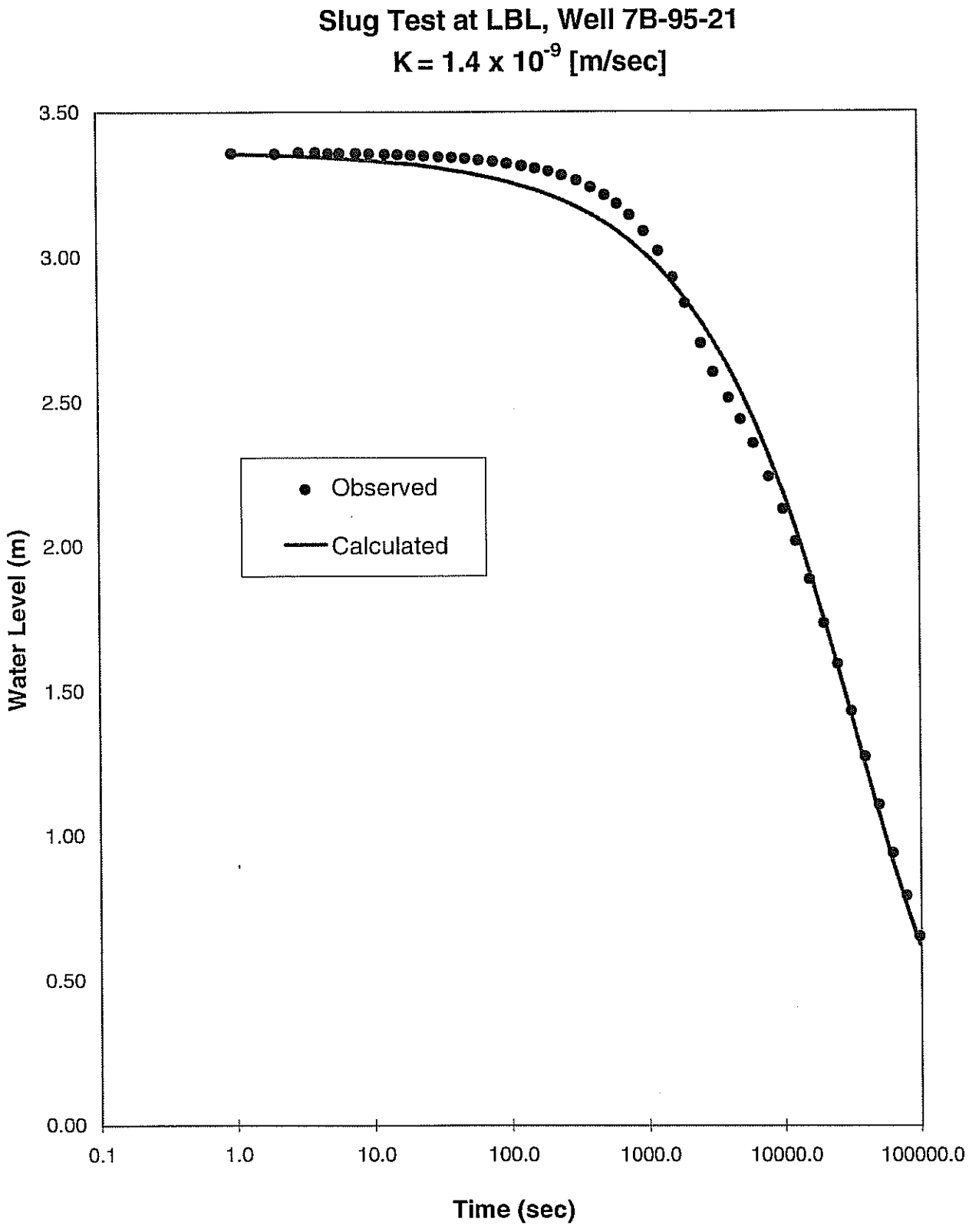

Slug Test at LBL, Well 53-95-12
K = 9.2 x 10^-7 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
10.0
100.0
1000.0
Time (sec)

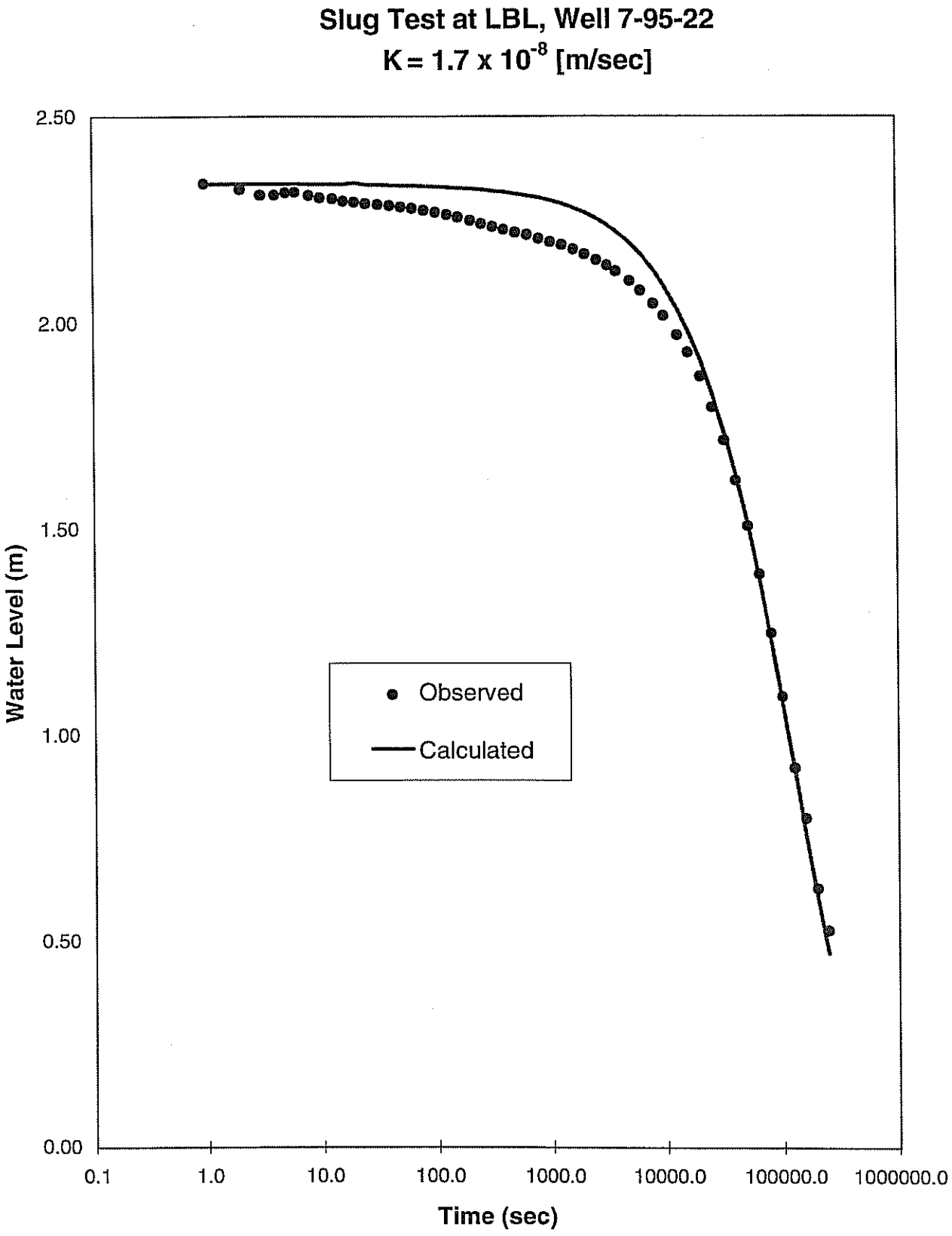

Slug Test at LBL, Well 52B-95-13
K = 1.2 x 10^-6 [m/sec]
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
1.0
10.0
100.0
1000.0
Time (sec)


Slug Test at LBL, Well 6-95-14
K = 2.8 x 10^-6 [m/sec]
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

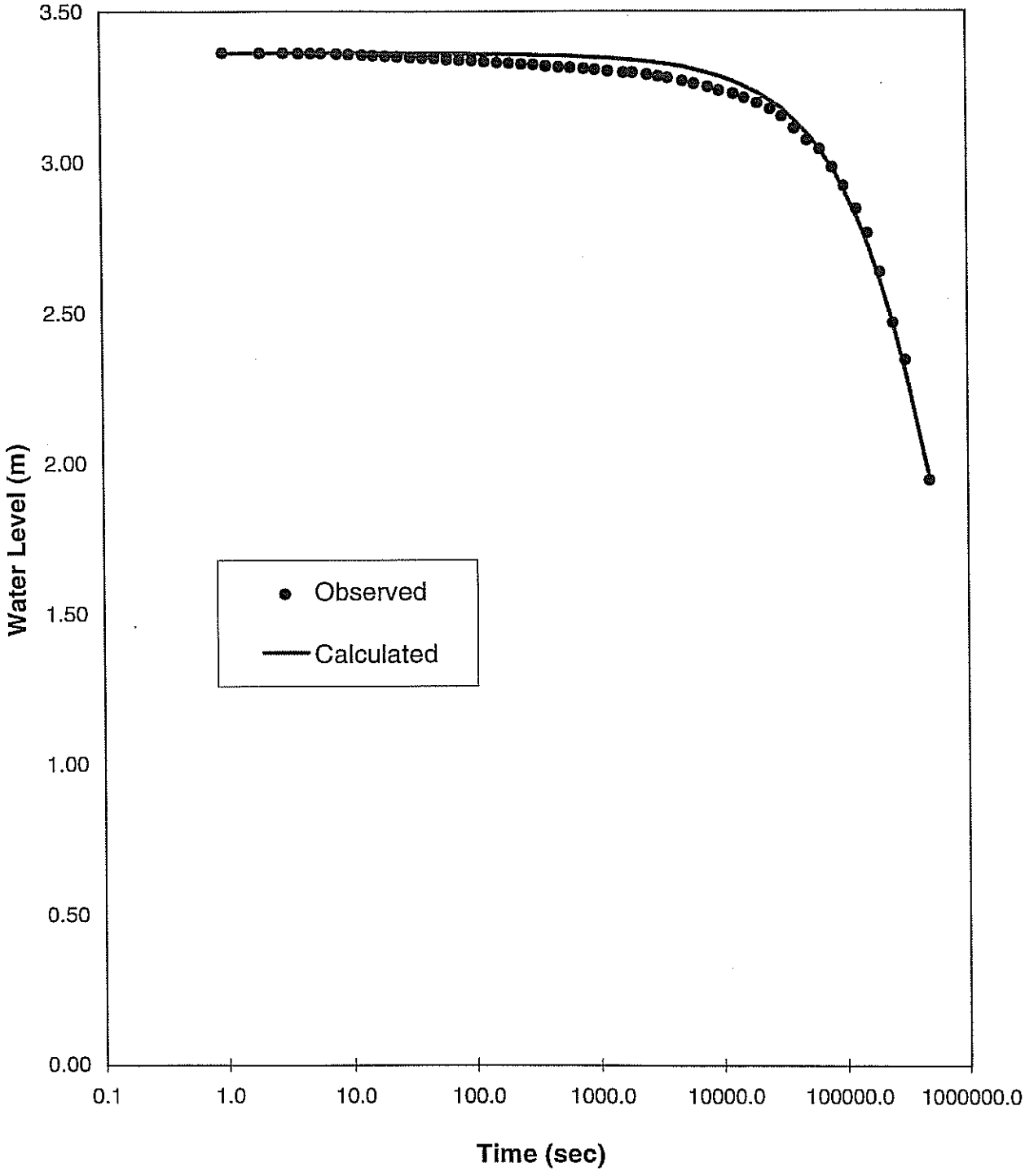

Slug Test at LBL, Well 25A-95-15
K = 1.7 x 10^-8 [m/sec]
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

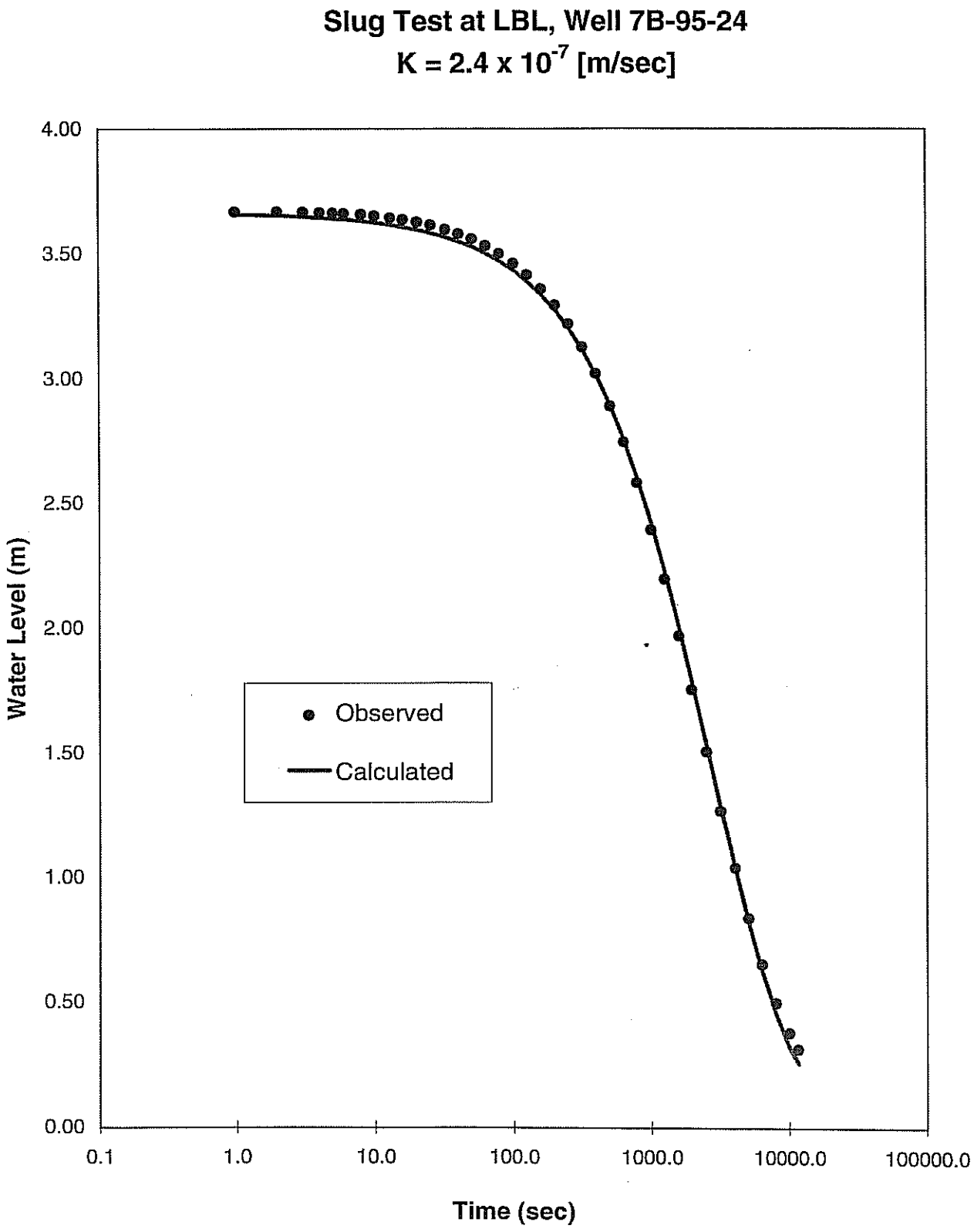

Slug Test at LBL, Well 58-95-20
K= 1.7 x 10^-8 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)


Slug Test at LBL, Well 7B-95-21
K = 1.4 x 10^-9 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)


Slug Test at LBL, Well 7-95-22
K = 1.7 x 10^-8 [m/sec]
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

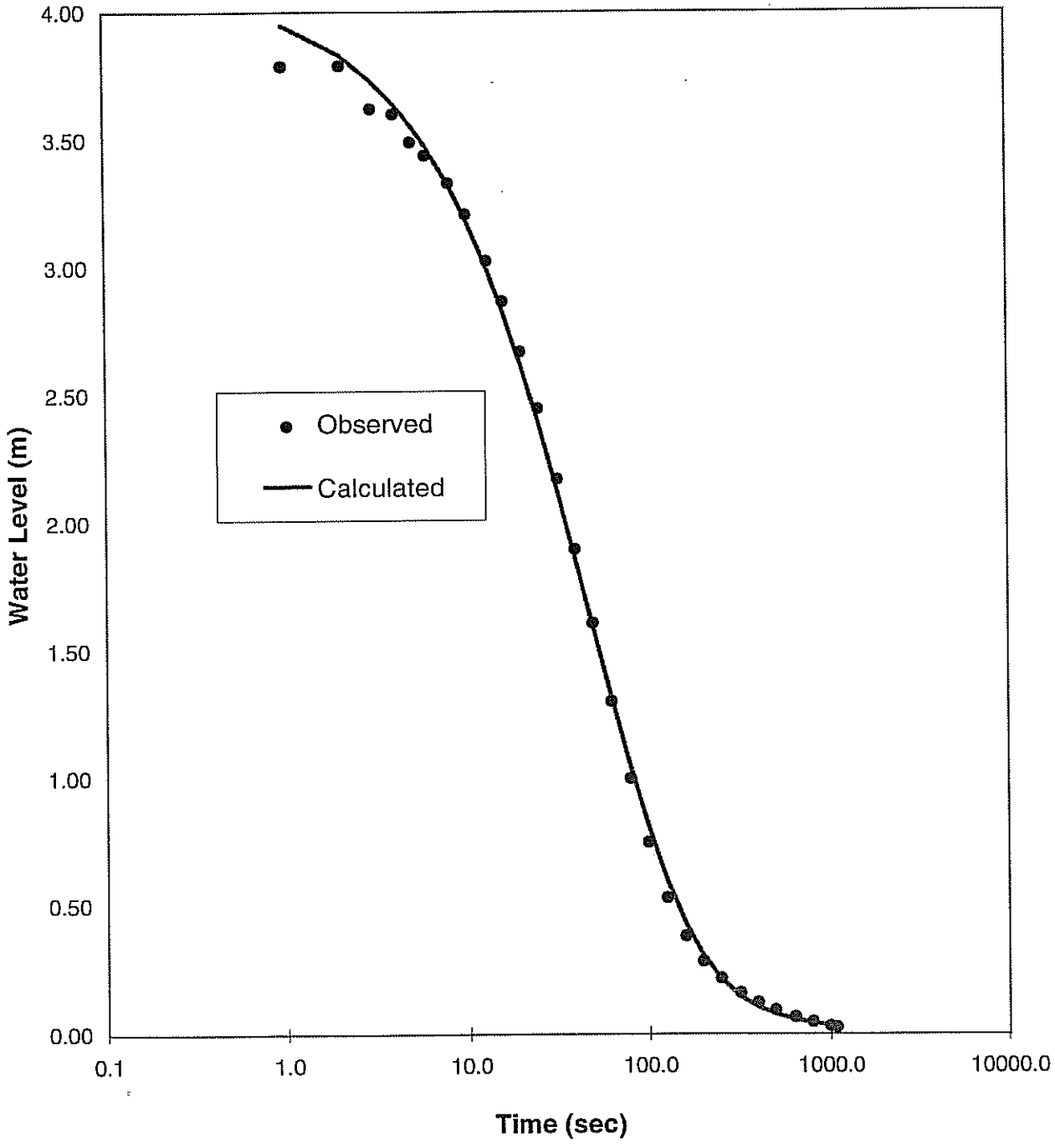
Slug Test at LBL, Well 7-95-23
$K = 1.3 \times 10^{-9}$ [m/sec]

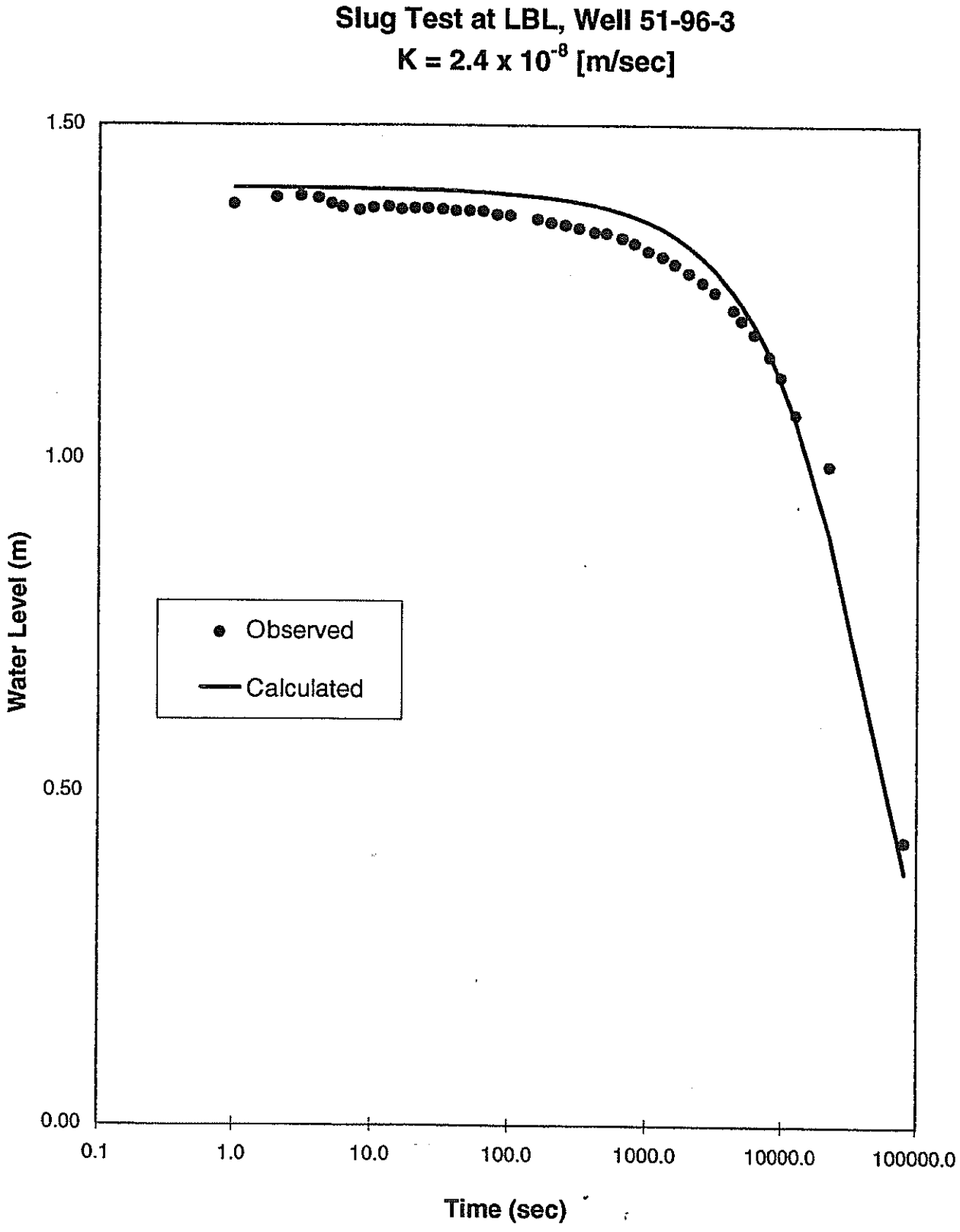


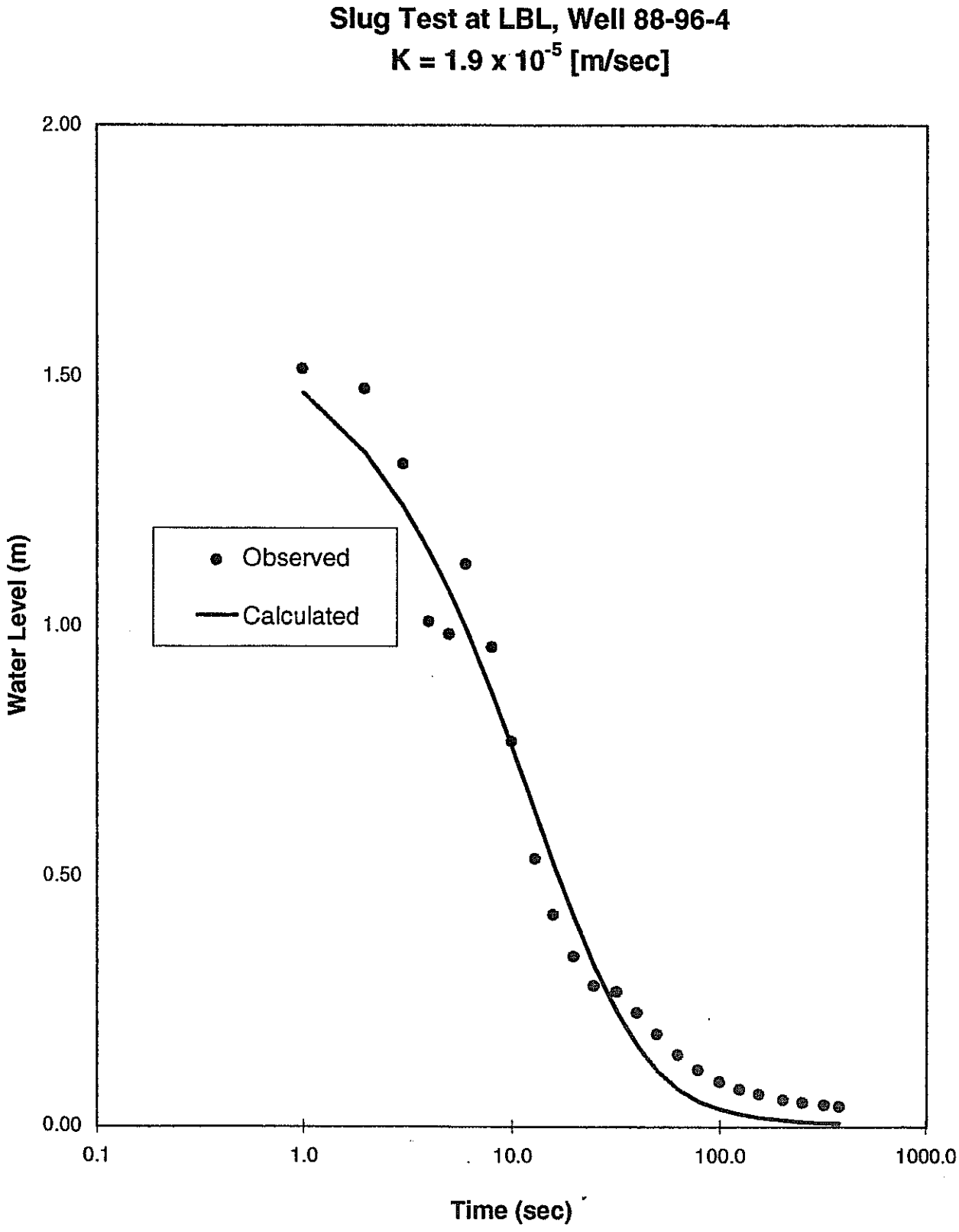

Slug Test at LBL, Well 7B-95-24
K = 2.4 x 10^-7 [m/sec]
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

Slug Test at LBL, Well 7B-95-25

K = 3.8 x 10^{-6} [m/sec]



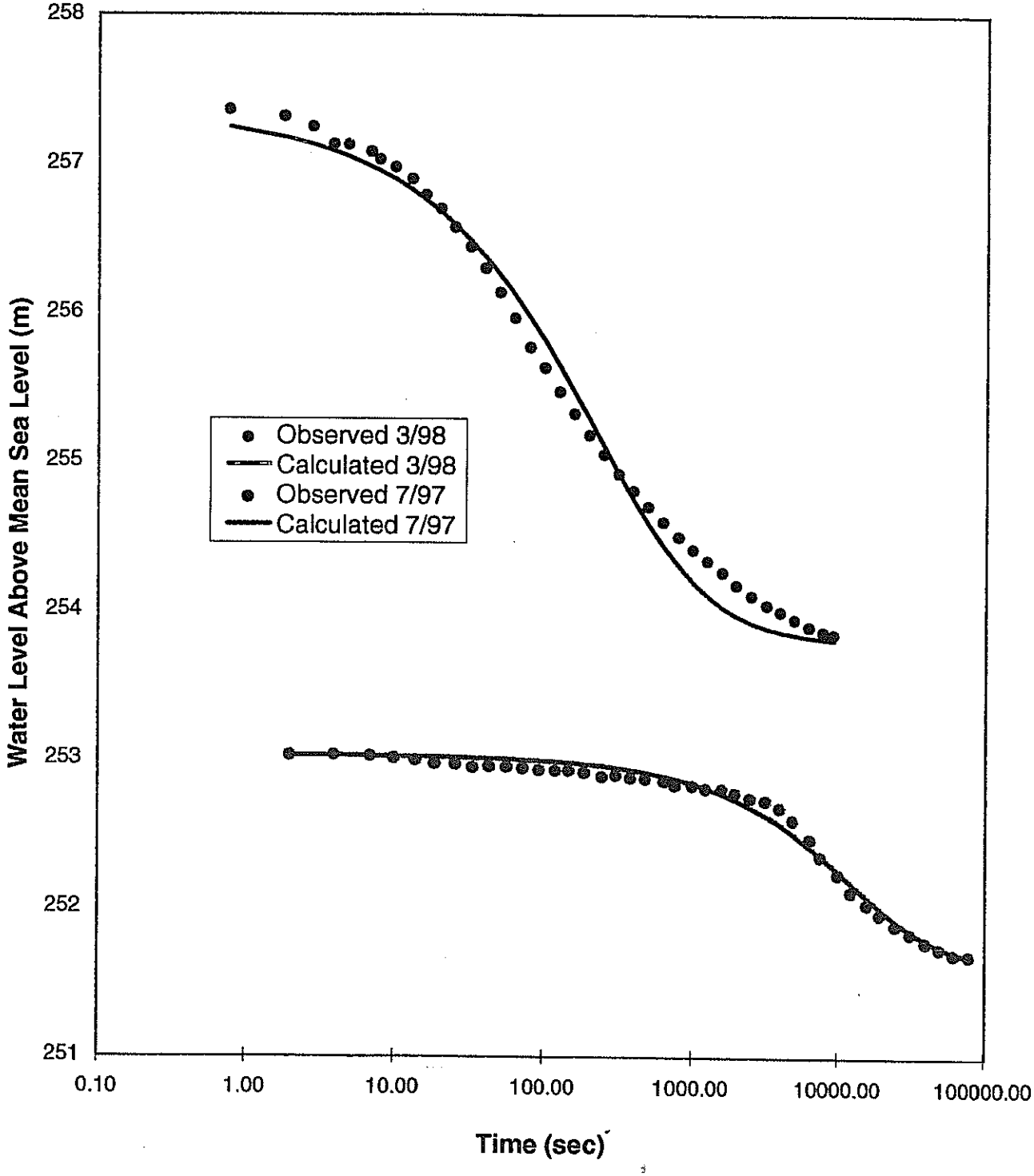

Slug Test at LBL, Well 51-96-3
K = 2.4 x 10^-8 [m/sec]
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

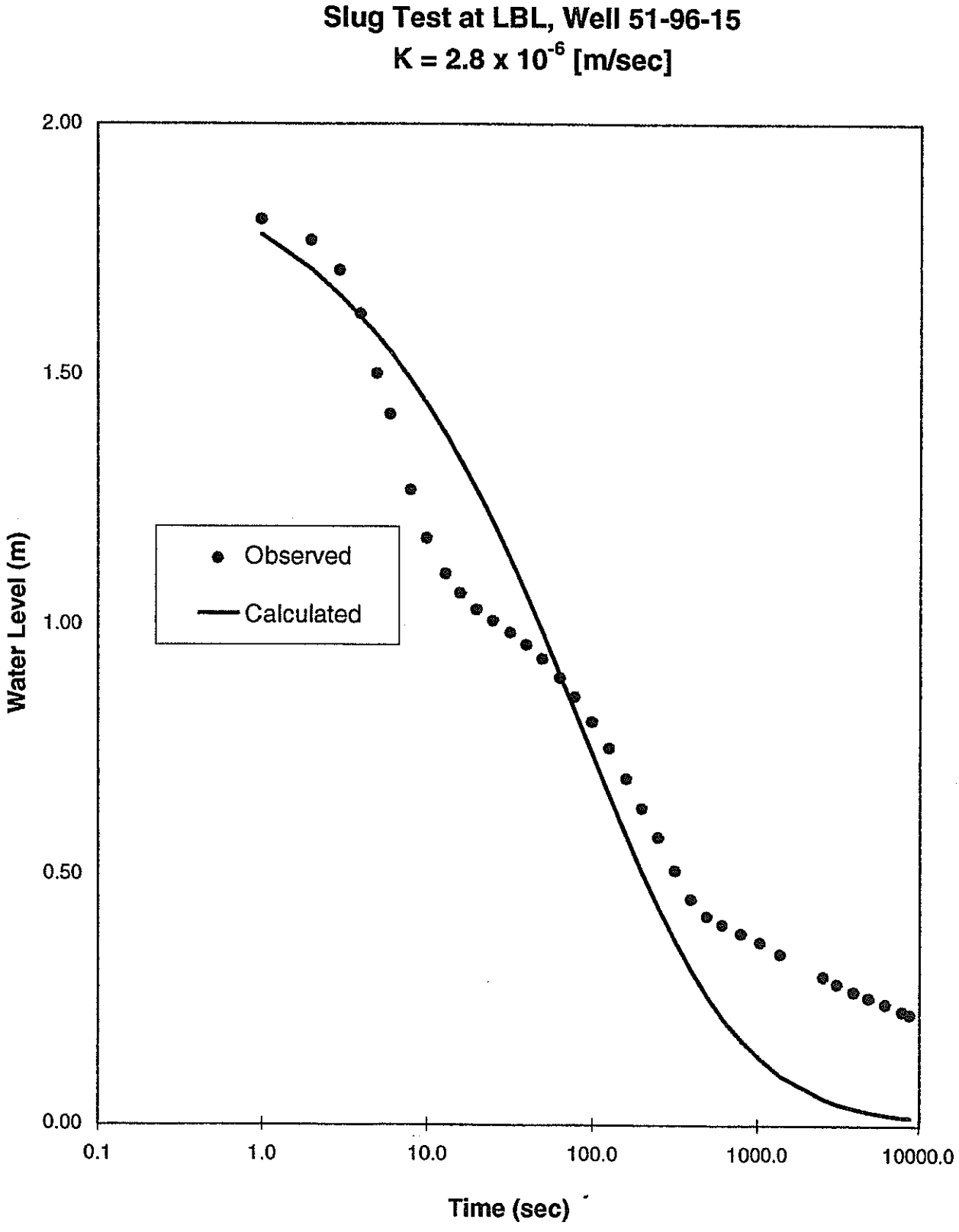

Slug Test at LBL, Well 88-96-4
K = 1.9 x 10^-5 [m/sec]
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
Time (sec)

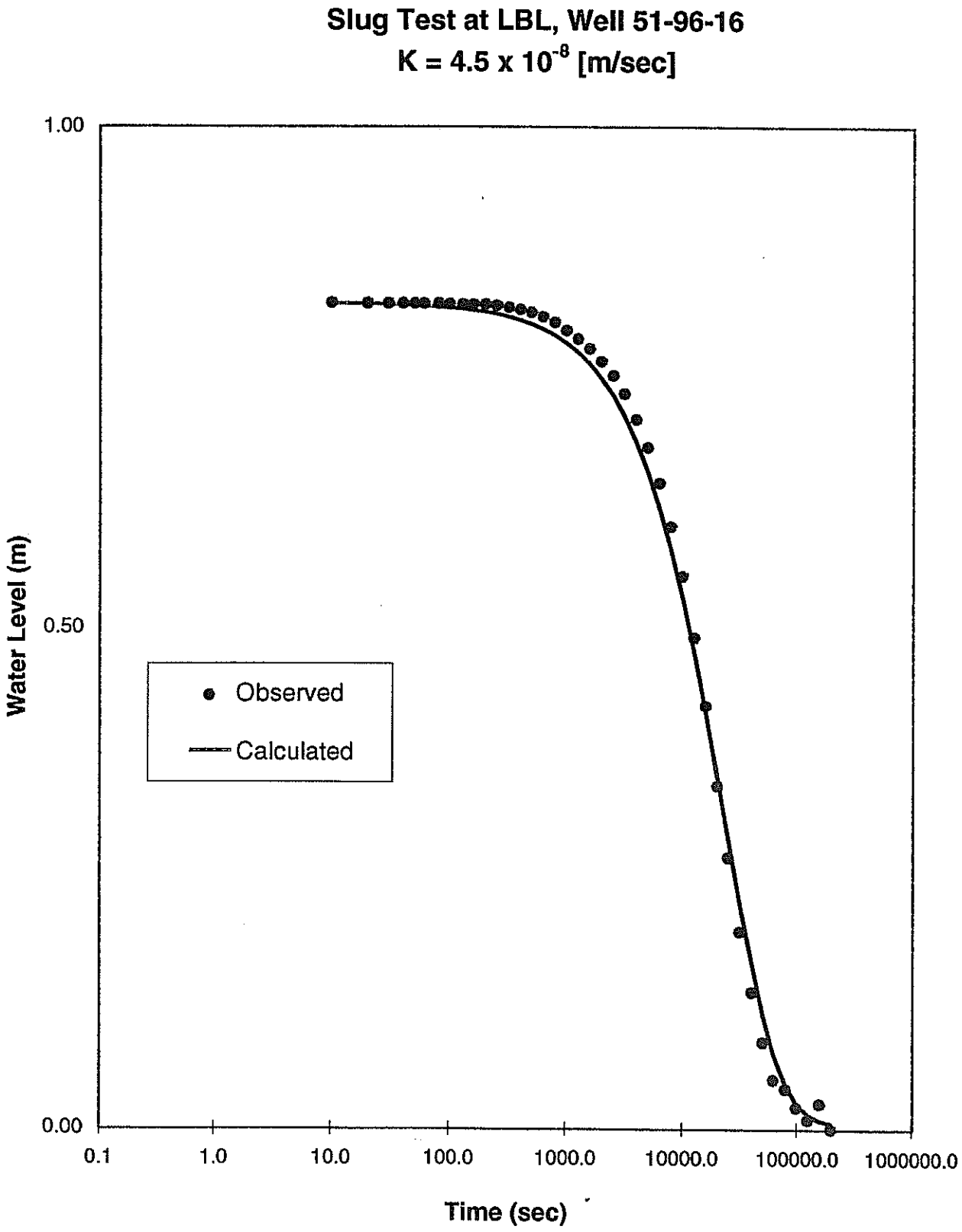
Slug Tests at LBL, Well 58-96-11

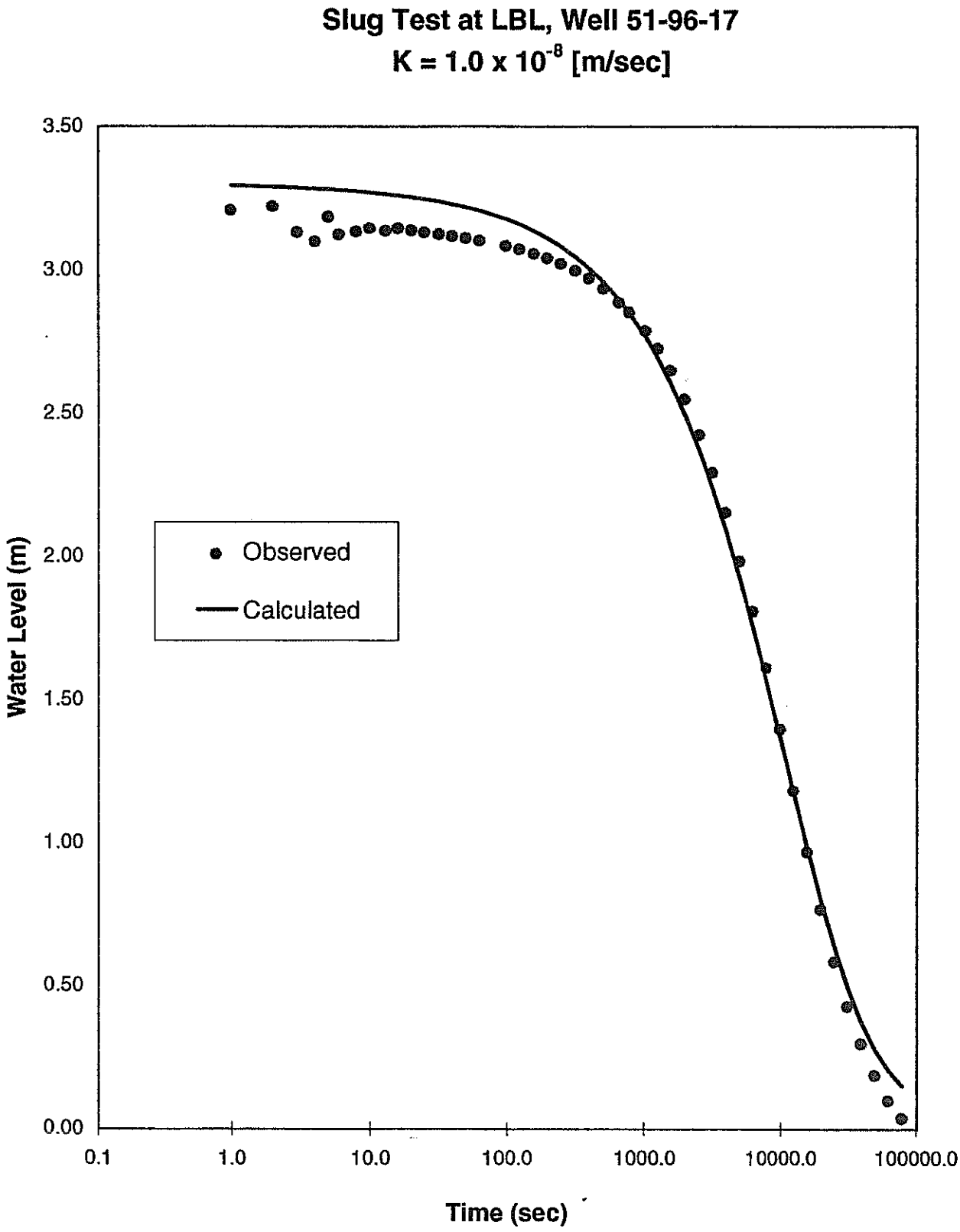
$K_{3/98} = 1.1 \times 10^{-8}$ [m/sec]

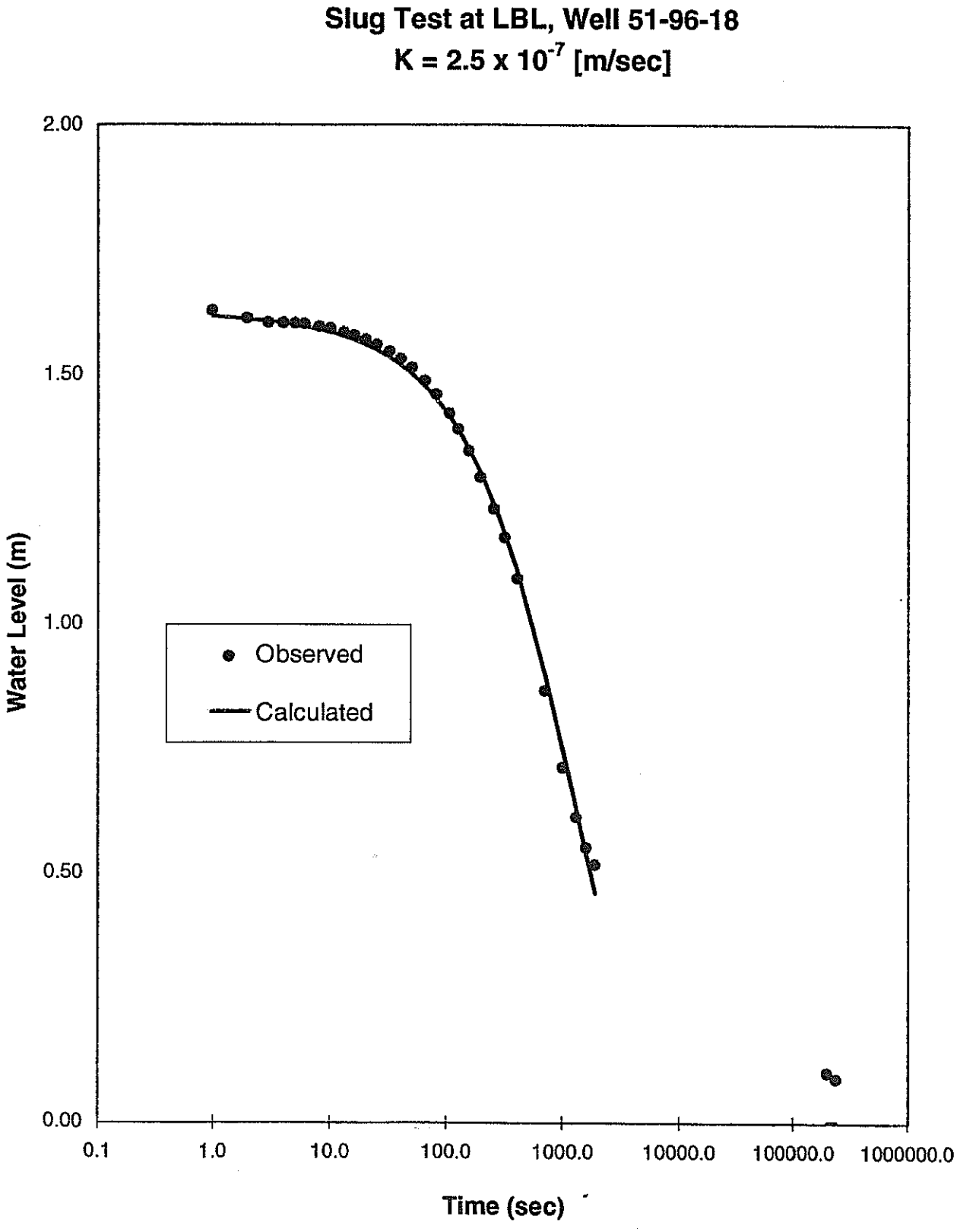
$K_{7/97} = 3.0 \times 10^{-7}$ [m/sec]

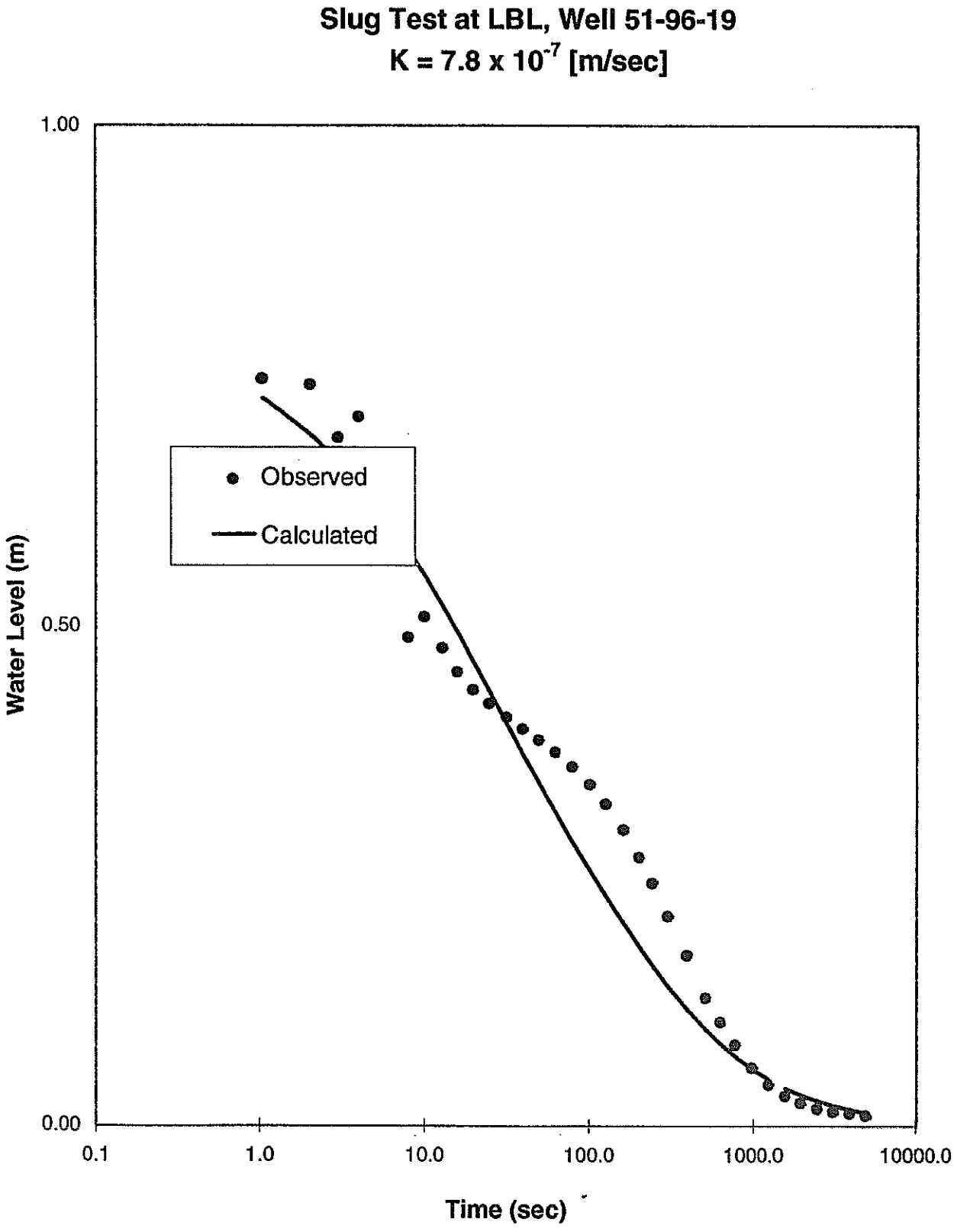


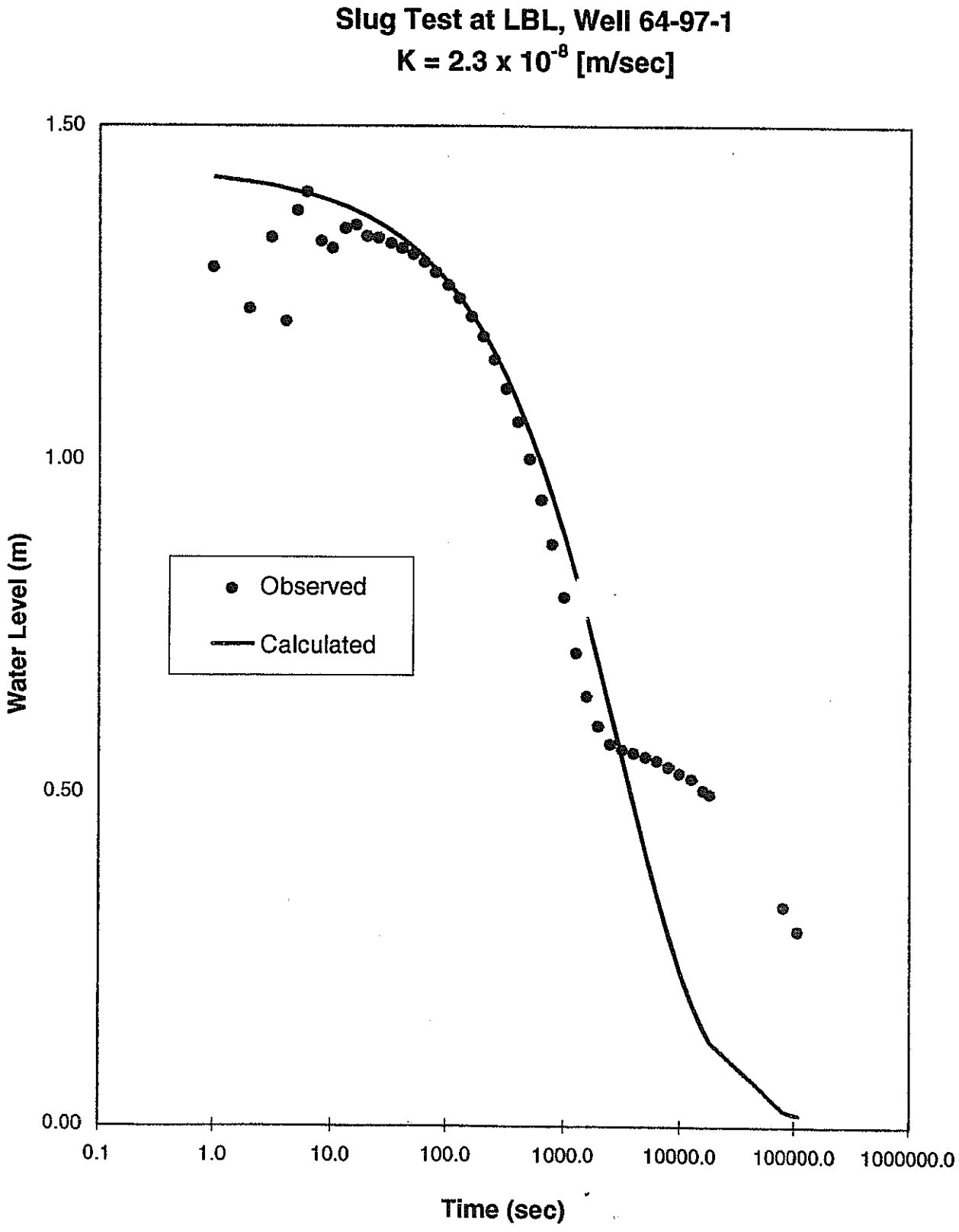

Slug Test at LBL, Well 51-96-15
K = 2.8 x 10^-6 [m/sec]
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

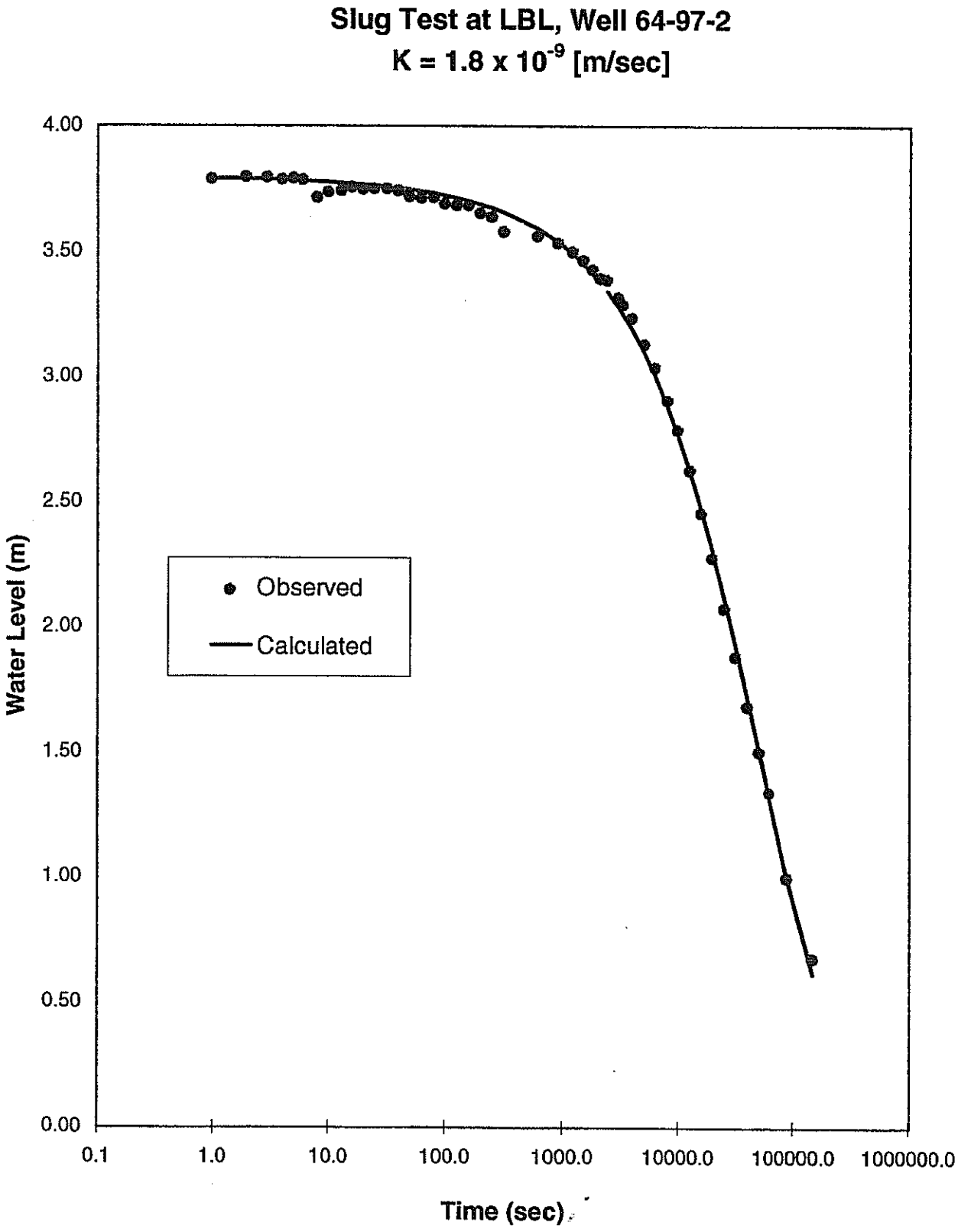

Slug Test at LBL, Well 51-96-16
K = 4.5 x 10^-8 [m/sec]
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

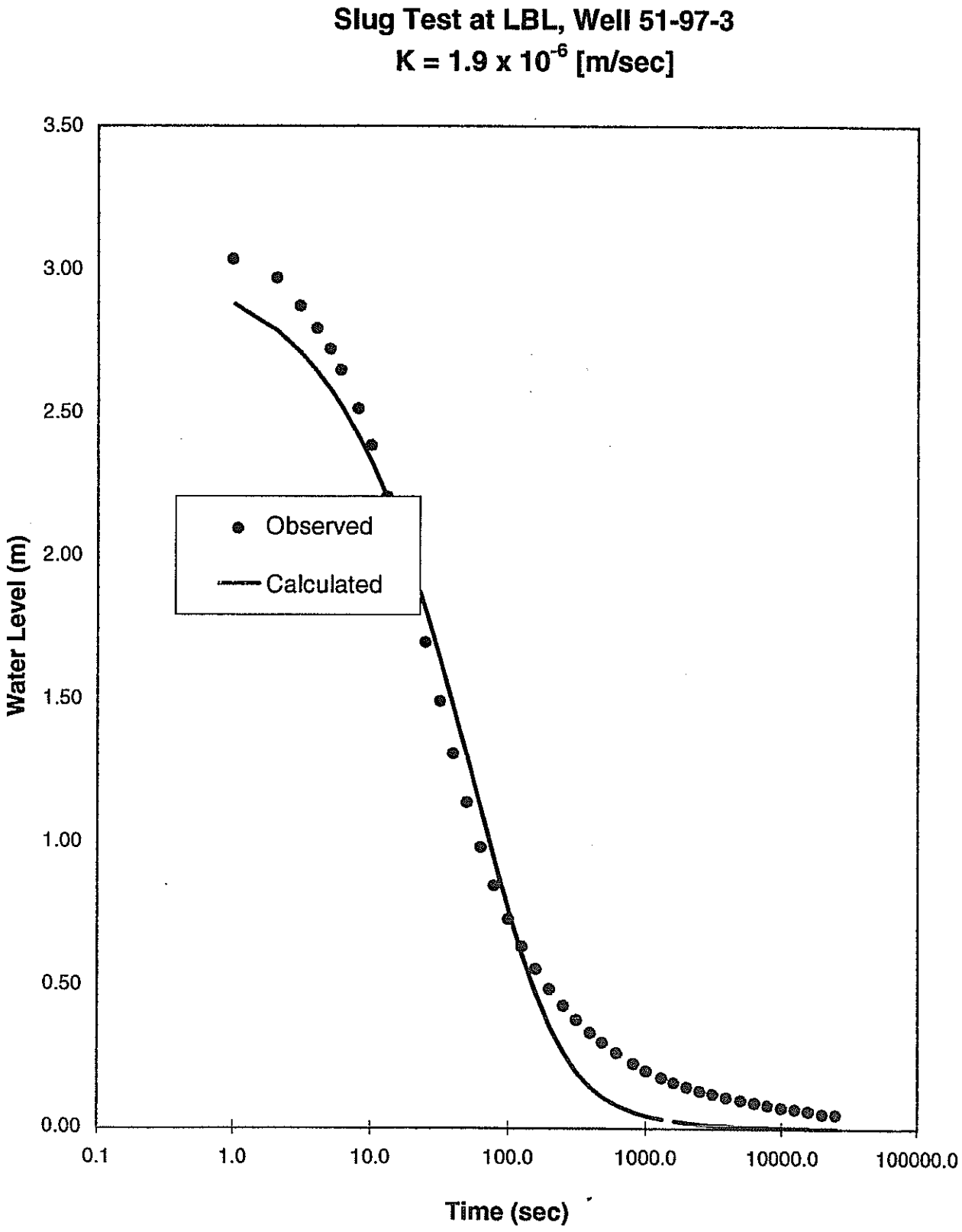

Slug Test at LBL, Well 51-96-17
K = 1.0 x 10^-8 [m/sec]
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)


Slug Test at LBL, Well 51-96-18
K = 2.5 x 10^-7 [m/sec]
2.00
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

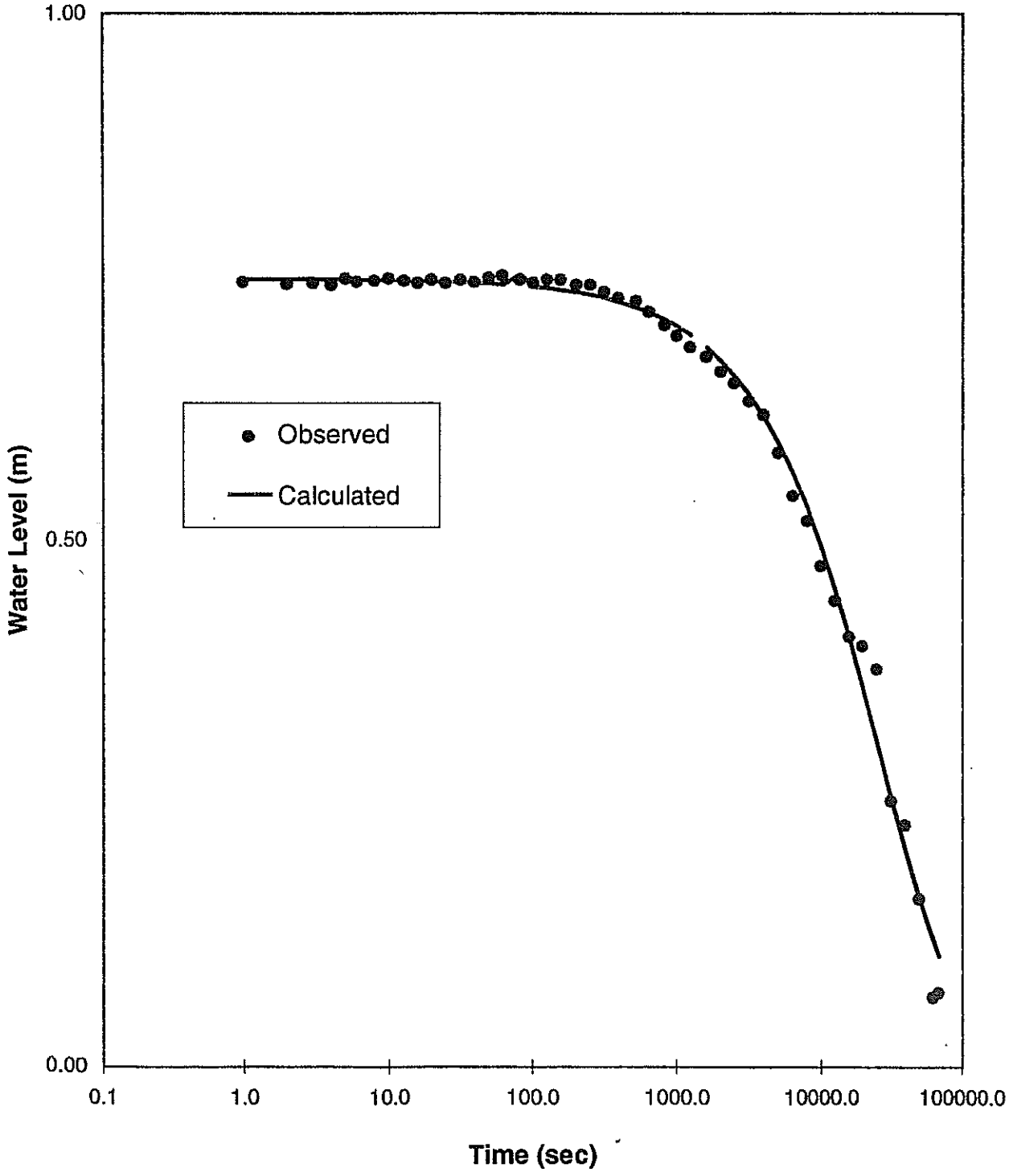

Slug Test at LBL, Well 51-96-19
K = 7.8 x 10^-7 [m/sec]
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
Time (sec)

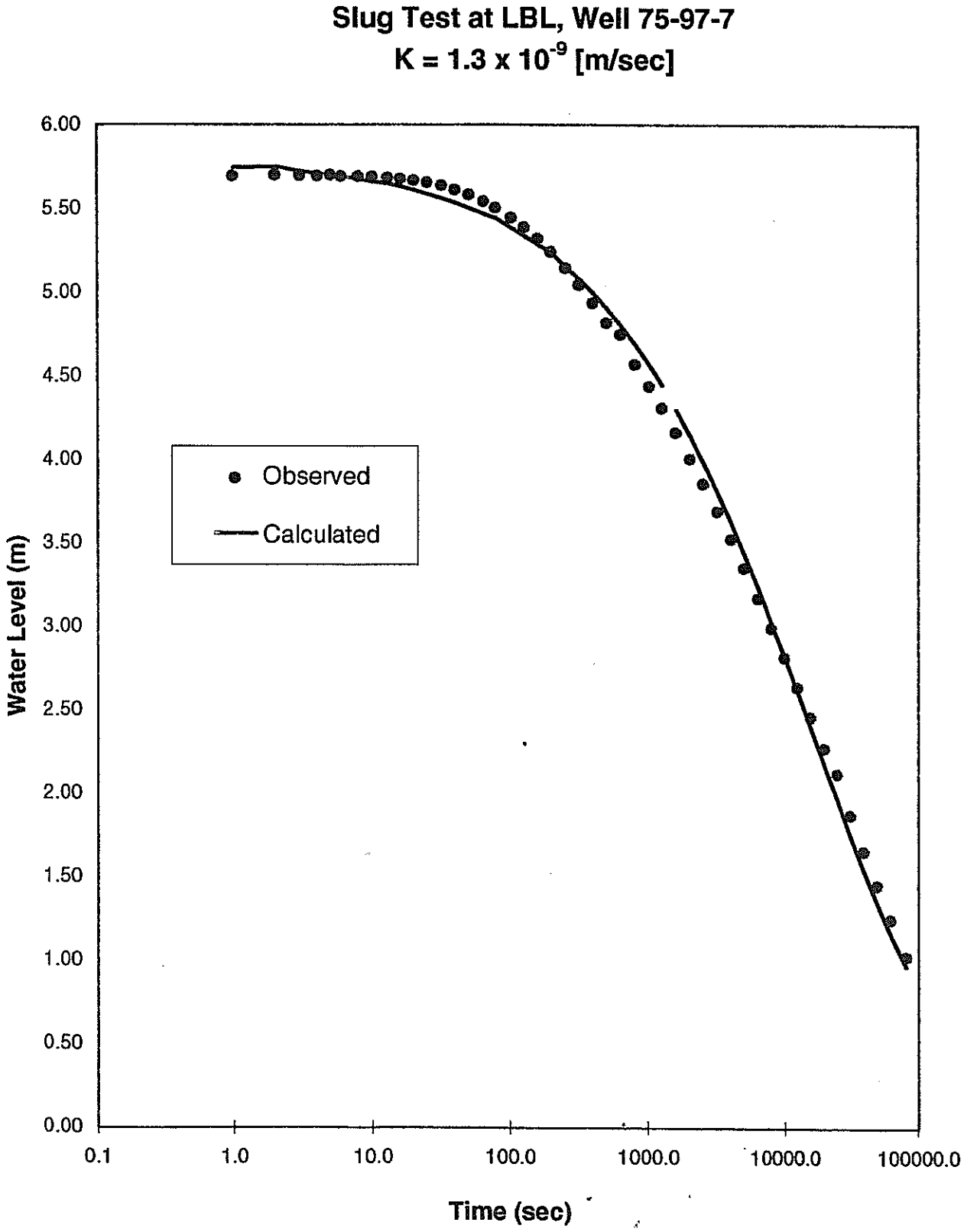

Slug Test at LBL, Well 64-97-1
K = 2.3 x 10^-8 [m/sec]
1.50
1.00
0.50
0.00
Water Level (m)
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)


Slug Test at LBL, Well 64-97-2
K = 1.8 x 10^-9 [m/sec]
Water Level (m)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
1000000.0
Time (sec)

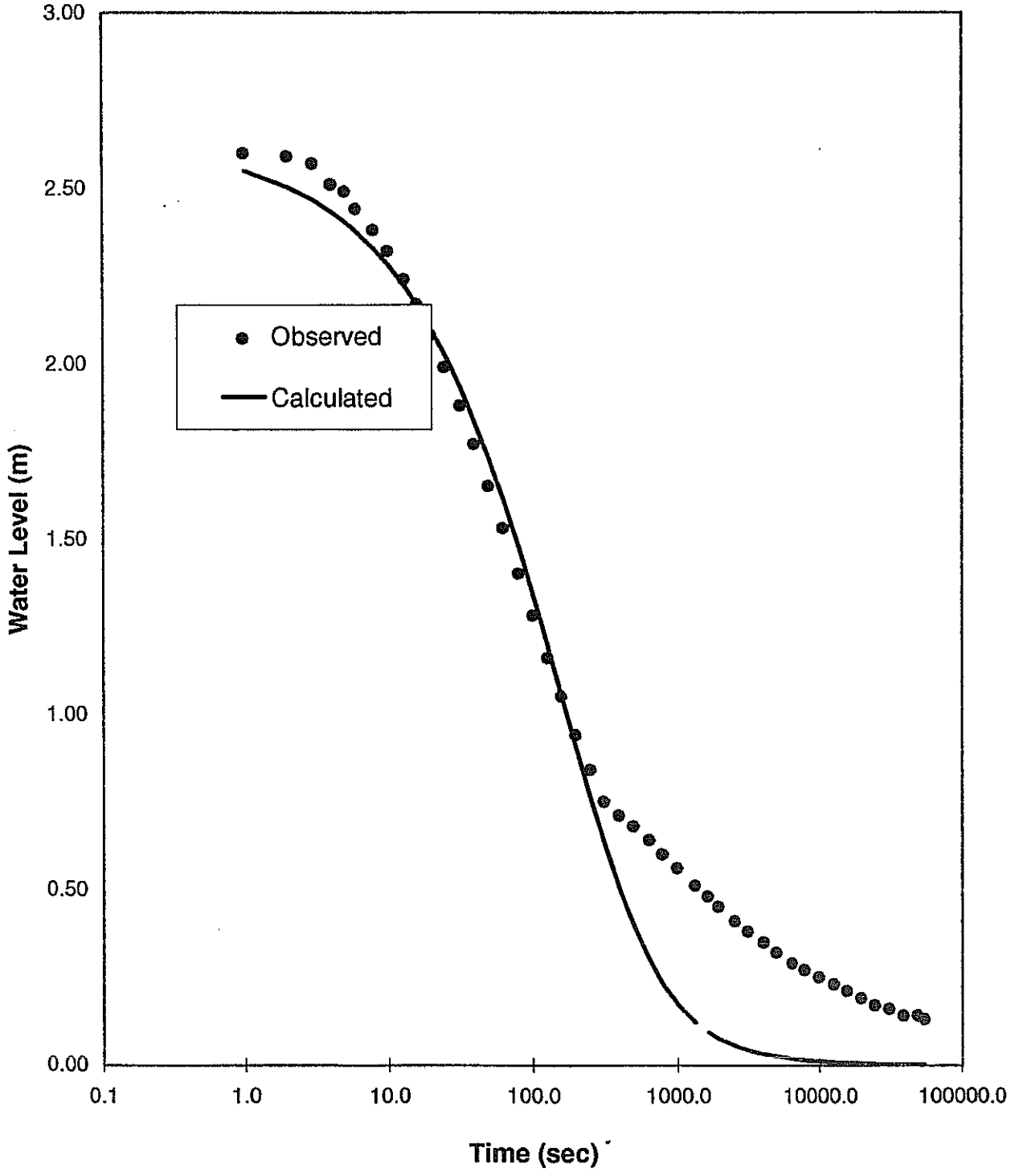

Slug Test at LBL, Well 51-97-3
K = 1.9 x 10^-6 [m/sec]
Water Level (m)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

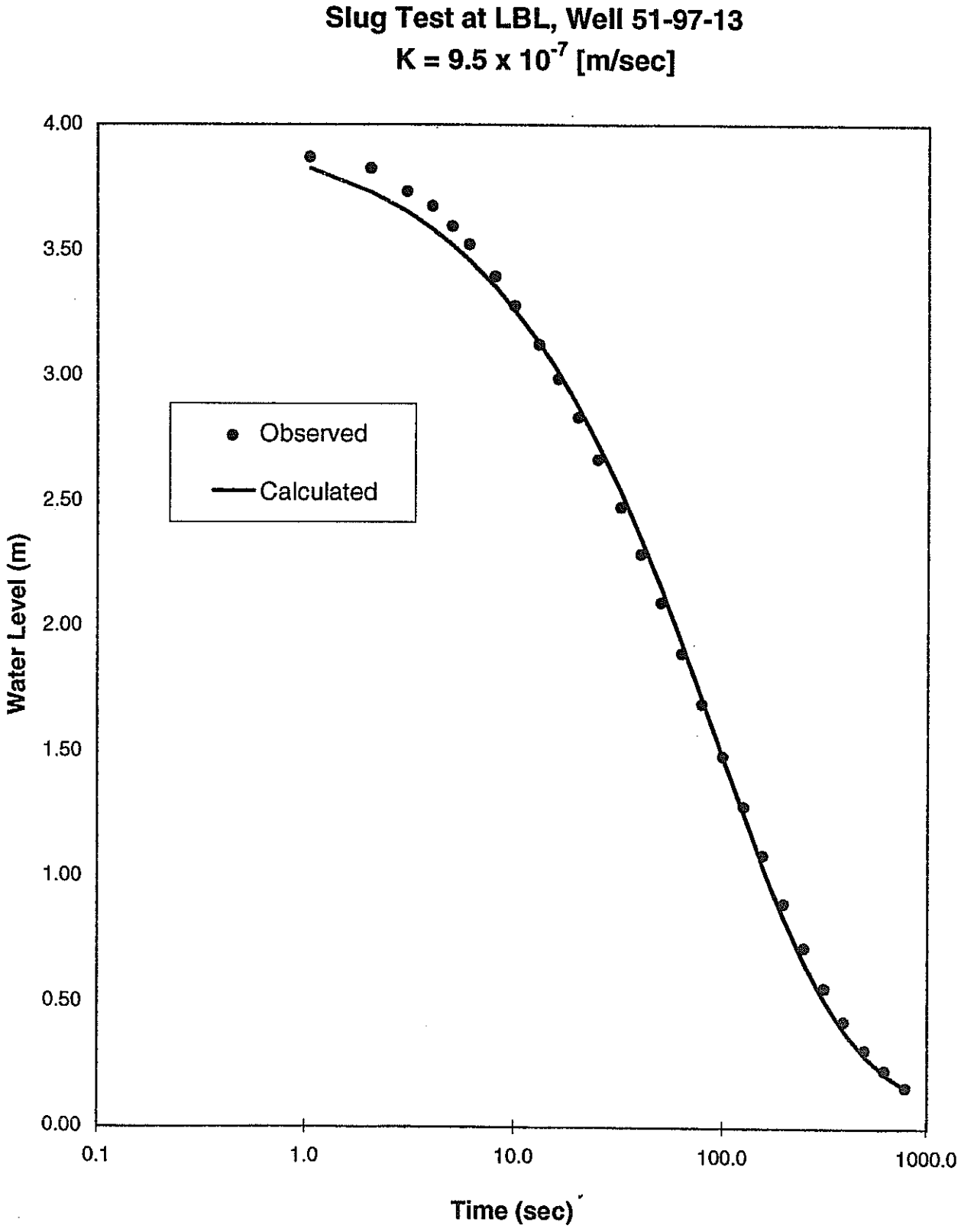
Slug Test at LBL, Well 75-97-6
K = 1.0 x 10^{-7} [m/sec]

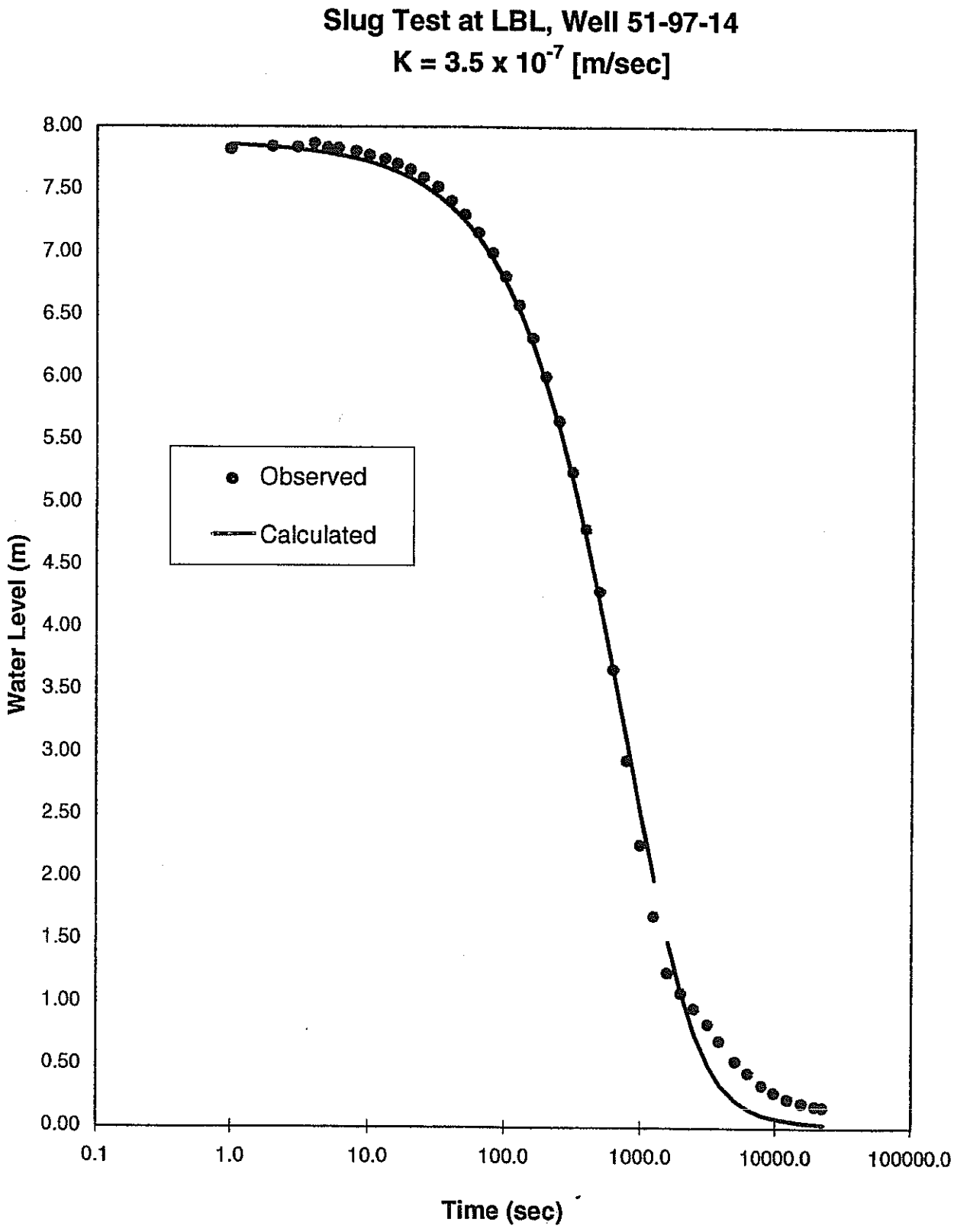


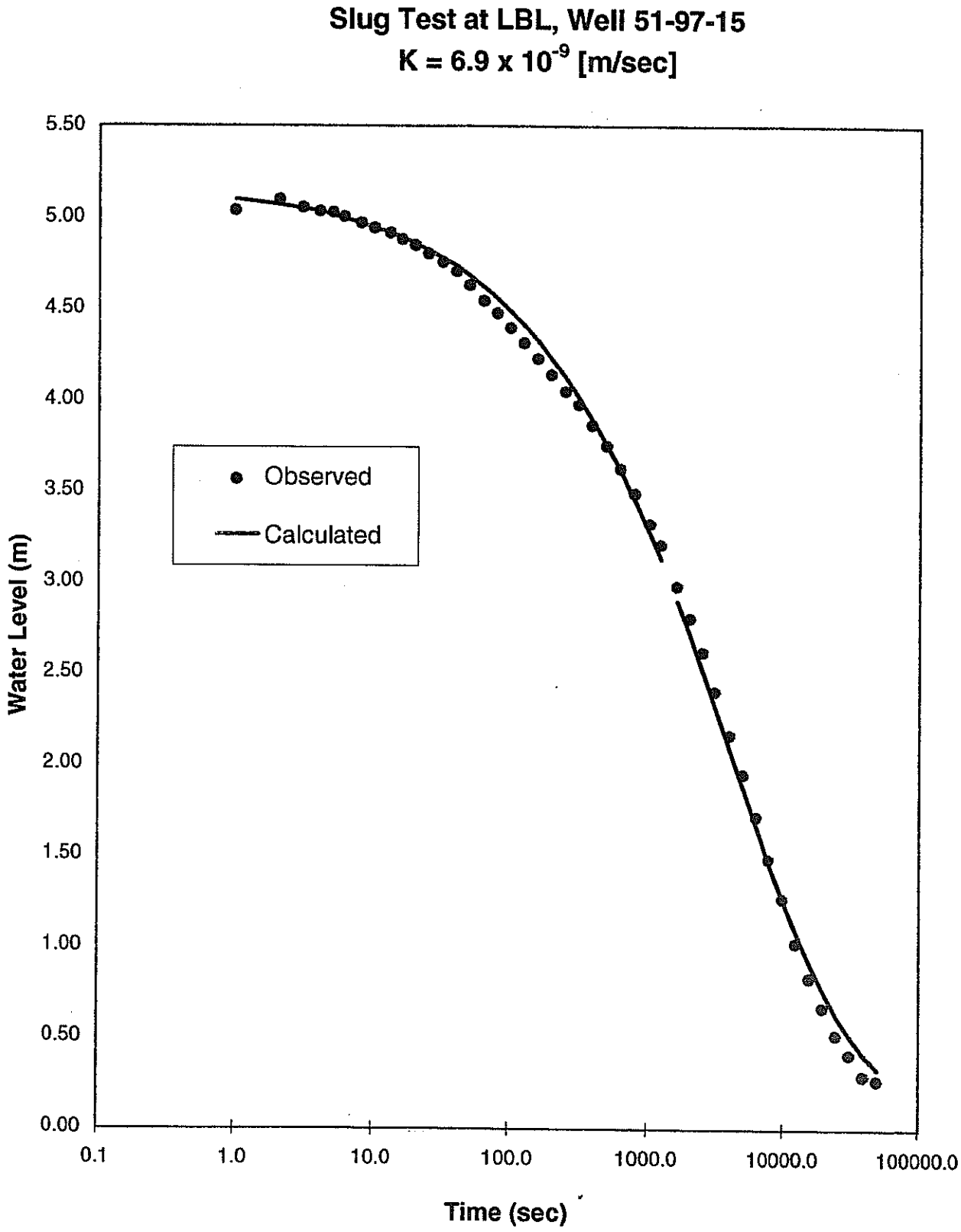

Slug Test at LBL, Well 75-97-7
K = 1.3 x 10^-9 [m/sec]
Water Level (m)
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Observed
Calculated
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

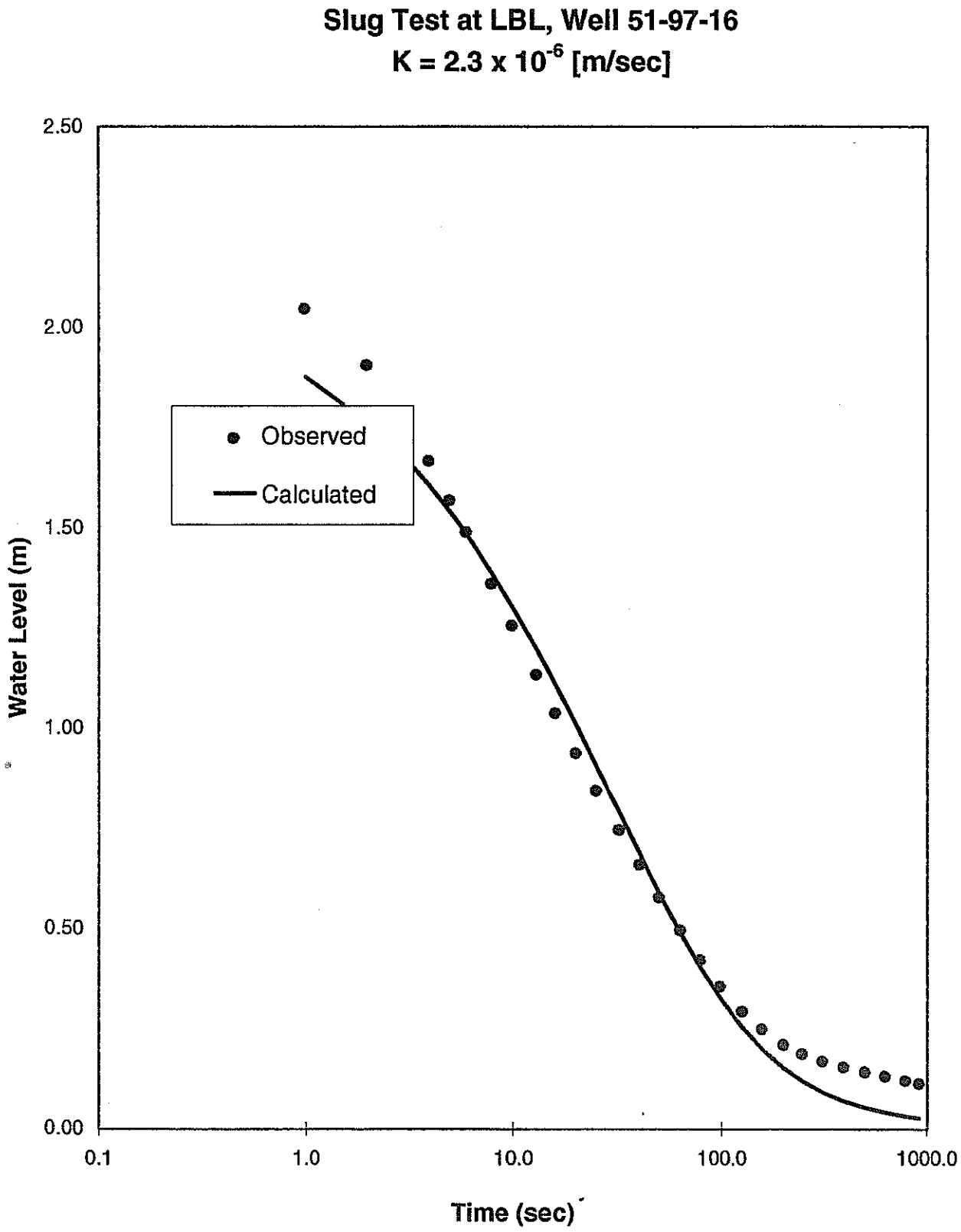
Slug Test at LBL, Well 51-97-12
K = 7.1 x 10^{-7} [m/sec]

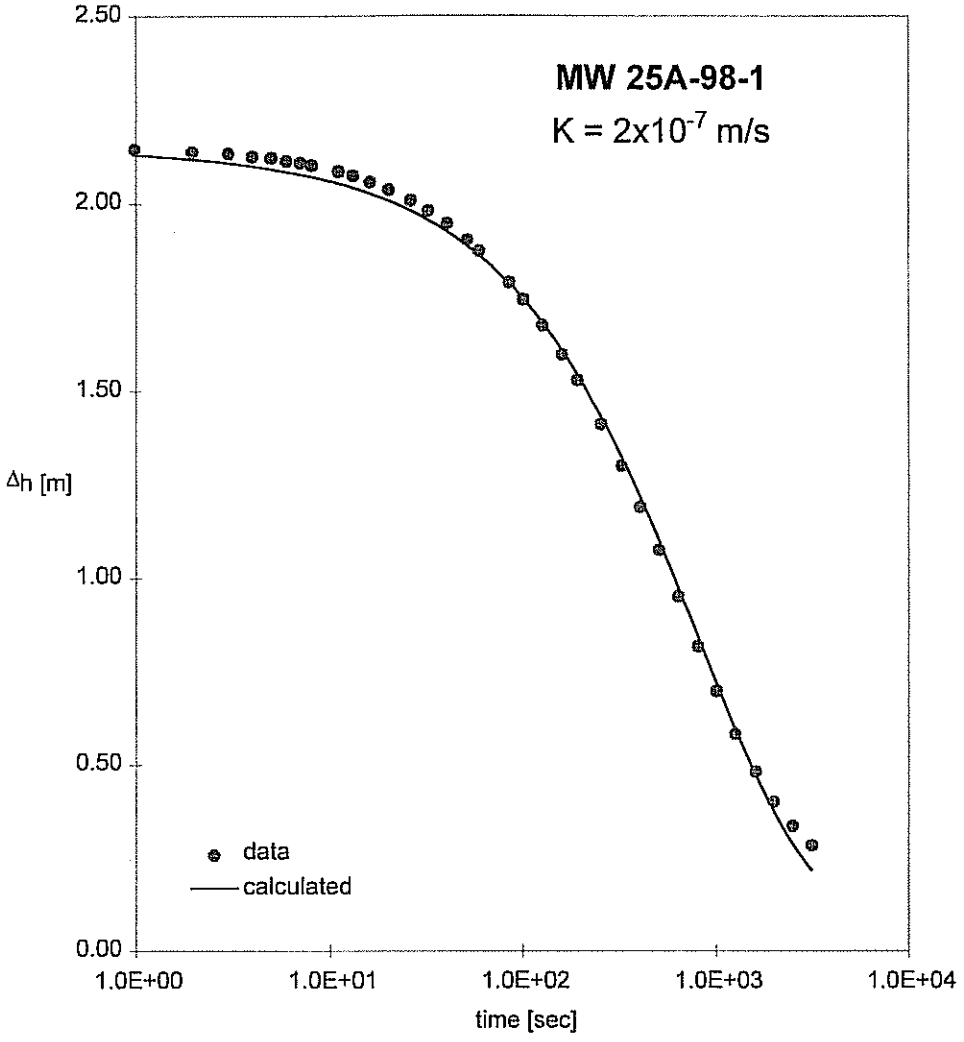


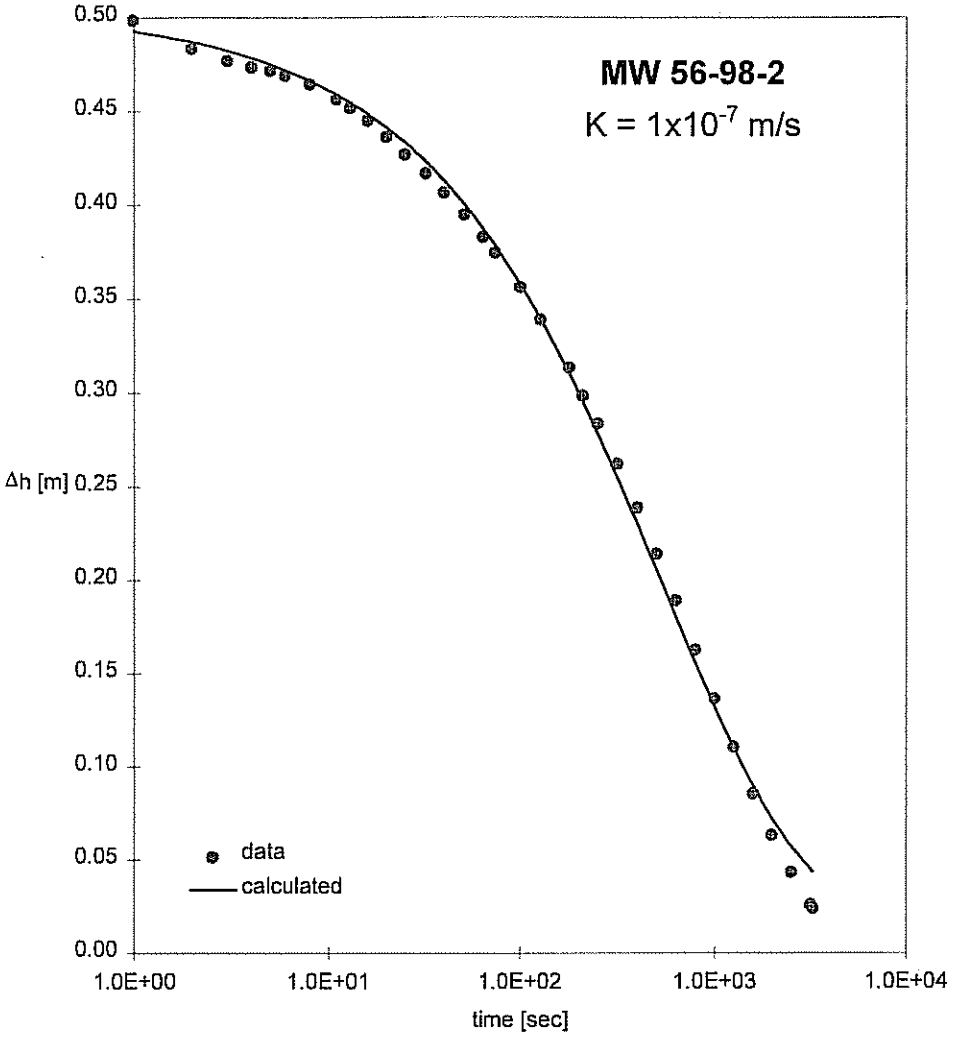

Slug Test at LBL, Well 51-97-13
K = 9.5 x 10^-7 [m/sec]
Observed
Calculated
Water Level (m)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
Time (sec)

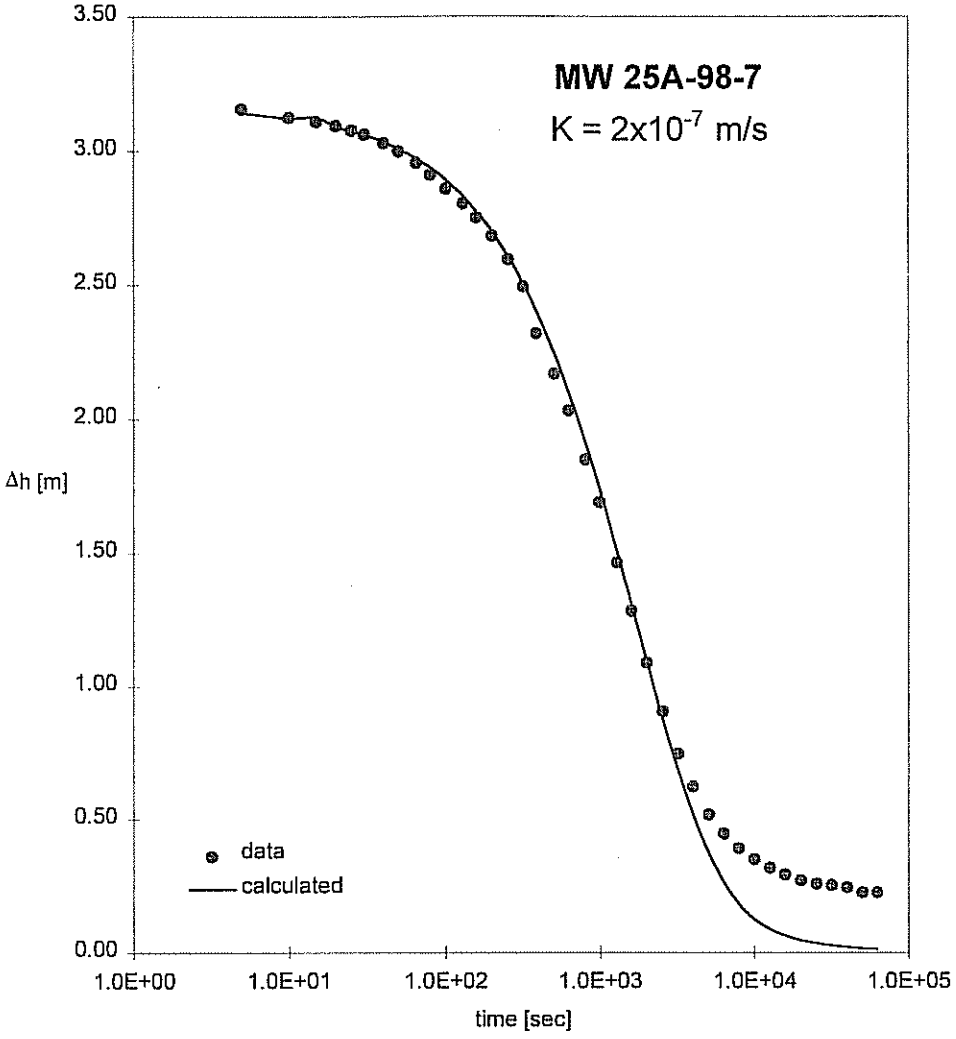

Slug Test at LBL, Well 51-97-14
K = 3.5 x 10^-7 [m/sec]
Observed
Calculated
Water Level (m)
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

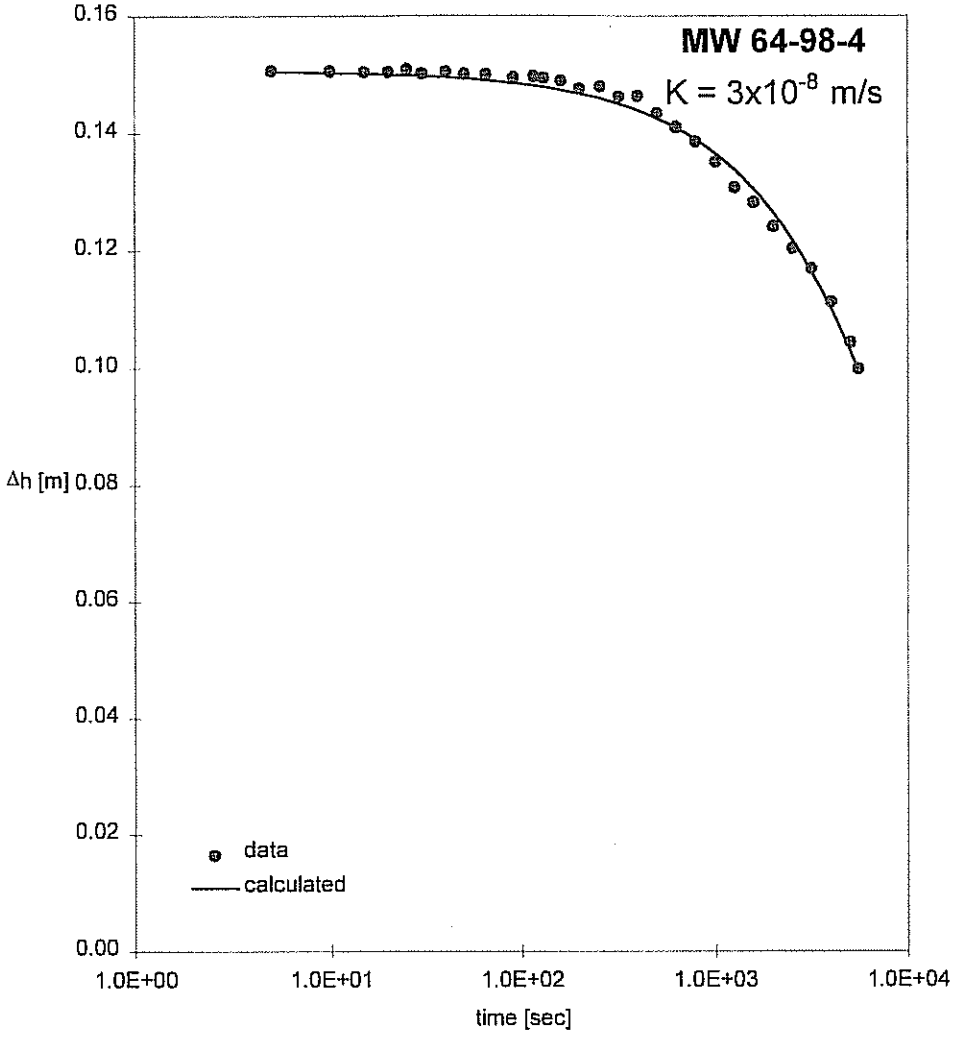

Slug Test at LBL, Well 51-97-15
K = 6.9 x 10^-9 [m/sec]
Observed
Calculated
Water Level (m)
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
10000.0
100000.0
Time (sec)

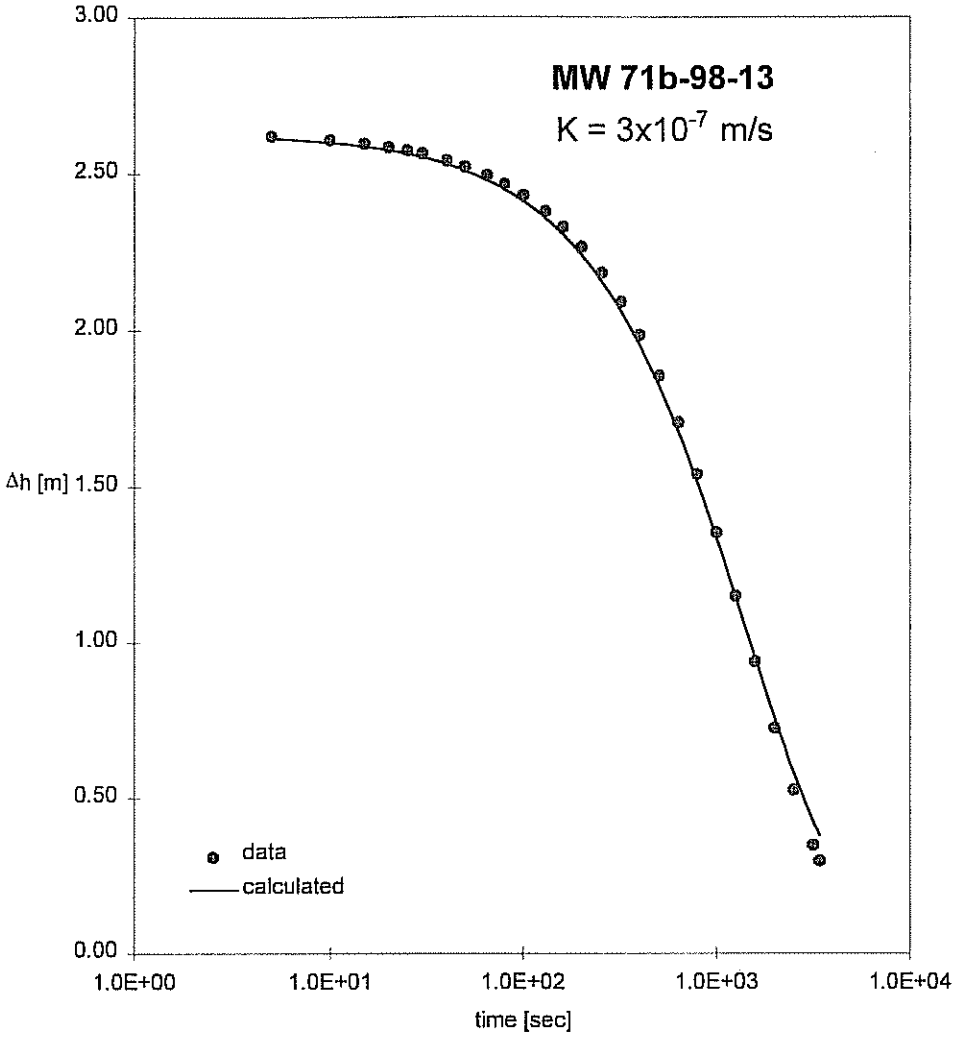

Slug Test at LBL, Well 51-97-16
K = 2.3 x 10^-6 [m/sec]
Observed
Calculated
Water Level (m)
2.50
2.00
1.50
1.00
0.50
0.00
0.1
1.0
10.0
100.0
1000.0
Time (sec)

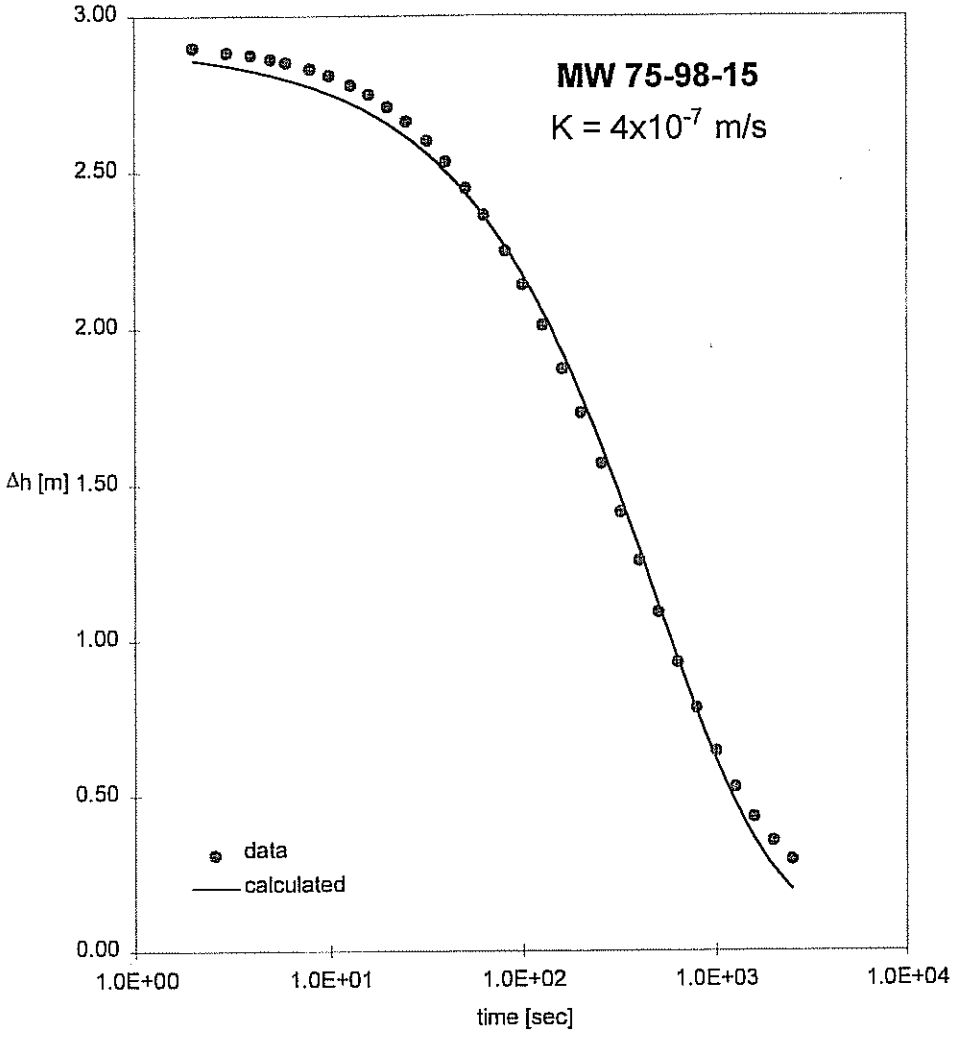

MW 25A-98-1
K = 2x10-7 m/s
2.50
2.00
1.50
1.00
0.50
0.00
Δh [m]
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
time [sec]

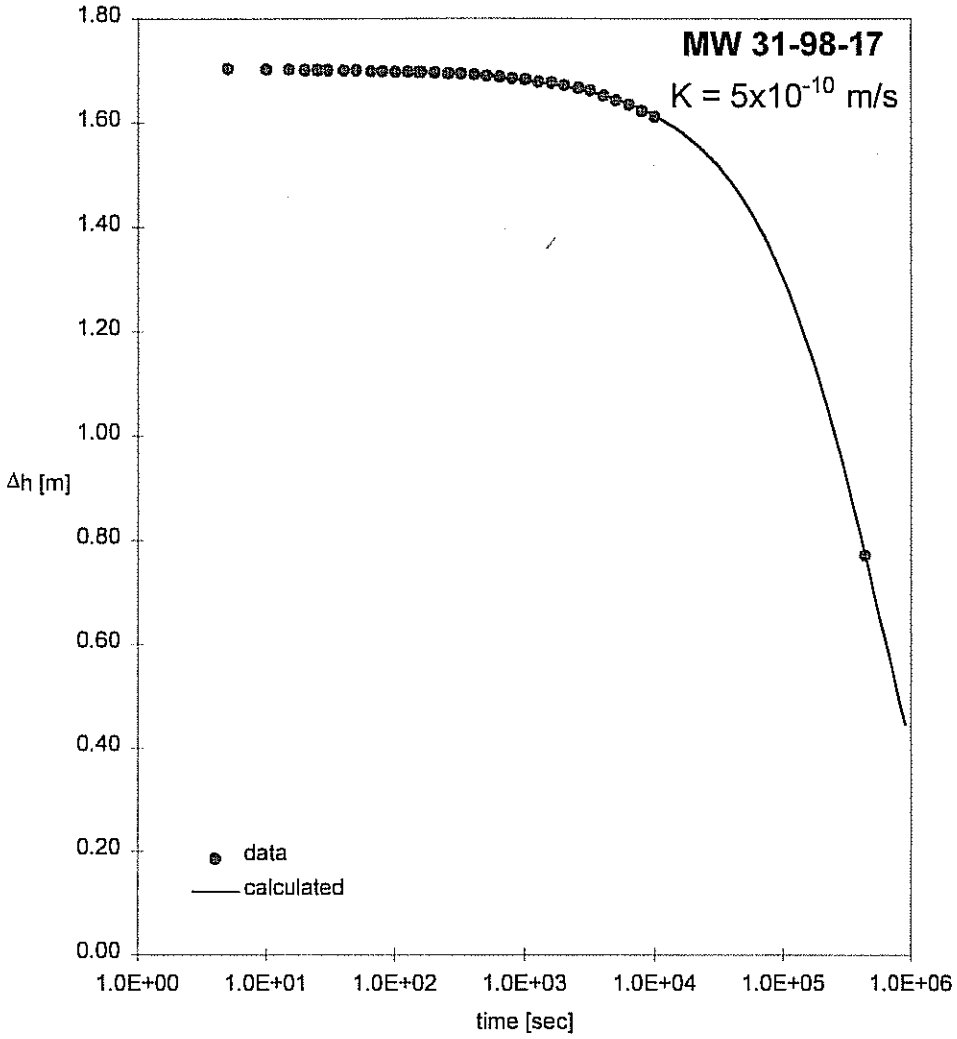

MW 56-98-2
K = 1x10-7 m/s
0.50
0.45
0.40
0.35
0.30
Δh [m] 0.25
0.20
0.15
0.10
0.05
0.00
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
time [sec]

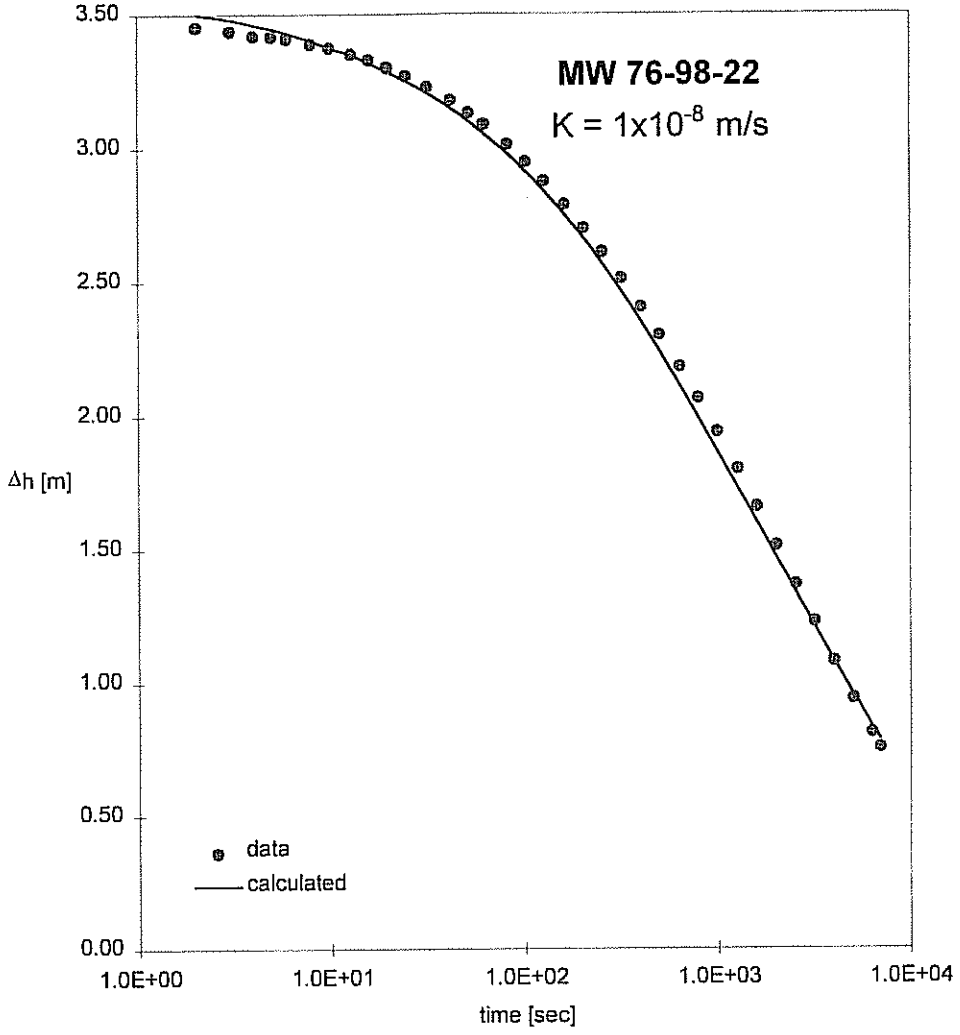

MW 25A-98-7
K = 2x10-7 m/s
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Δh [m]
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
1.0E+05
time [sec]


MW 64-98-4
K = 3x10-8 m/s
0.16
0.14
0.12
0.10
Δh [m] 0.08
0.06
0.04
0.02
0.00
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
time [sec]


MW 71b-98-13
K = 3x10-7 m/s
3.00
2.50
2.00
Δh [m] 1.50
1.00
0.50
0.00
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
time [sec]

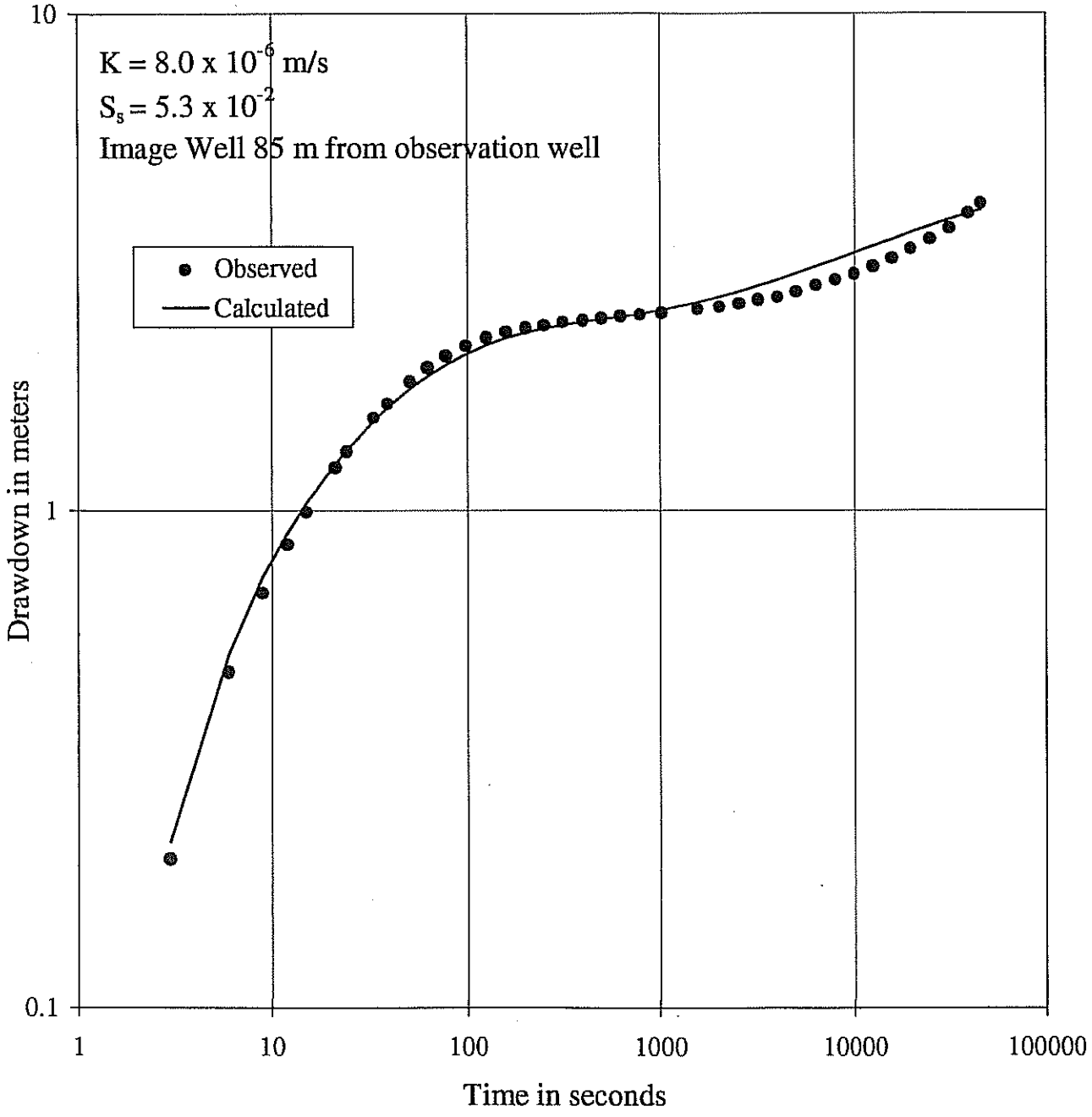

MW 75-98-15
K = 4x10-7 m/s
3.00
2.50
2.00
Δh [m] 1.50
1.00
0.50
0.00
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
time [sec]


MW 31-98-17
K = 5x10-10 m/s
1.80
1.60
1.40
1.20
1.00
Δh [m]
0.80
0.60
0.40
0.20
0.00
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
1.0E+05
1.0E+06
time [sec]

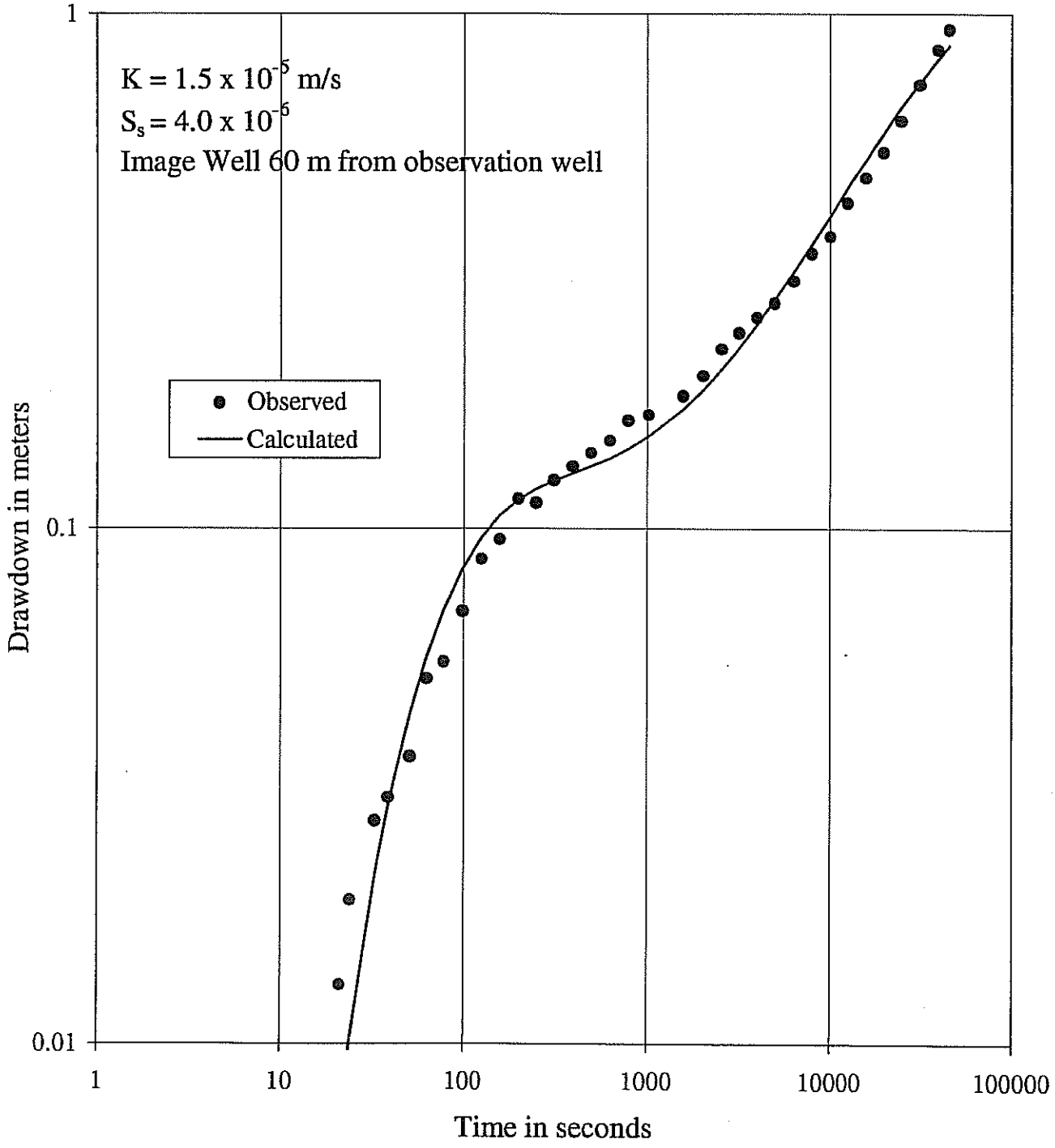

MW 76-98-22
K = 1x10-8 m/s
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Δh [m]
data
calculated
1.0E+00
1.0E+01
1.0E+02
1.0E+03
1.0E+04
time [sec]

Pumping/Recovery Test Data

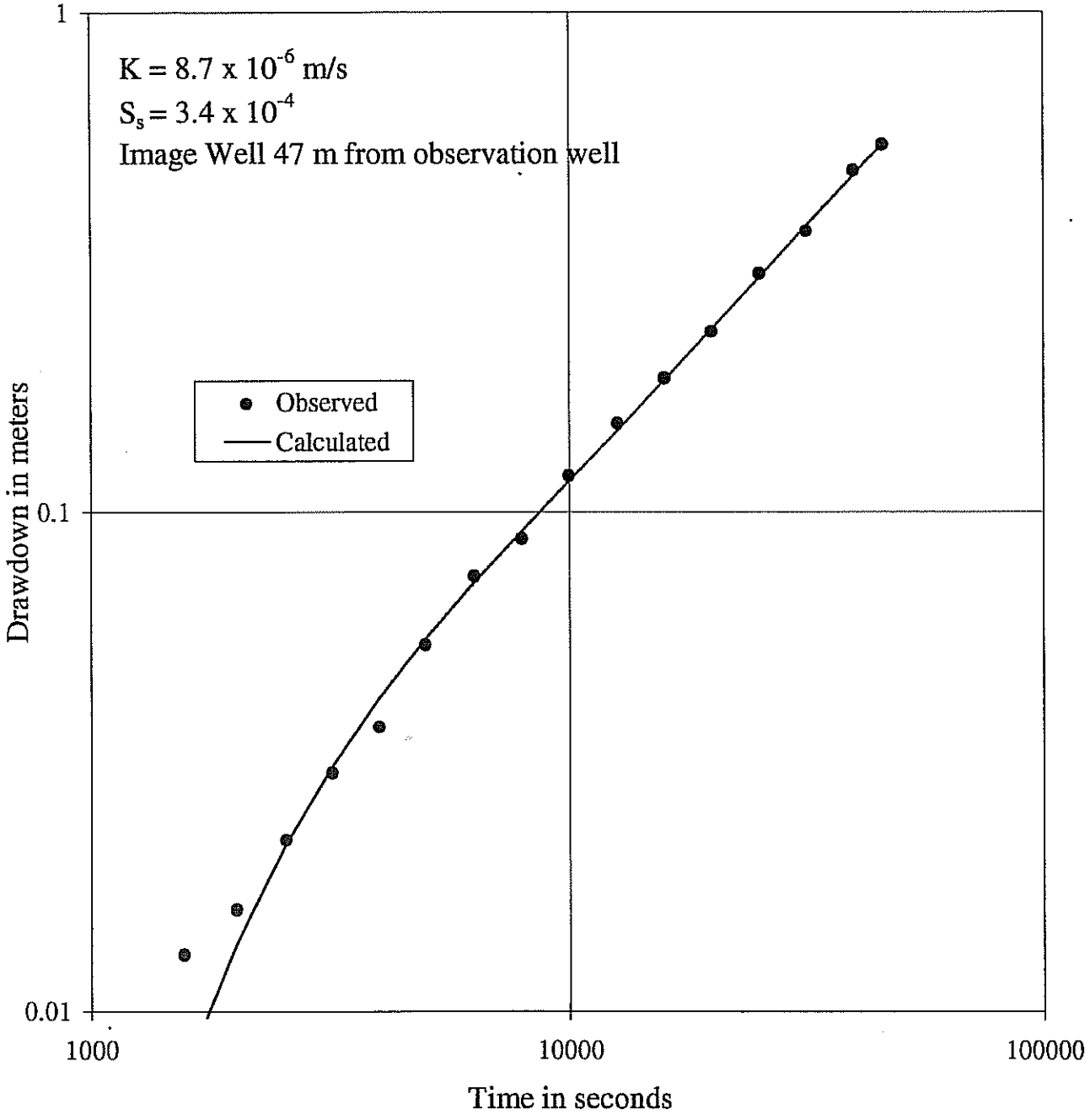
Drawdown for Well 91-8 for 5gpm Pumping Test from MW91-8



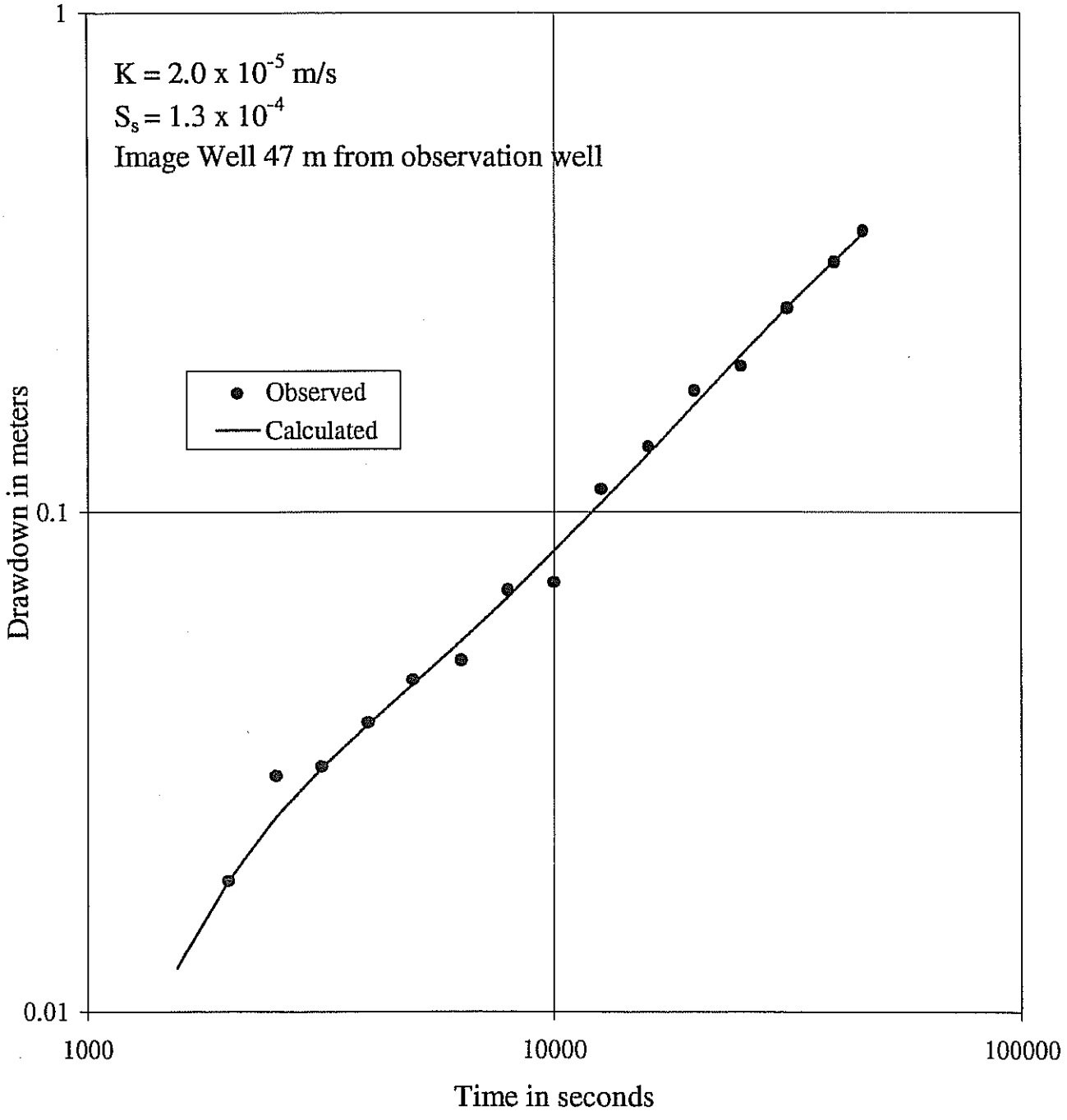
Drawdown for Well 27-92-20 for 5gpm Pumping Test from MW91-8



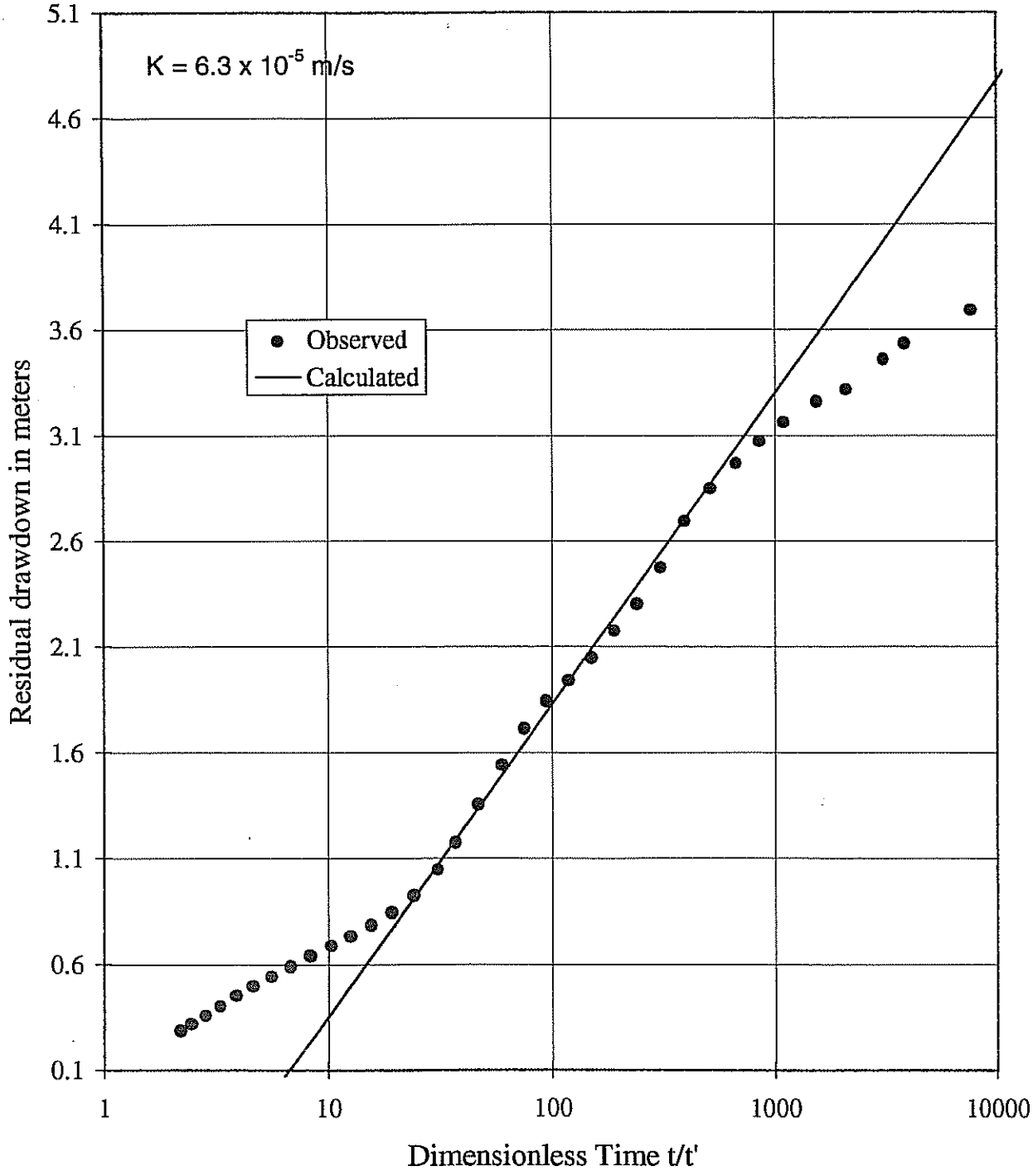
Drawdown for Well 7-102 for 5gpm Pumping Test from MW91-8



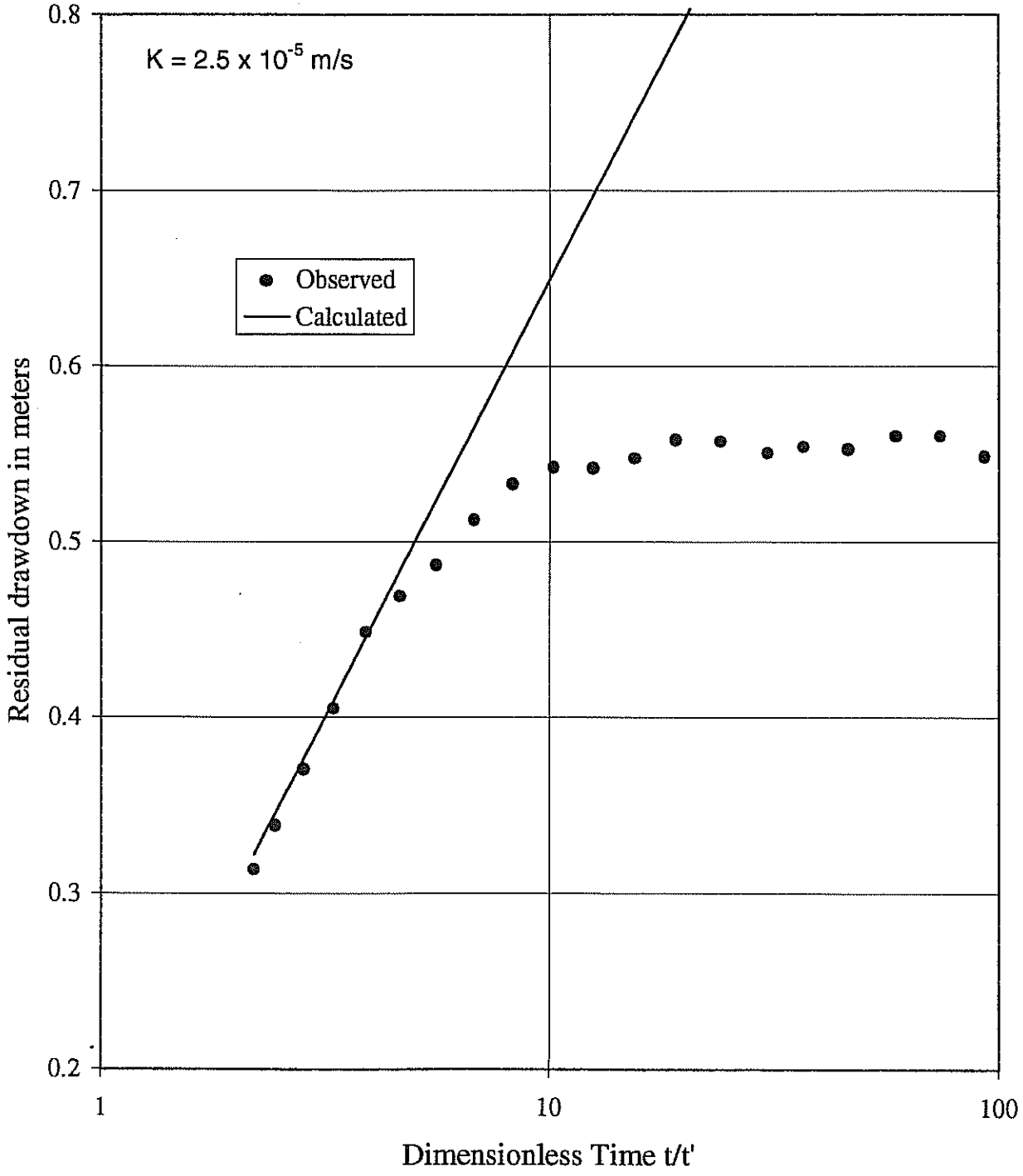
Drawdown for Well 91-7 for 5gpm Pumping Test from MW91-8



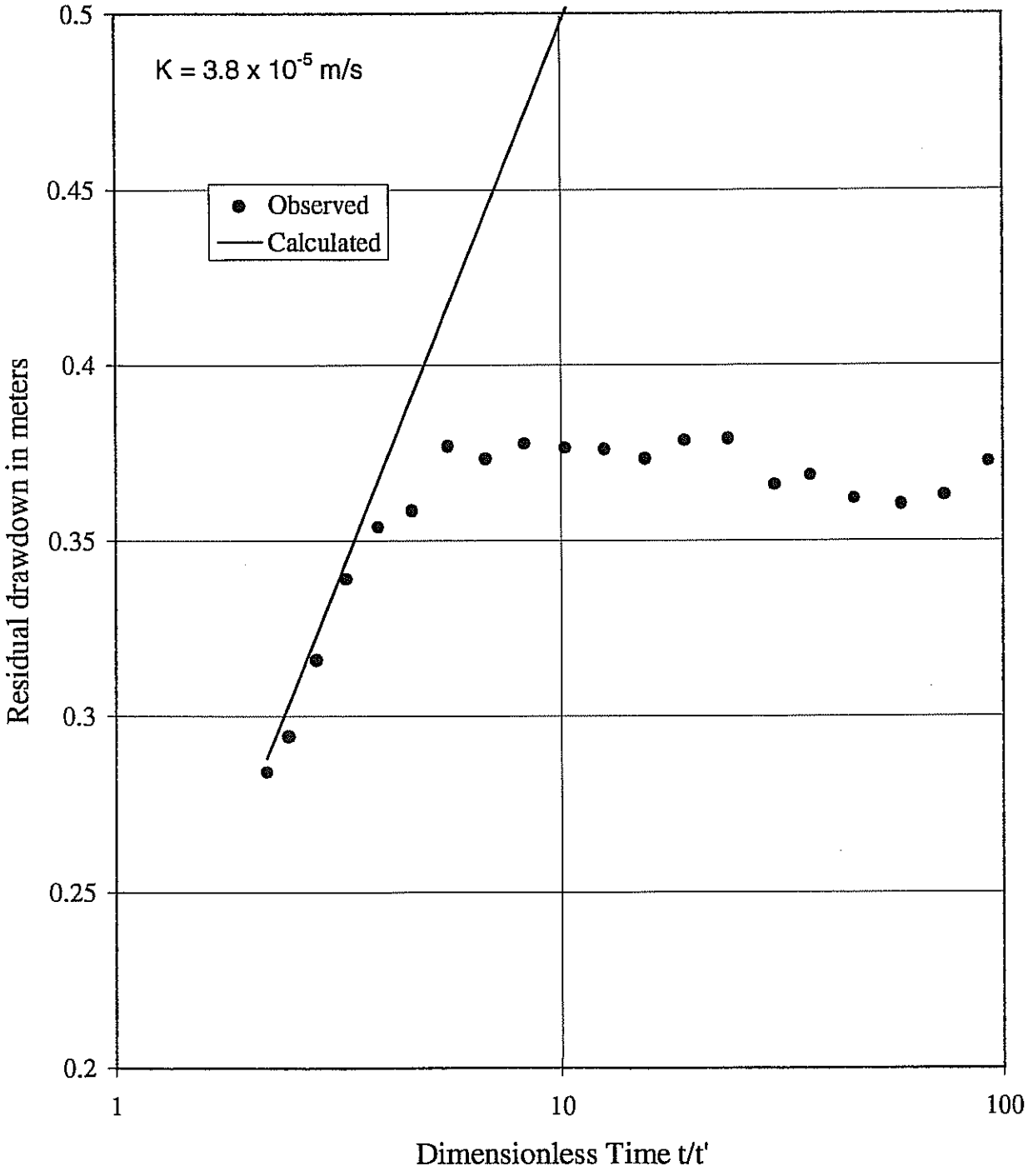
Recovery of well 91-8 for 5gpm Pumping Test from MW91-8



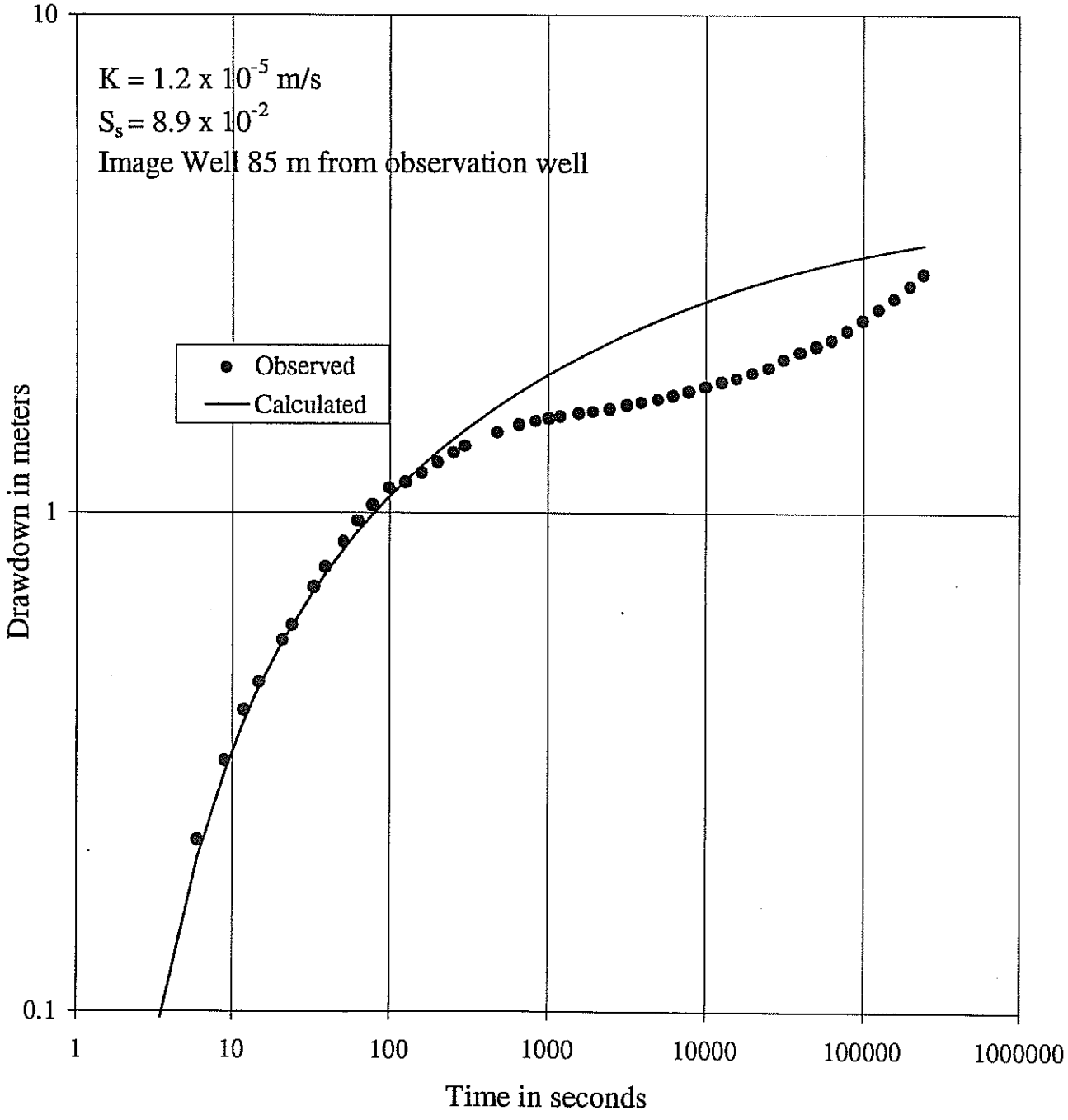
Recovery of well 7-102 for 5gpm Pumping Test from MW91-8



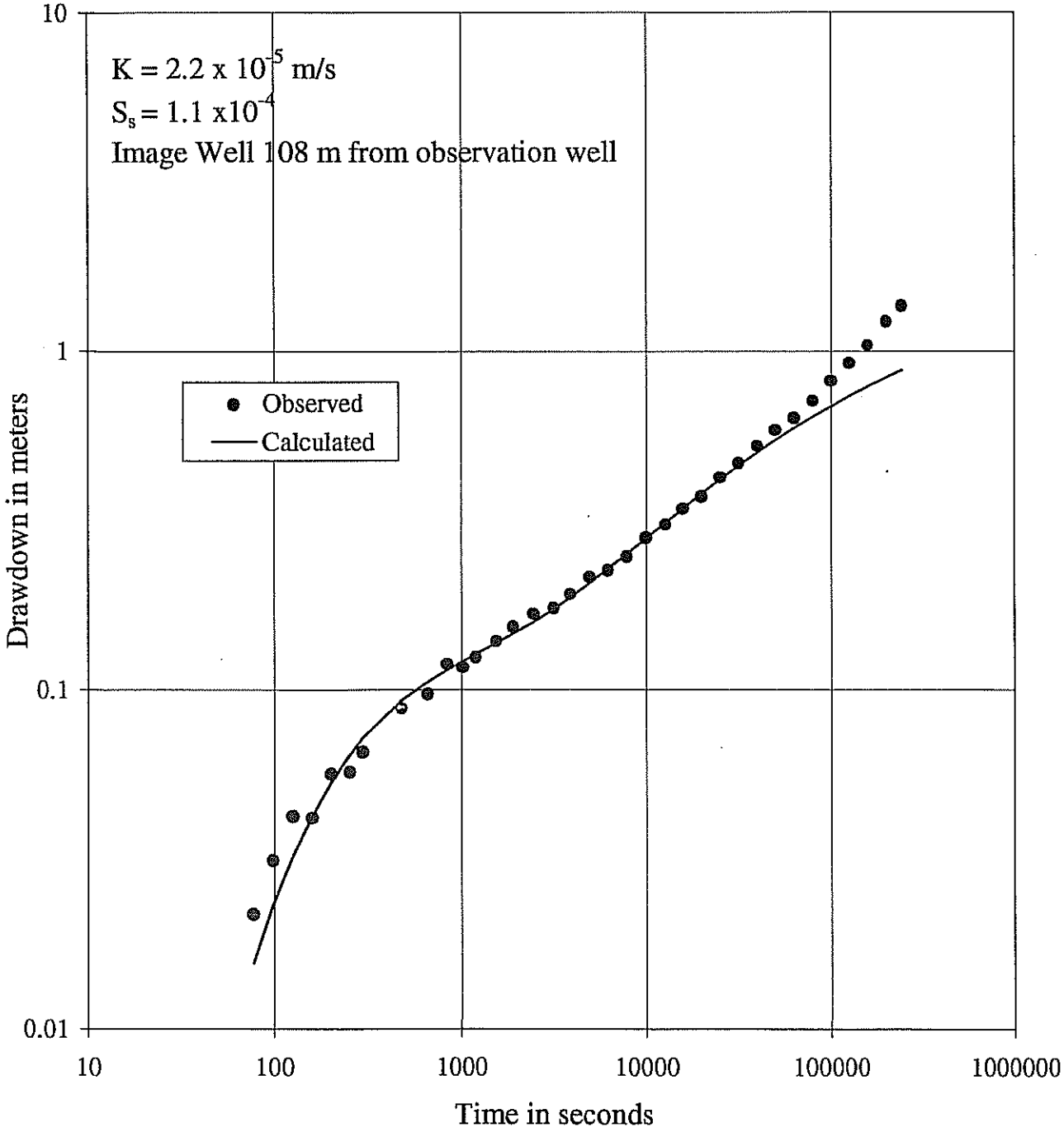
Recovery of well 91-7 for 5gpm Pumping Test from MW 91-8



Drawdown for Well 91-8 for 3gpm Pumping Test from MW91-8

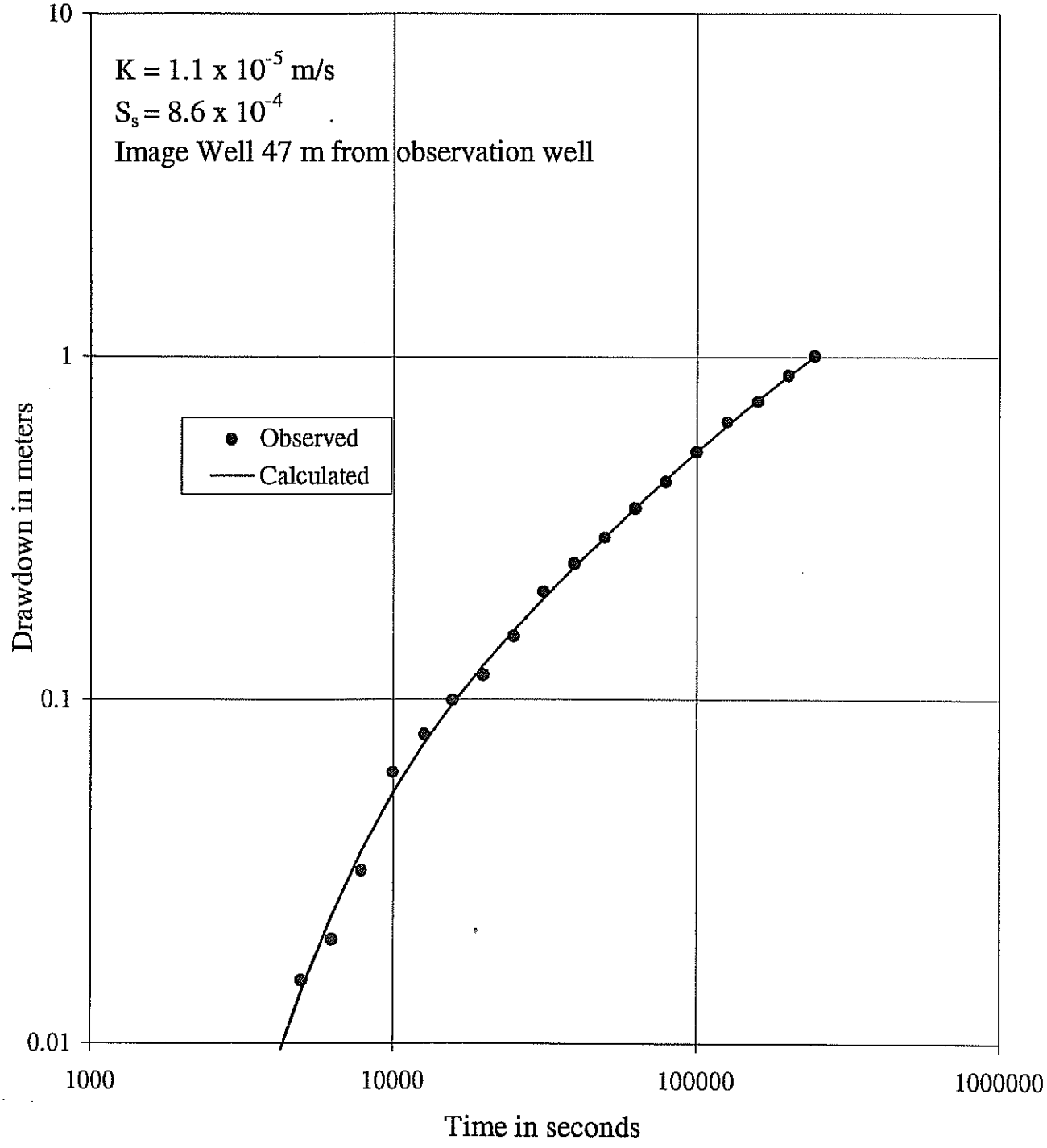


Drawdown for Well 27-92-20 for 3gpm Pumping Test from MW91-8

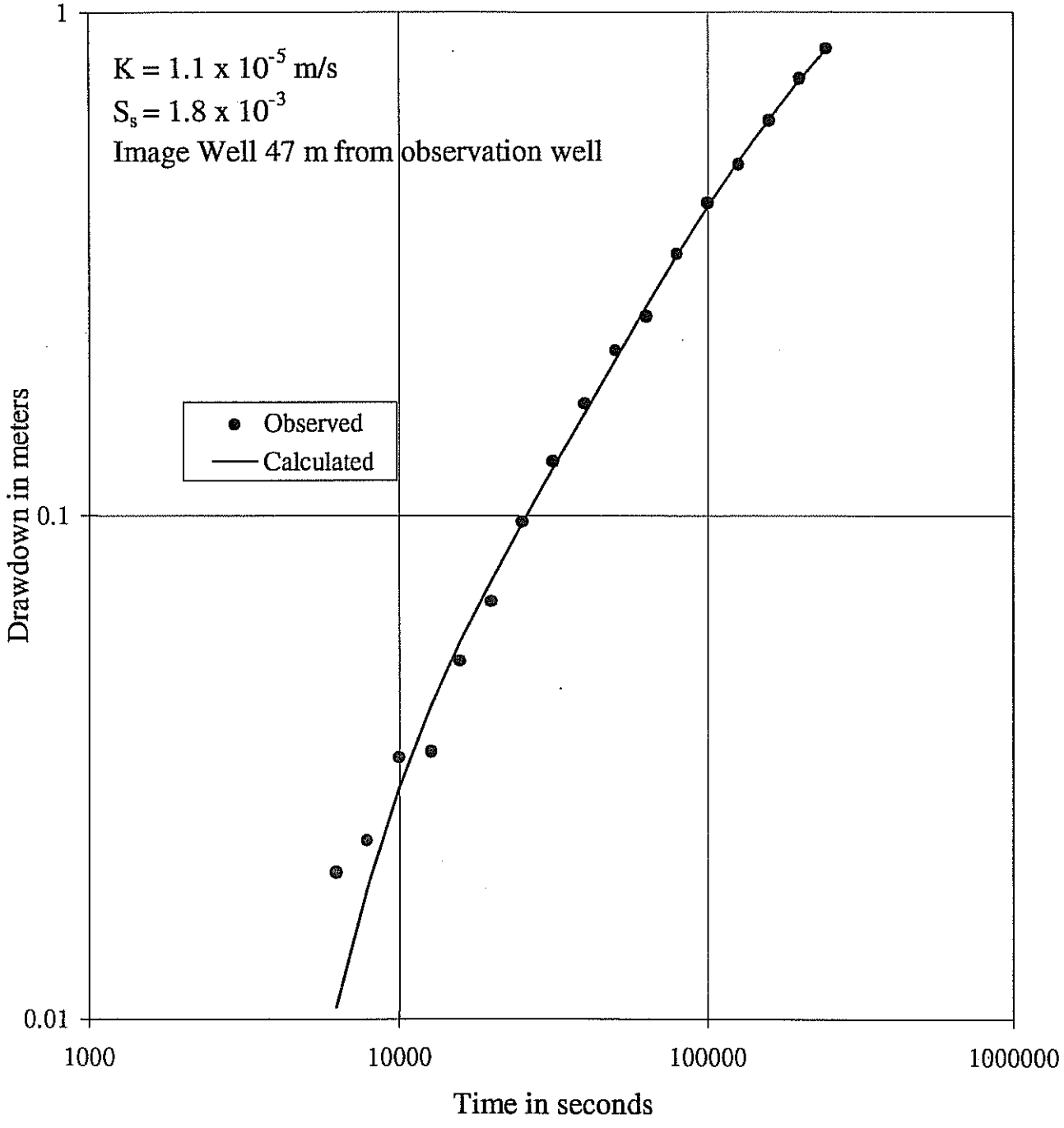


Drawdown for Well 53-93-16 69' for 3gpm Pumping Test from MW91-8

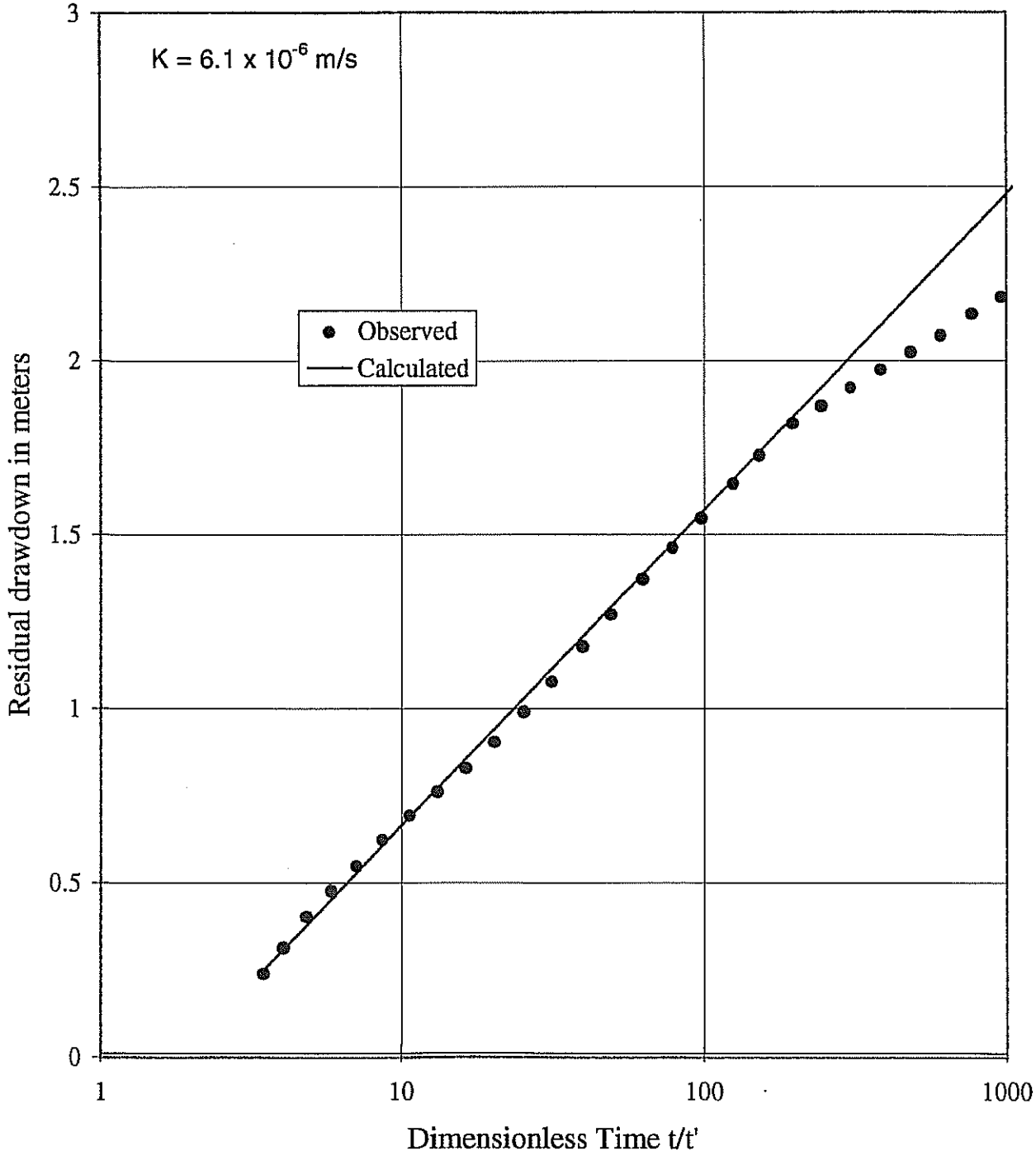
(well 53-93-16-69 used to be MW7-102)



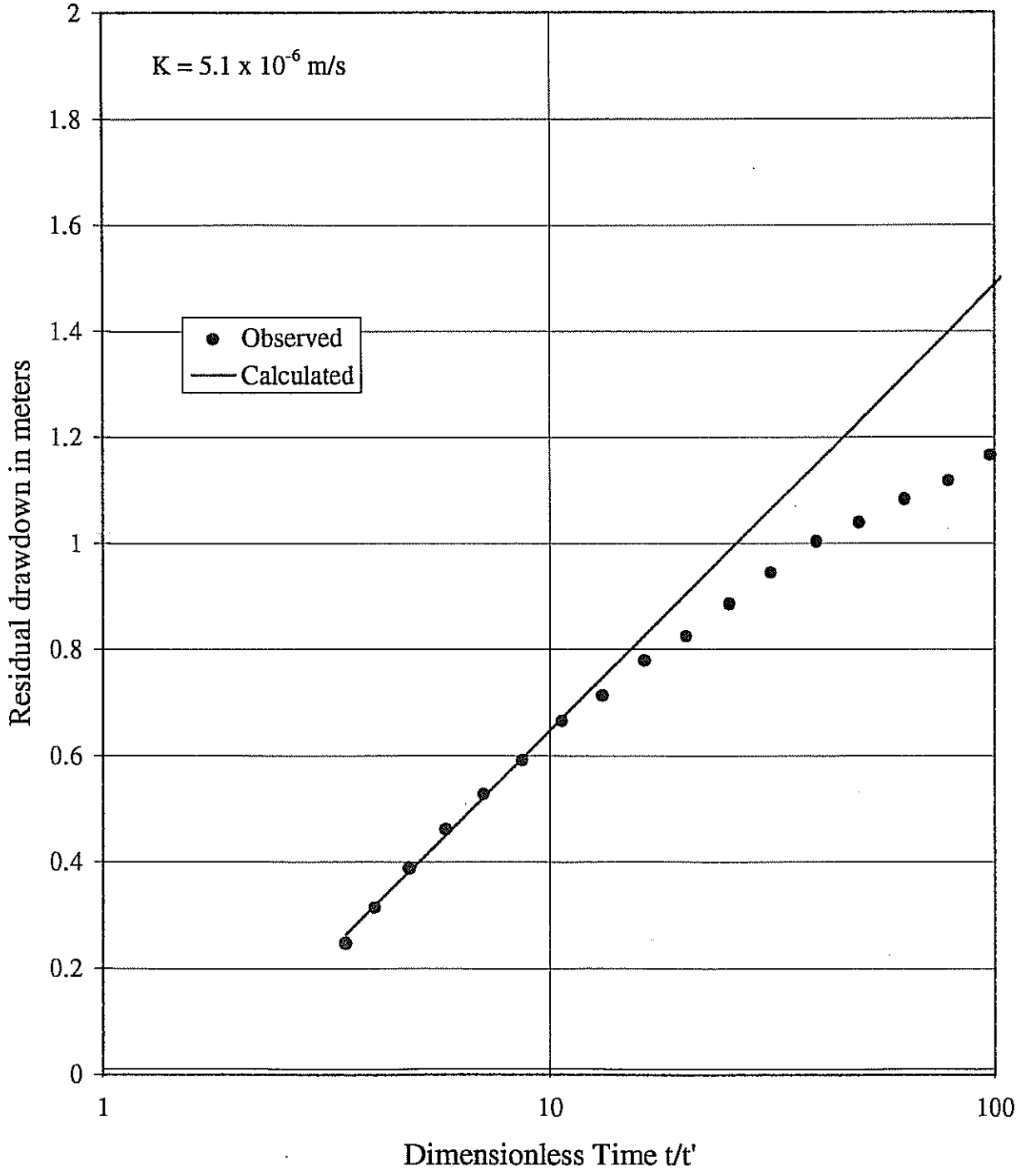
Drawdown for Well 91-7 for 3gpm Pumping Test from MW91-8



Recovery of well 91-8 for 3gpm Pumping Test from MW91-8

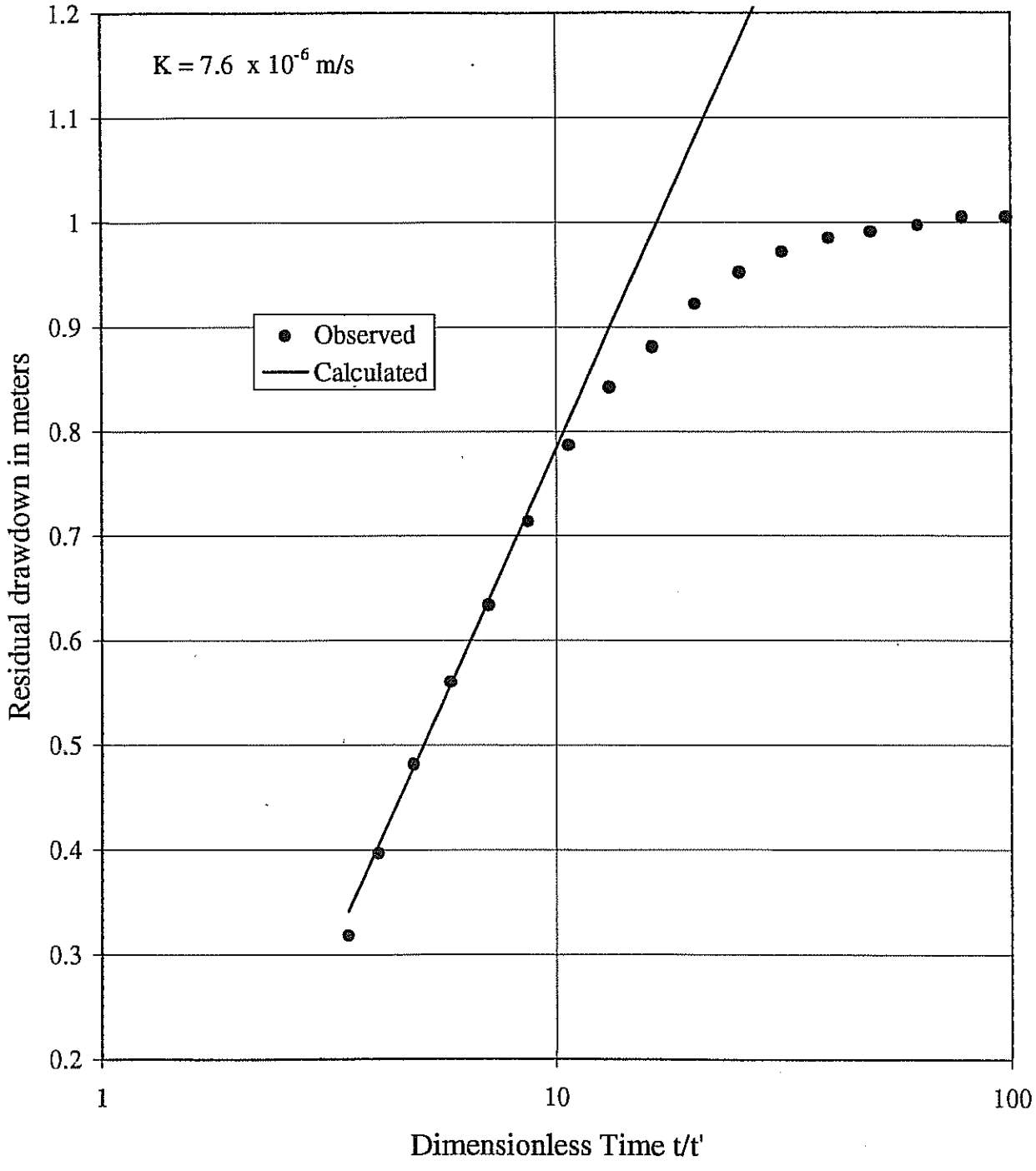


Recovery of well 27-92-20 for 3gpm Pumping Test from MW91-8

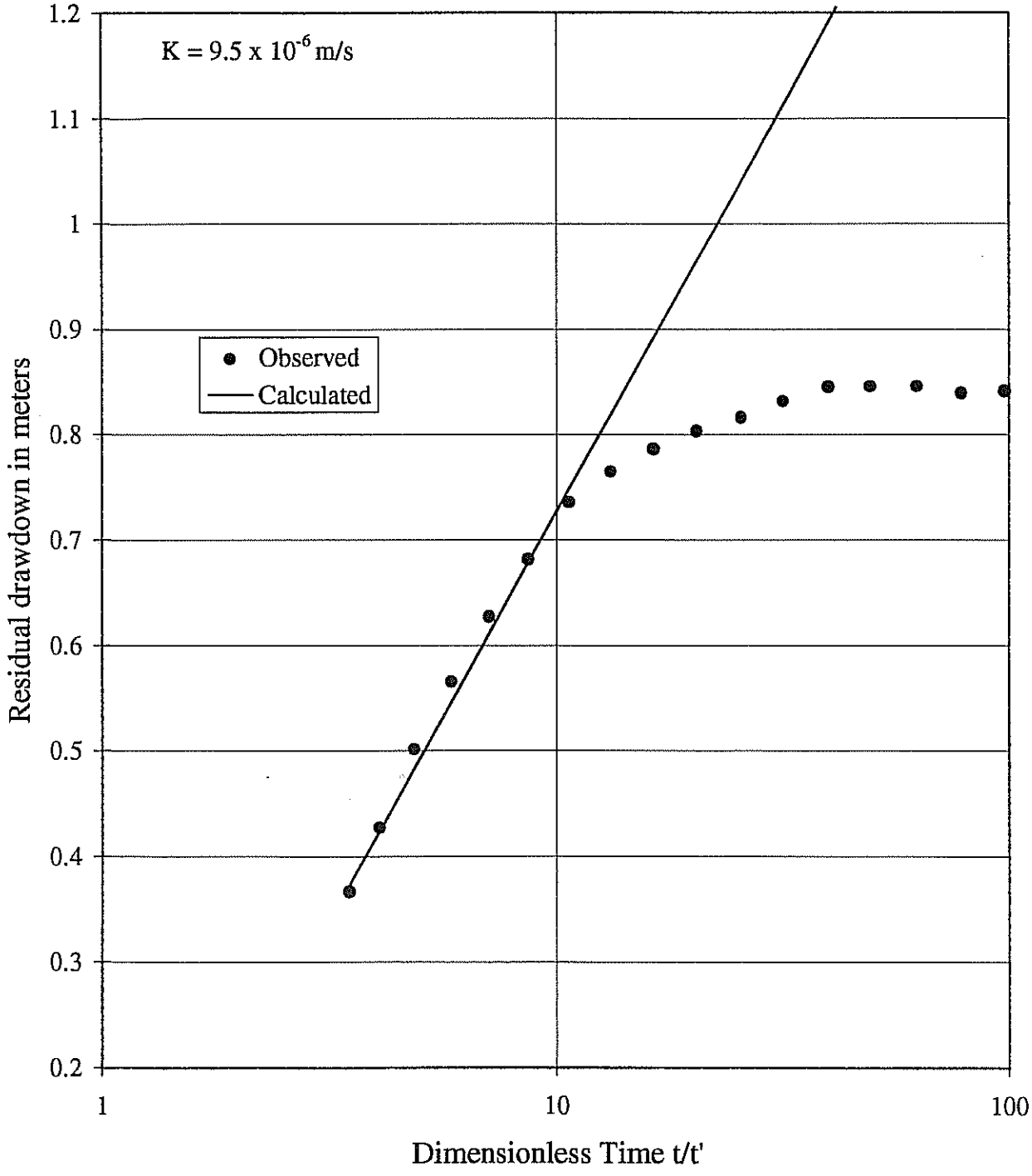


Recovery of well 53-93-16-69' for 3gpm Pumping Test from MW91-8

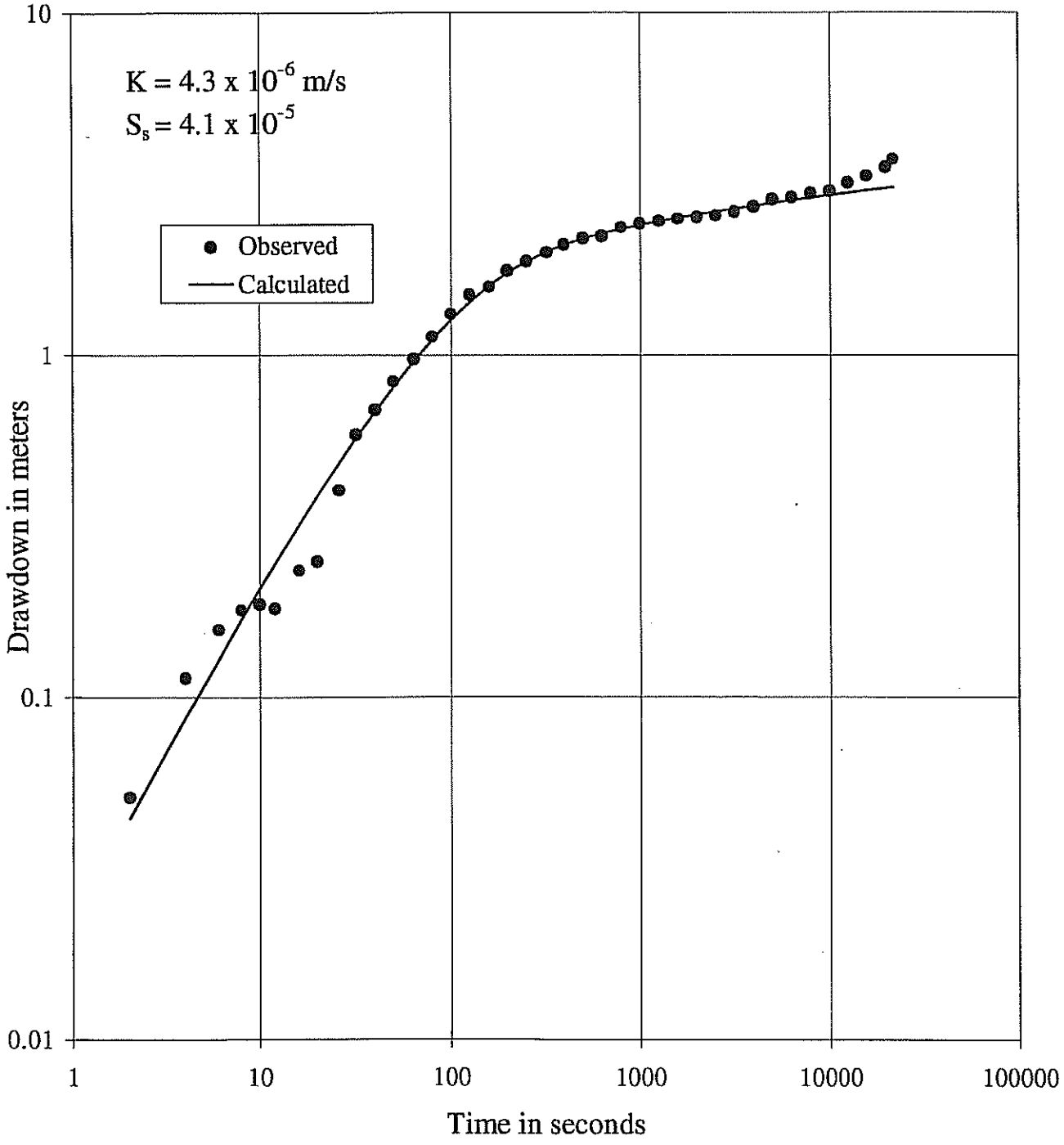
(well 53-93-16-69 used to be MW7-102)



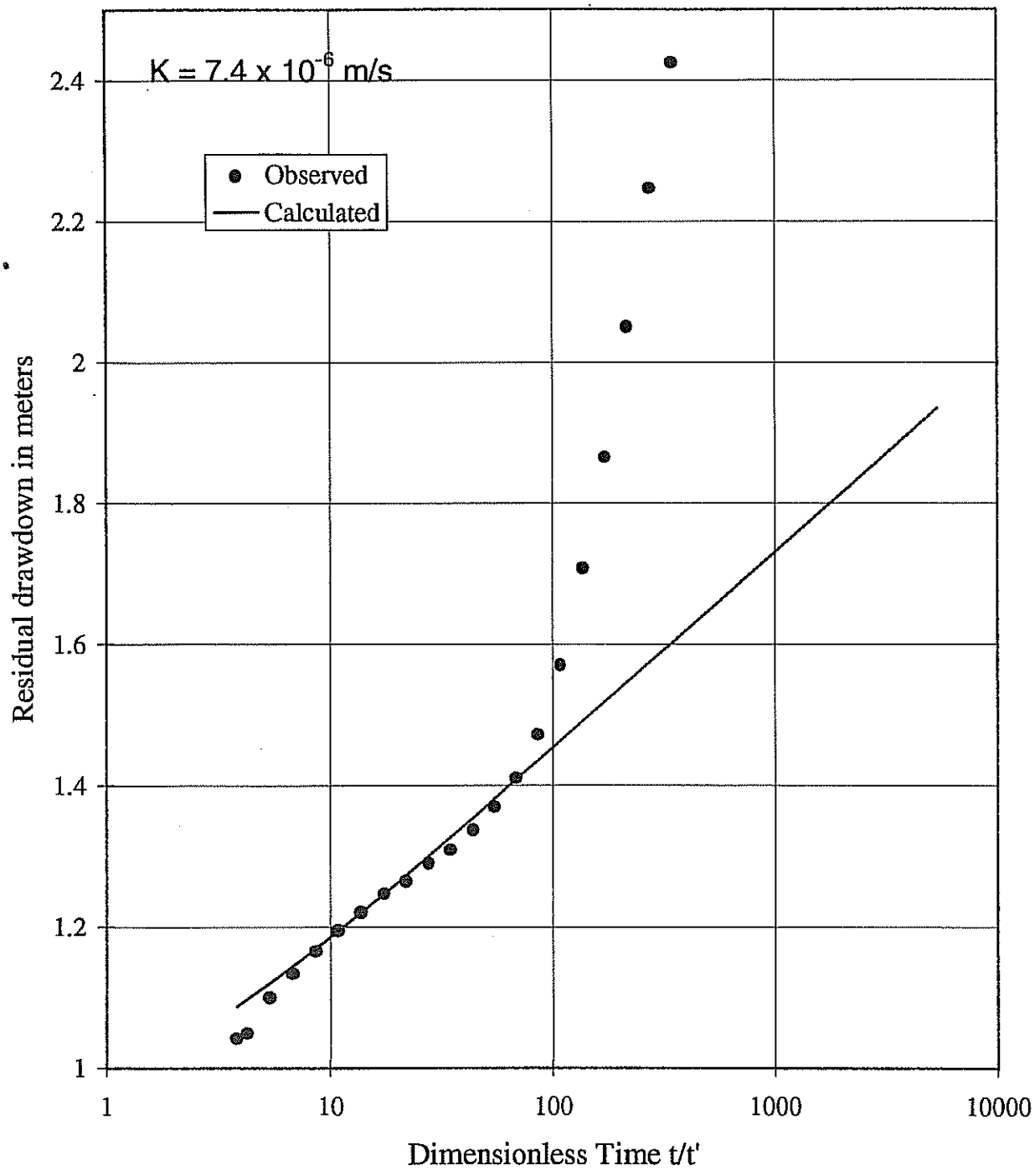
Recovery of well 91-7 for 3gpm Pumping Test from MW91-8



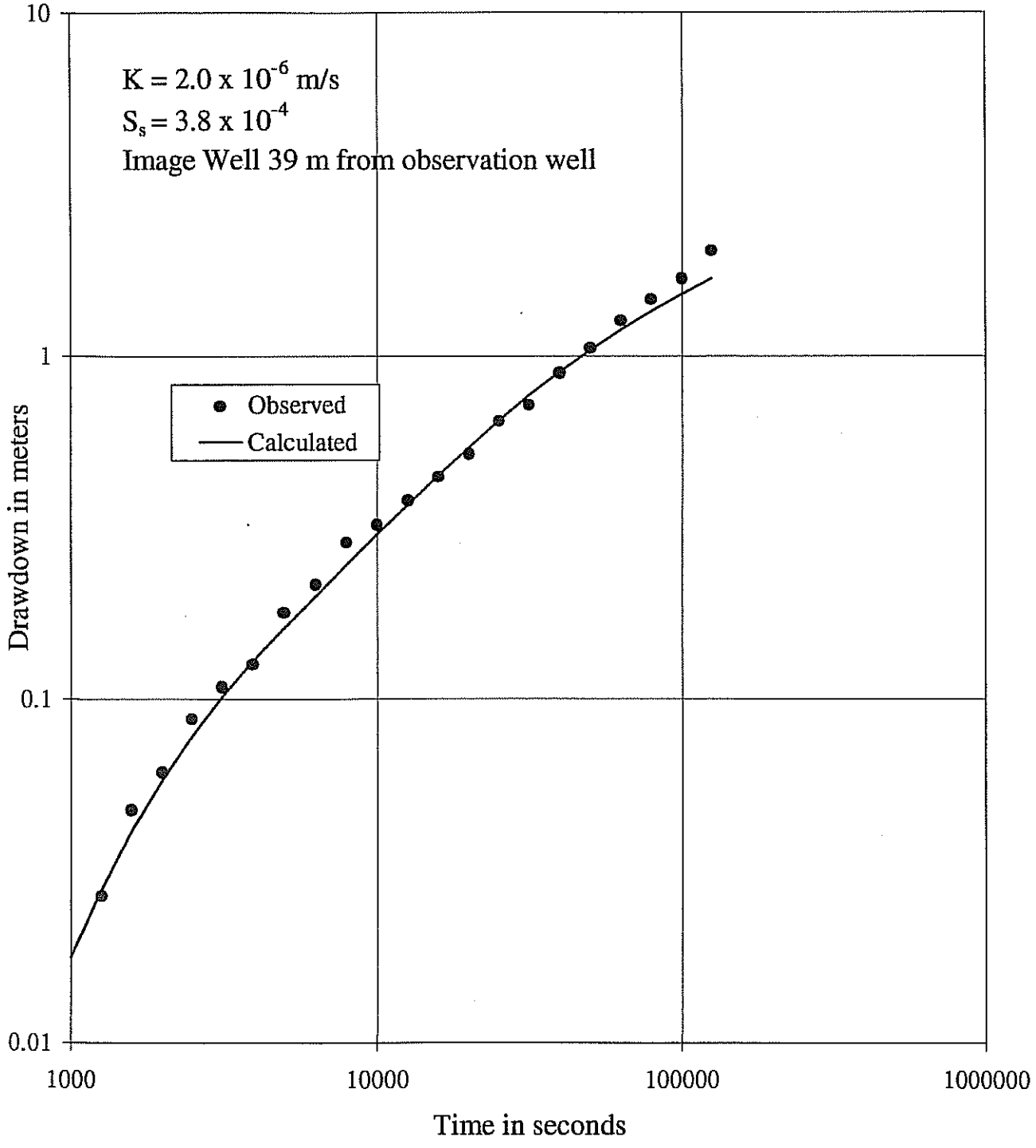
Drawdown for Well 74-92-13 for Pumping Test from MW 74-92-13



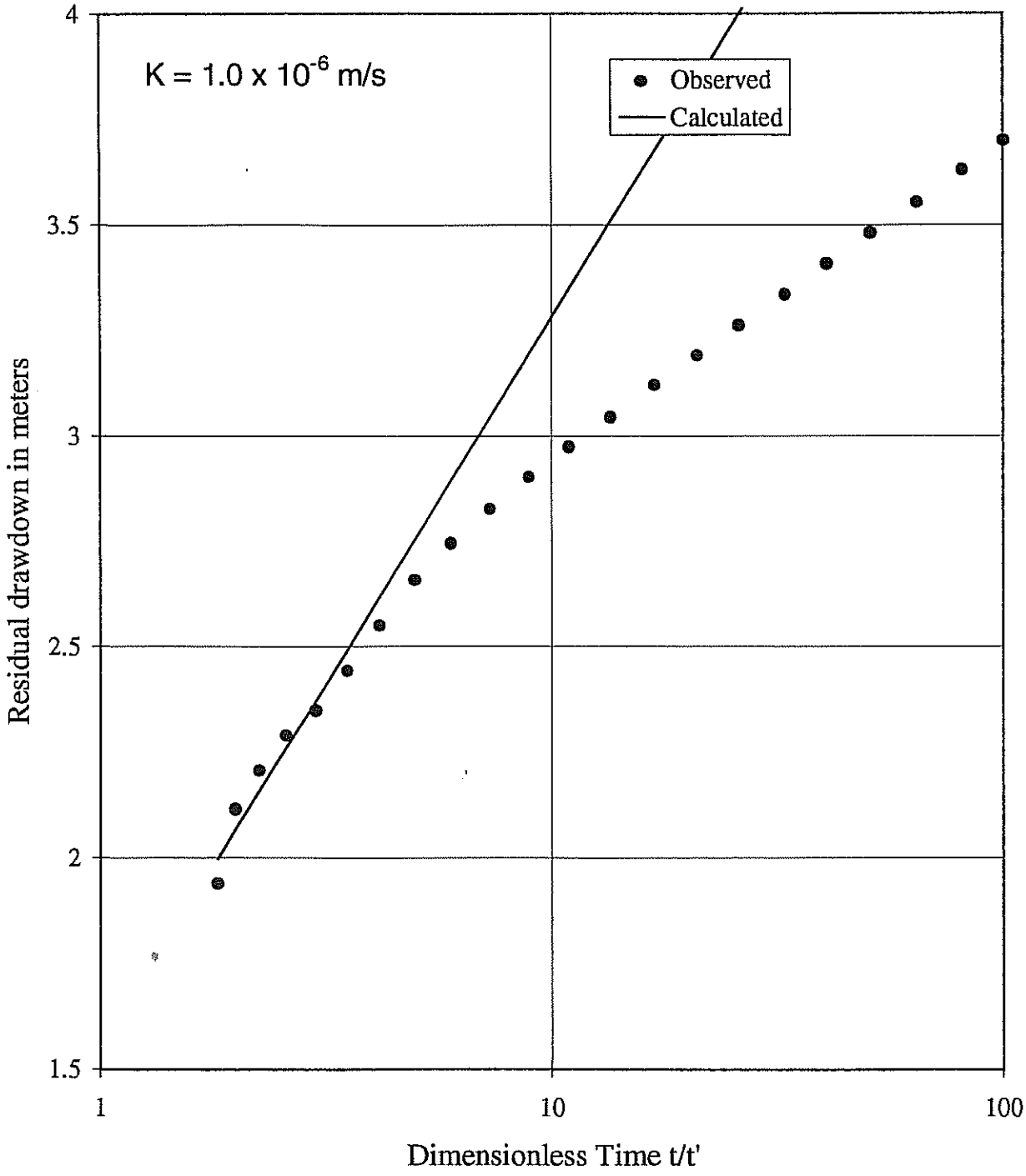
Recovery of MW74-92-13 for Pumping Test from MW74-92-13



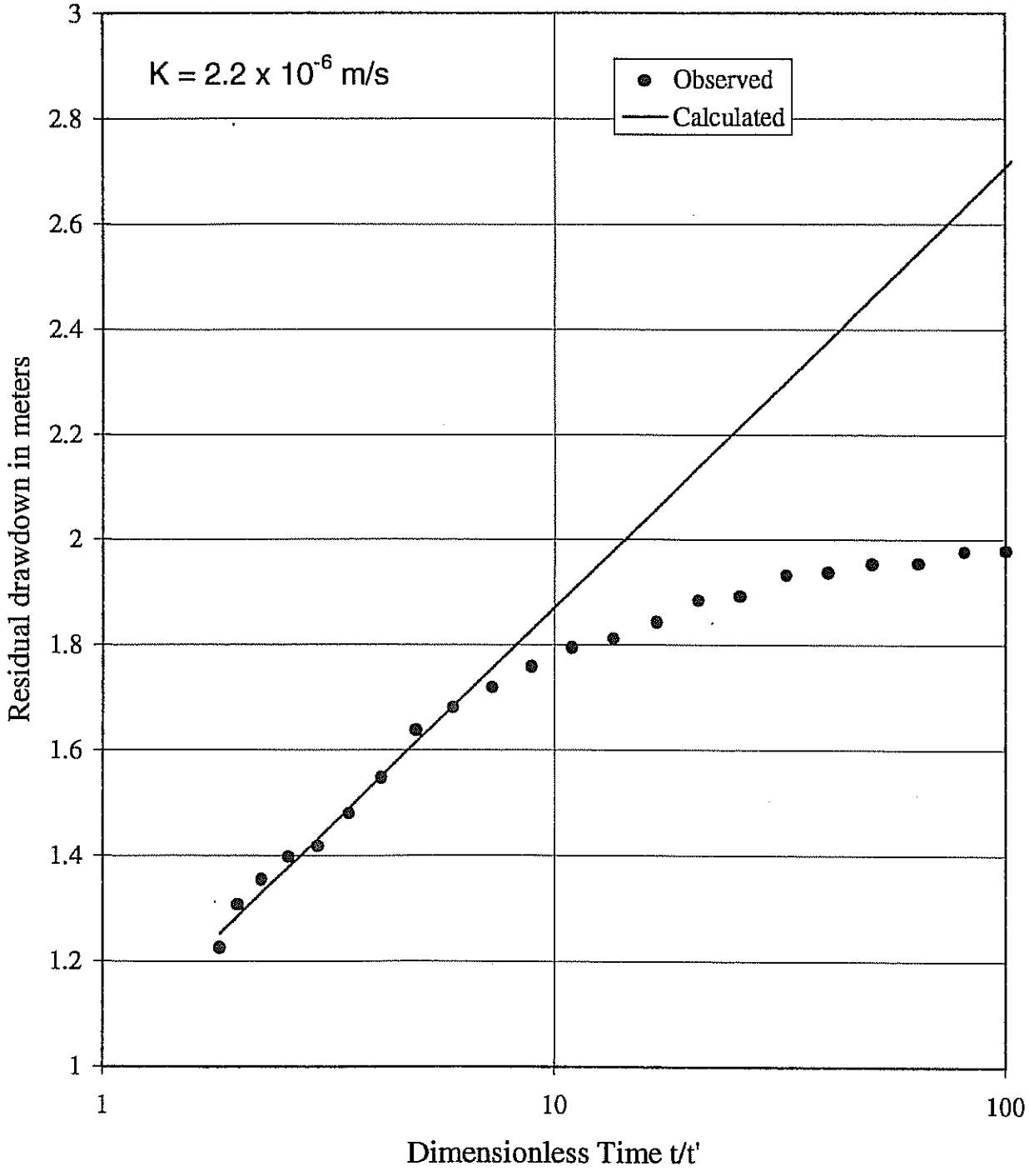
Drawdown for Well 6-93-4 for Pumping Test from MW 7-92-16



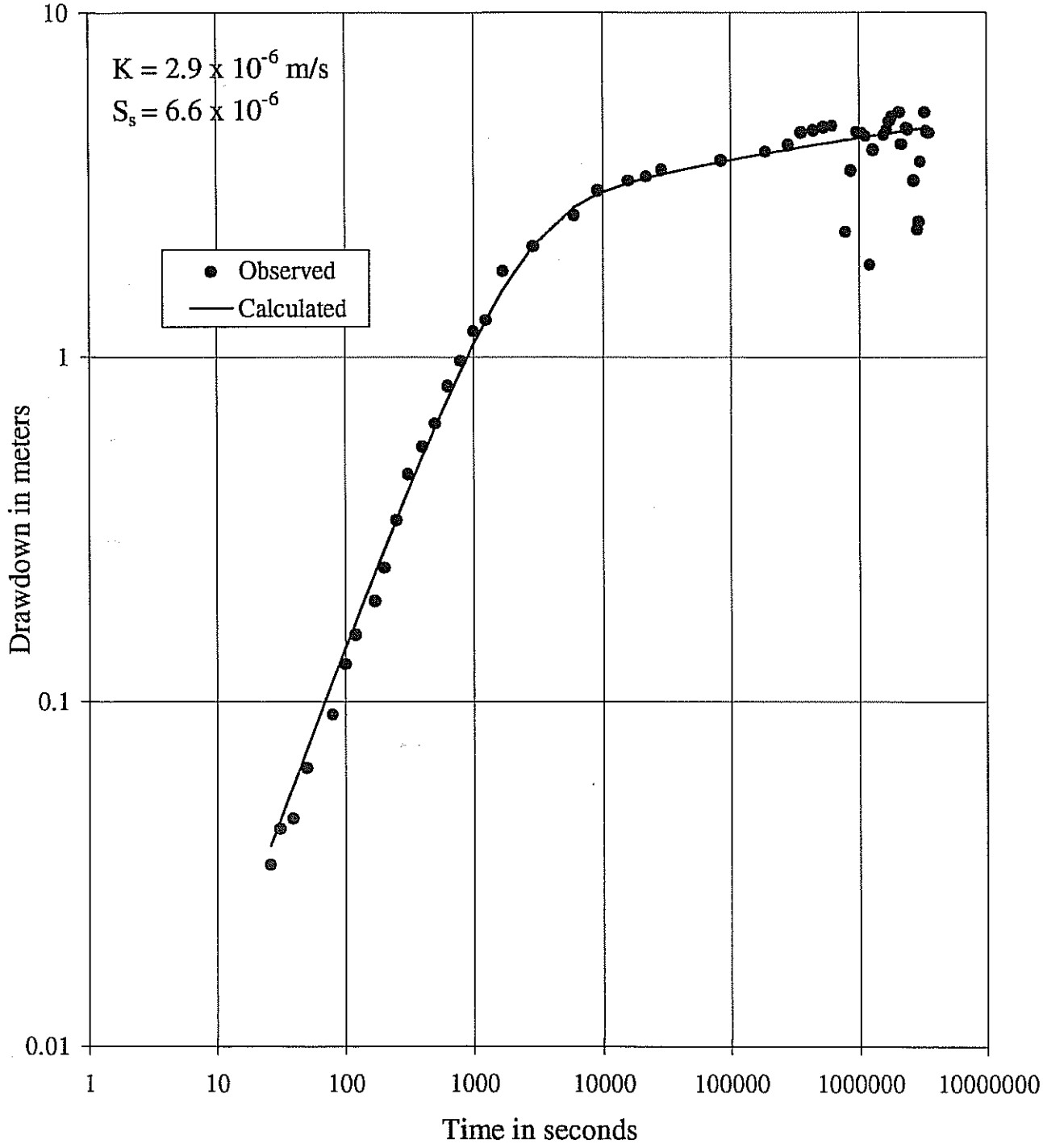
Recovery of MW7-92-16 for Pumping Test from MW7-92-16



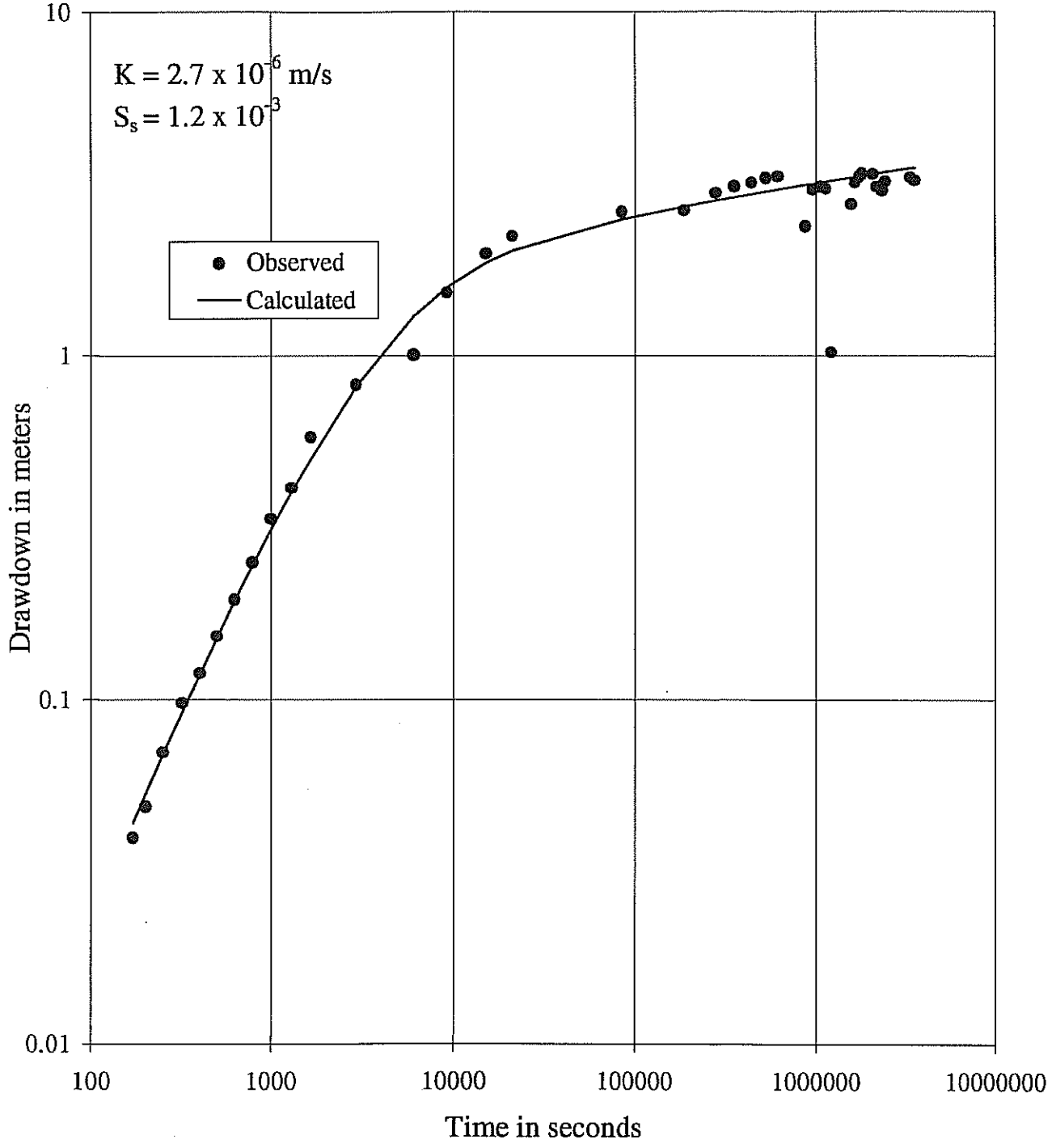
Recovery of MW6-93-4 for Pumping Test from MW7-92-16



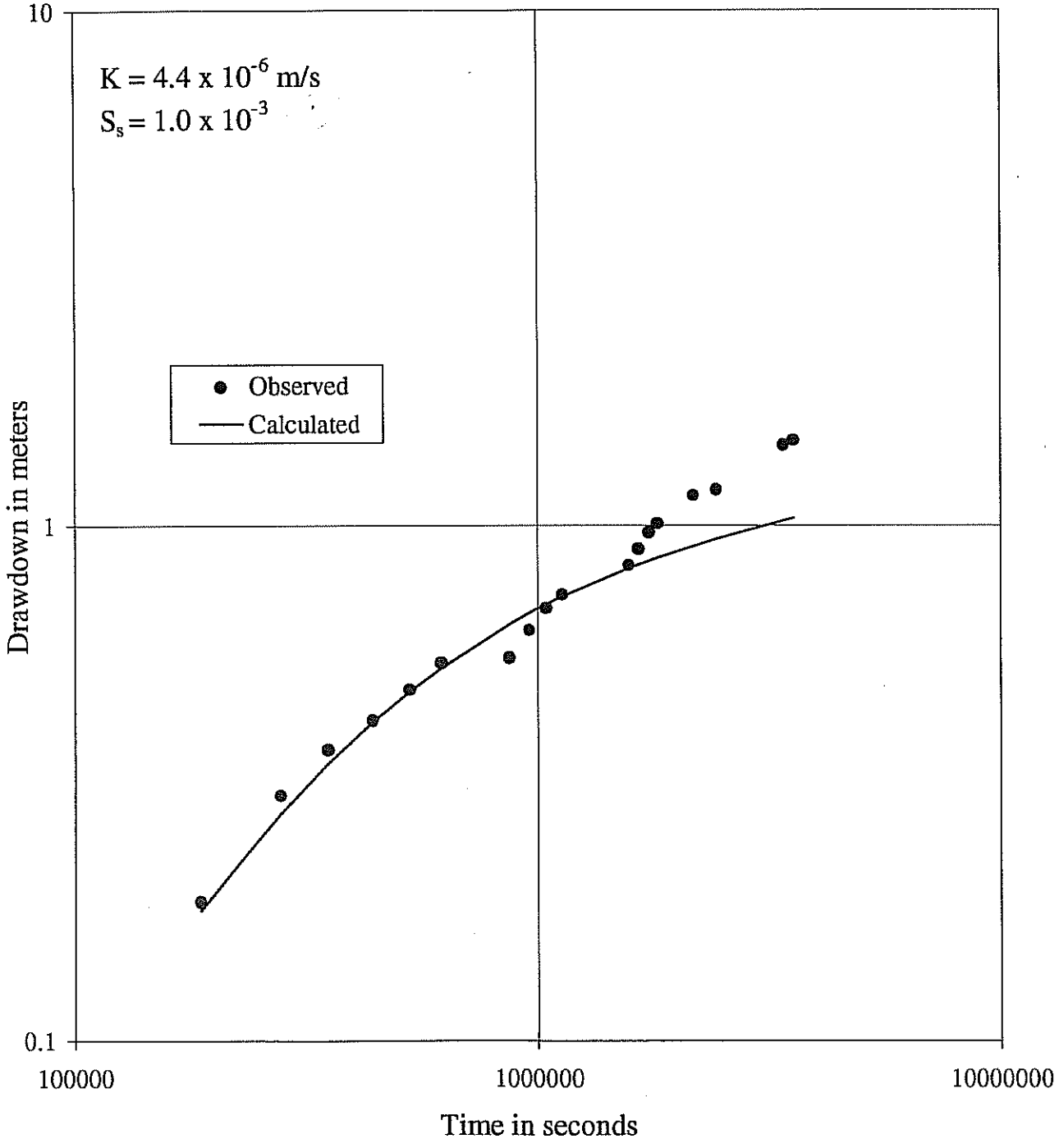
Drawdown for Well 53-93-16-69' Pumping Test from MW53-93-16-69'



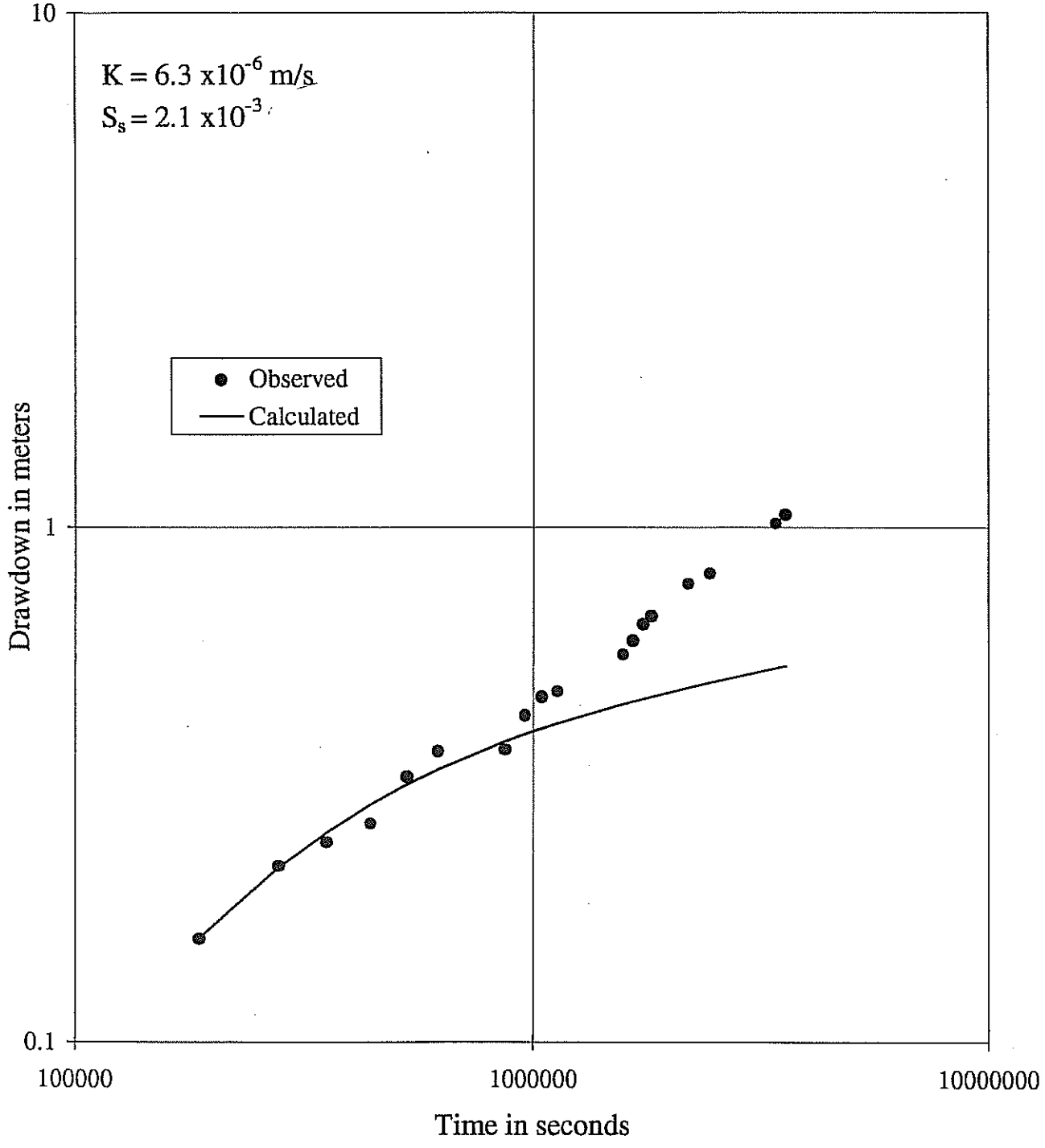
Drawdown for Well 91-7 for Pumping Test from MW53-93-16-69'



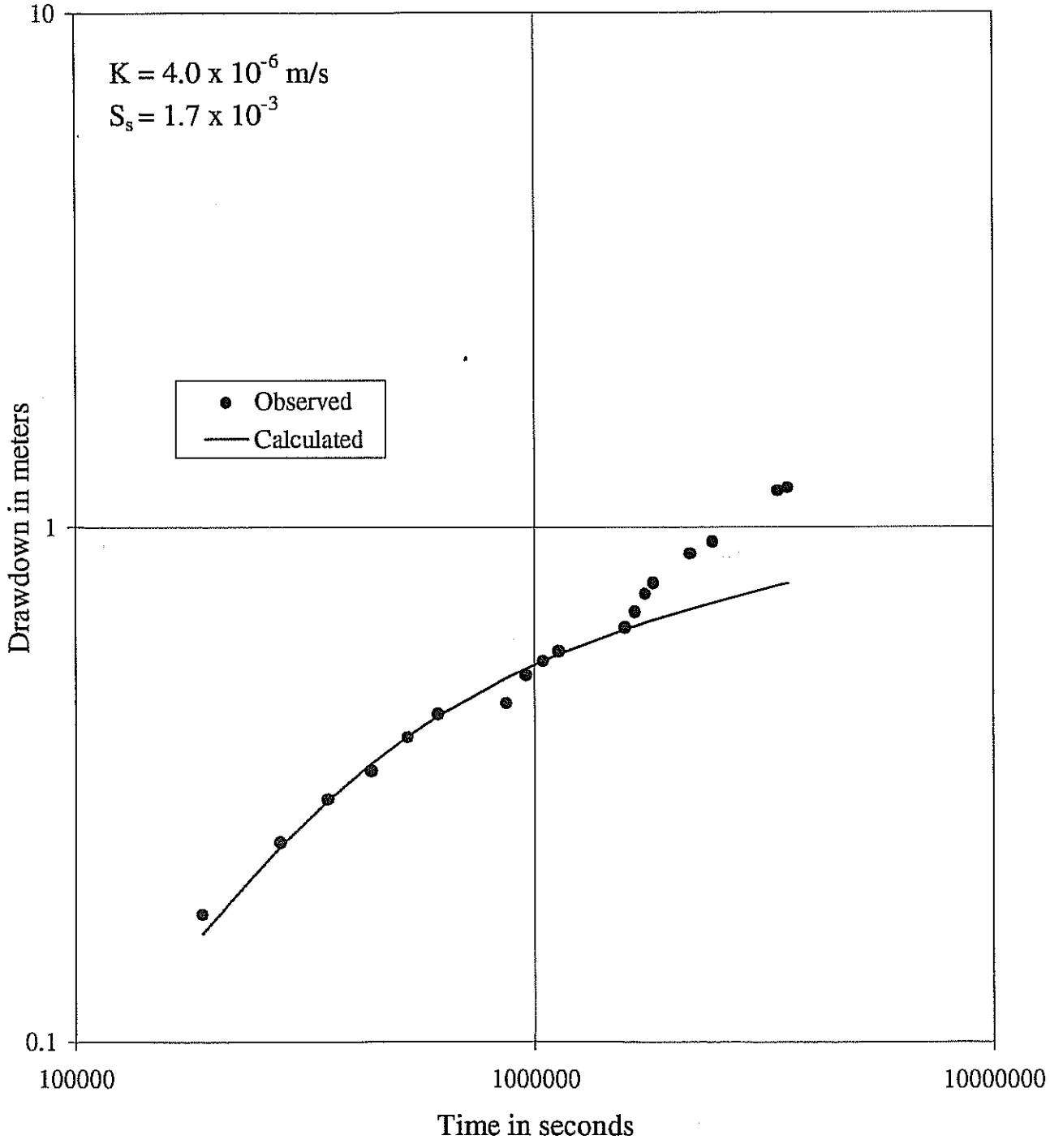
Drawdown for Well 53-93-17 Pumping Test from MW53-93-16-69'



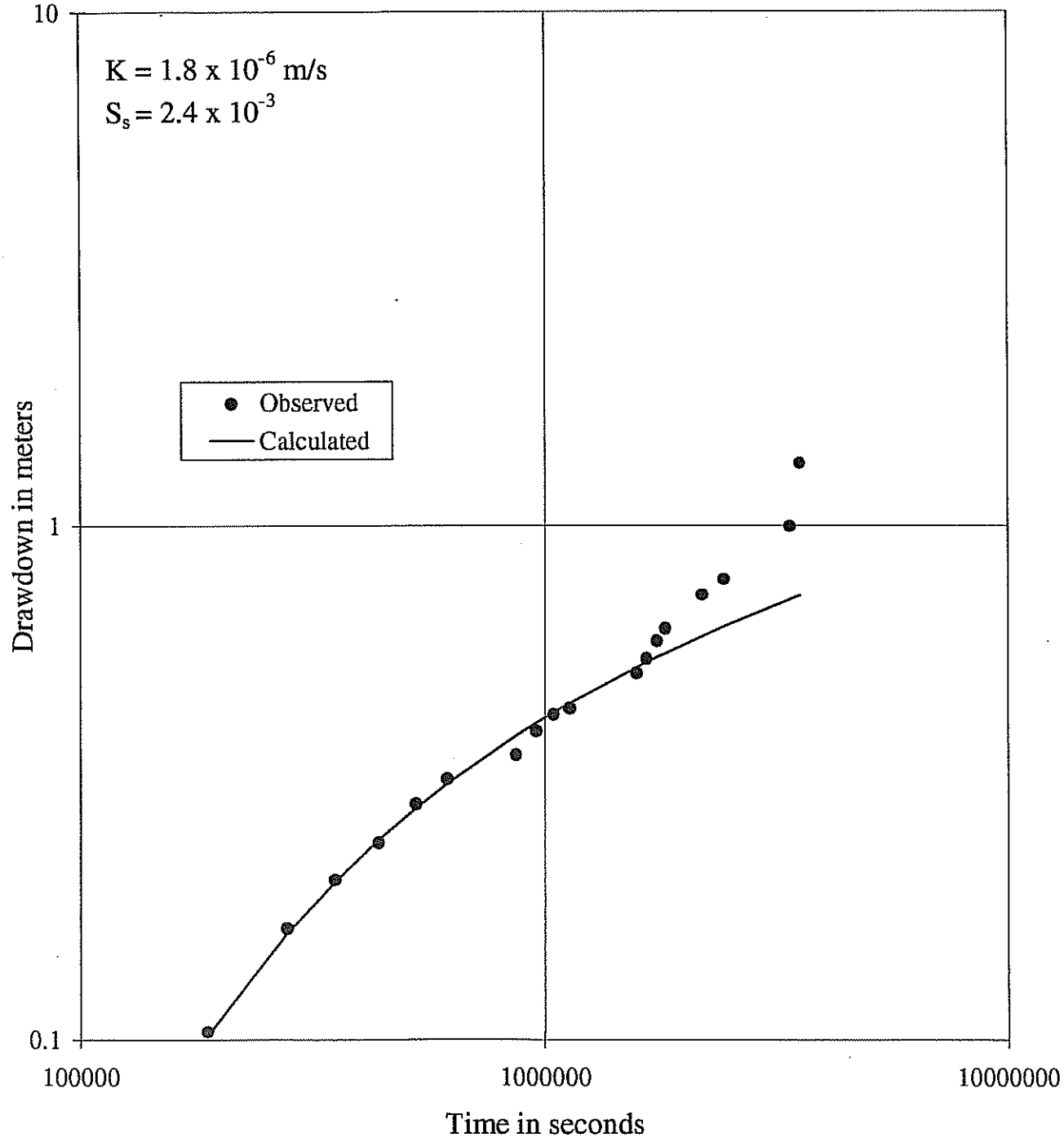
Drawdown for Well 53-93-9 Pumping Test from MW53-93-16-69'



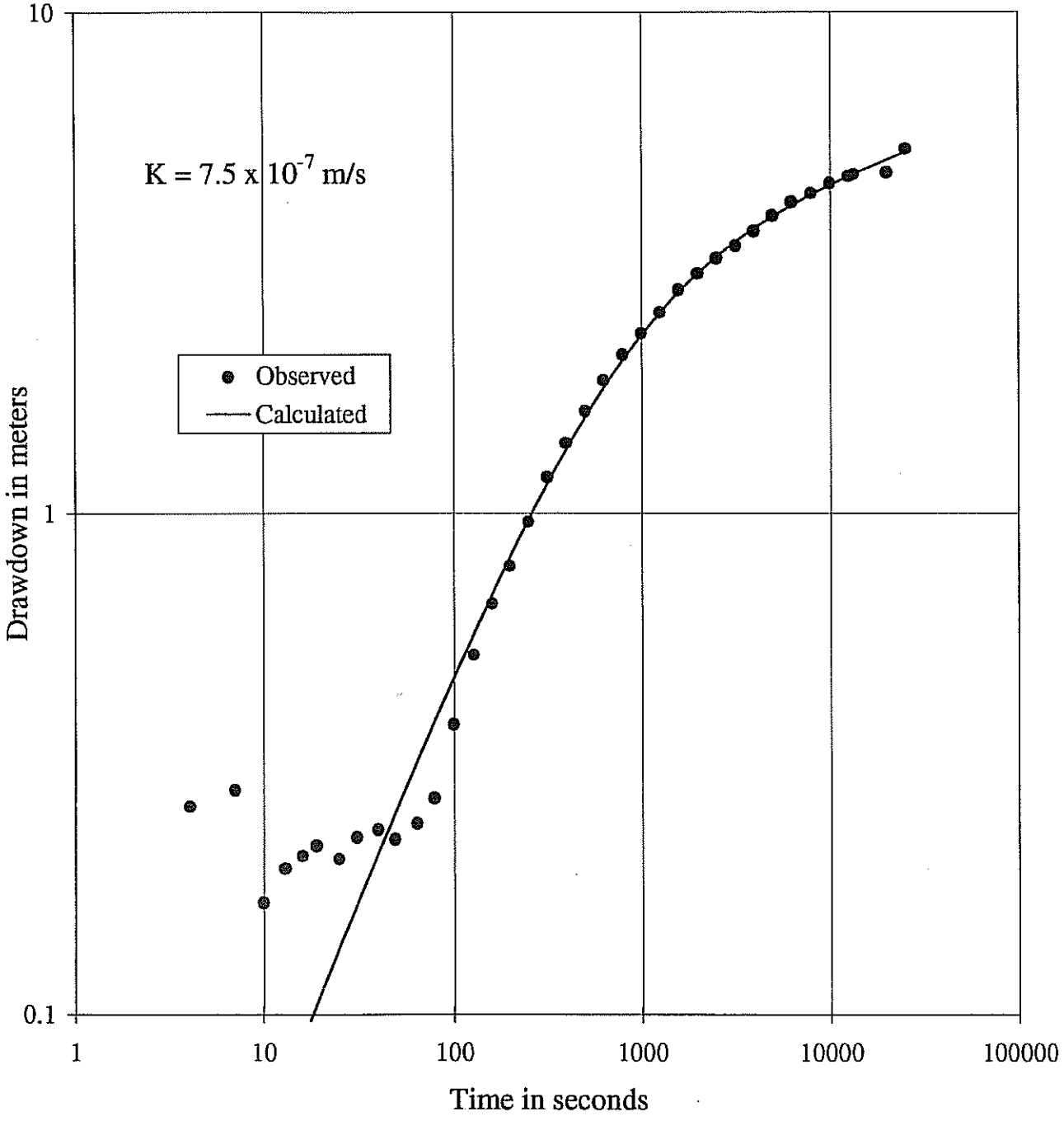
Drawdown for Well 91-8 for Pumping Test from MW53-93-16-69'



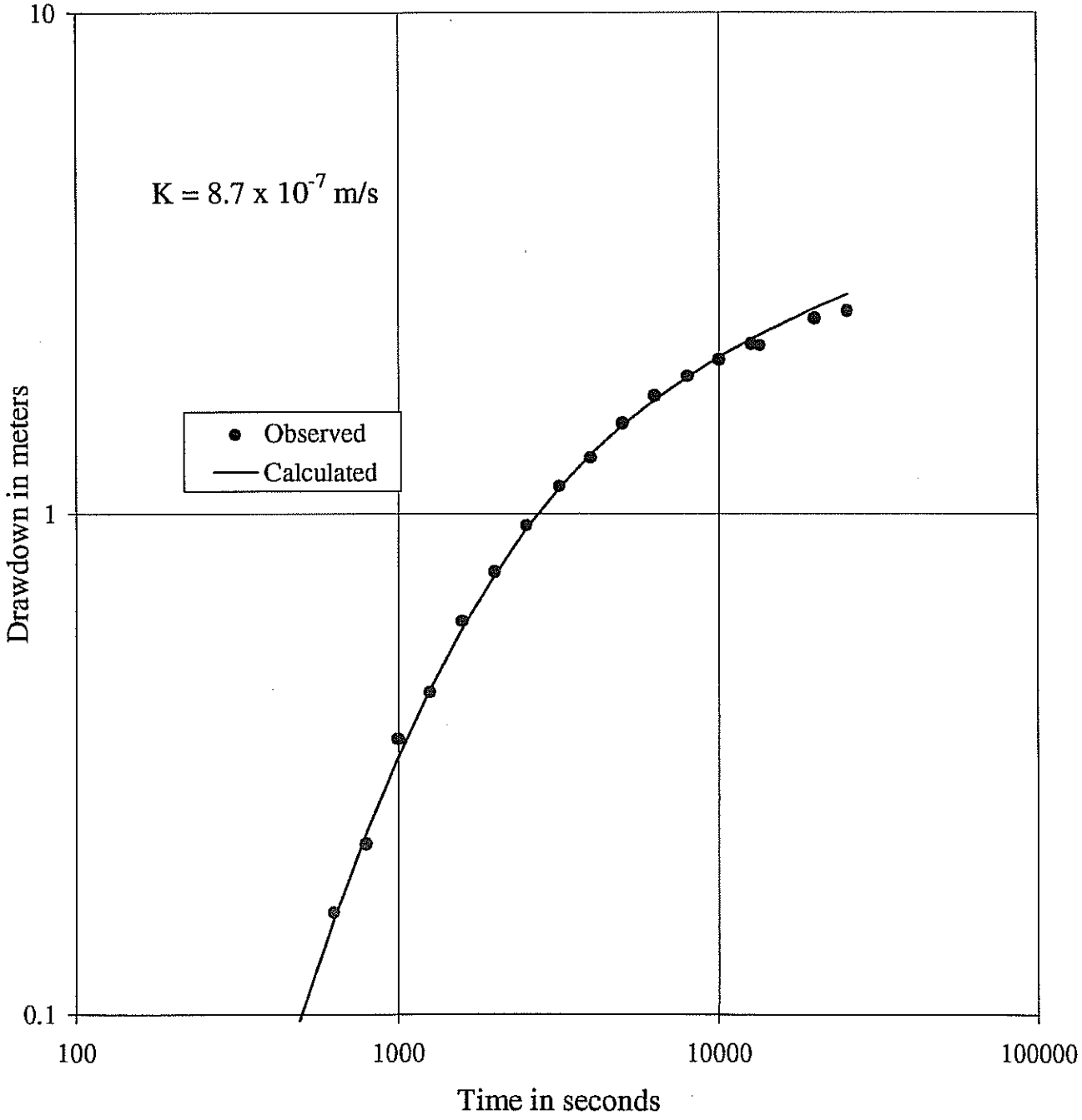
Drawdown for Well 27-92-20 for Pumping Test from MW53-93-16-69'



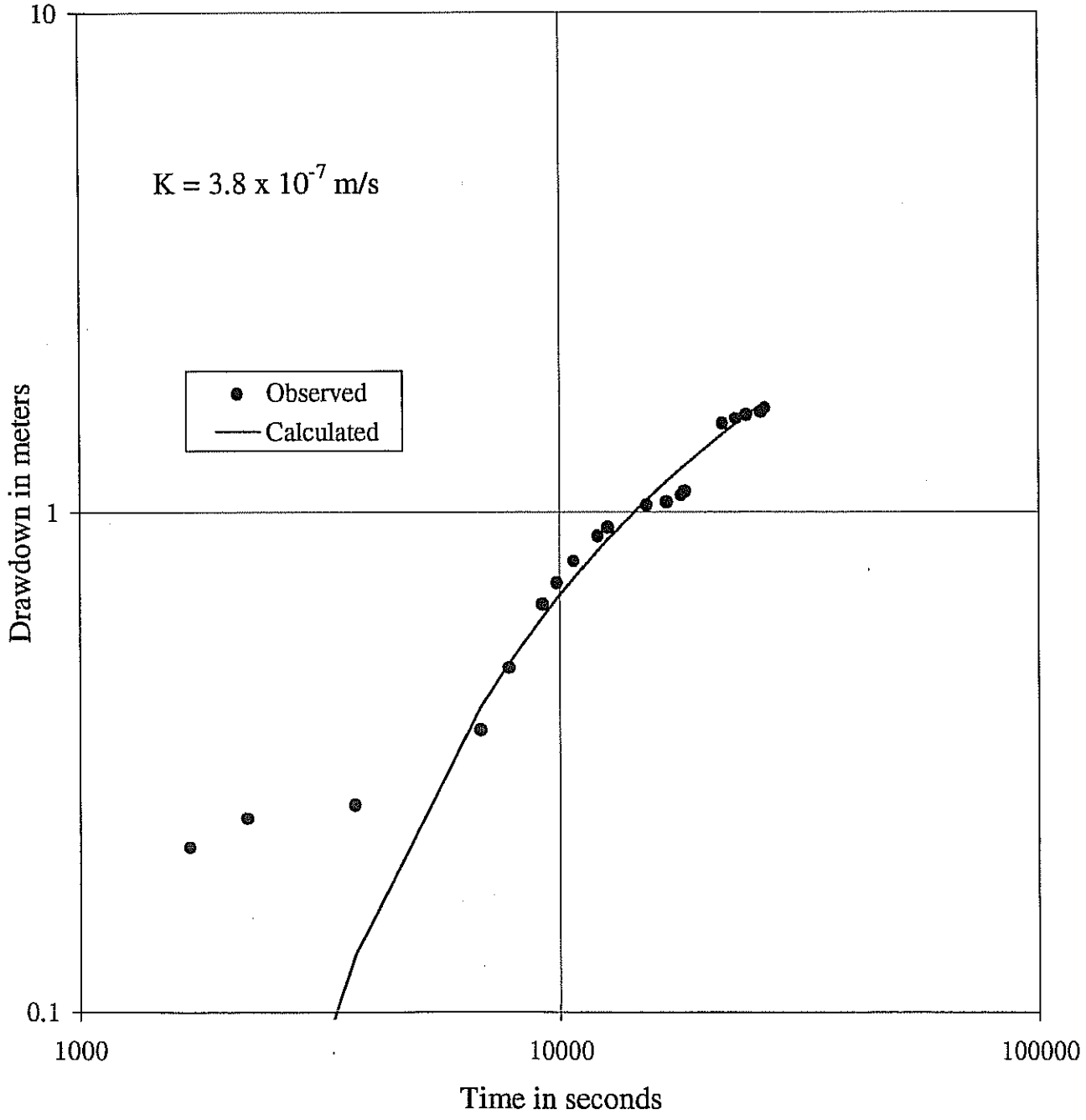
Drawdown for SB58-95-1 for Pumping Test from SB58-95-1



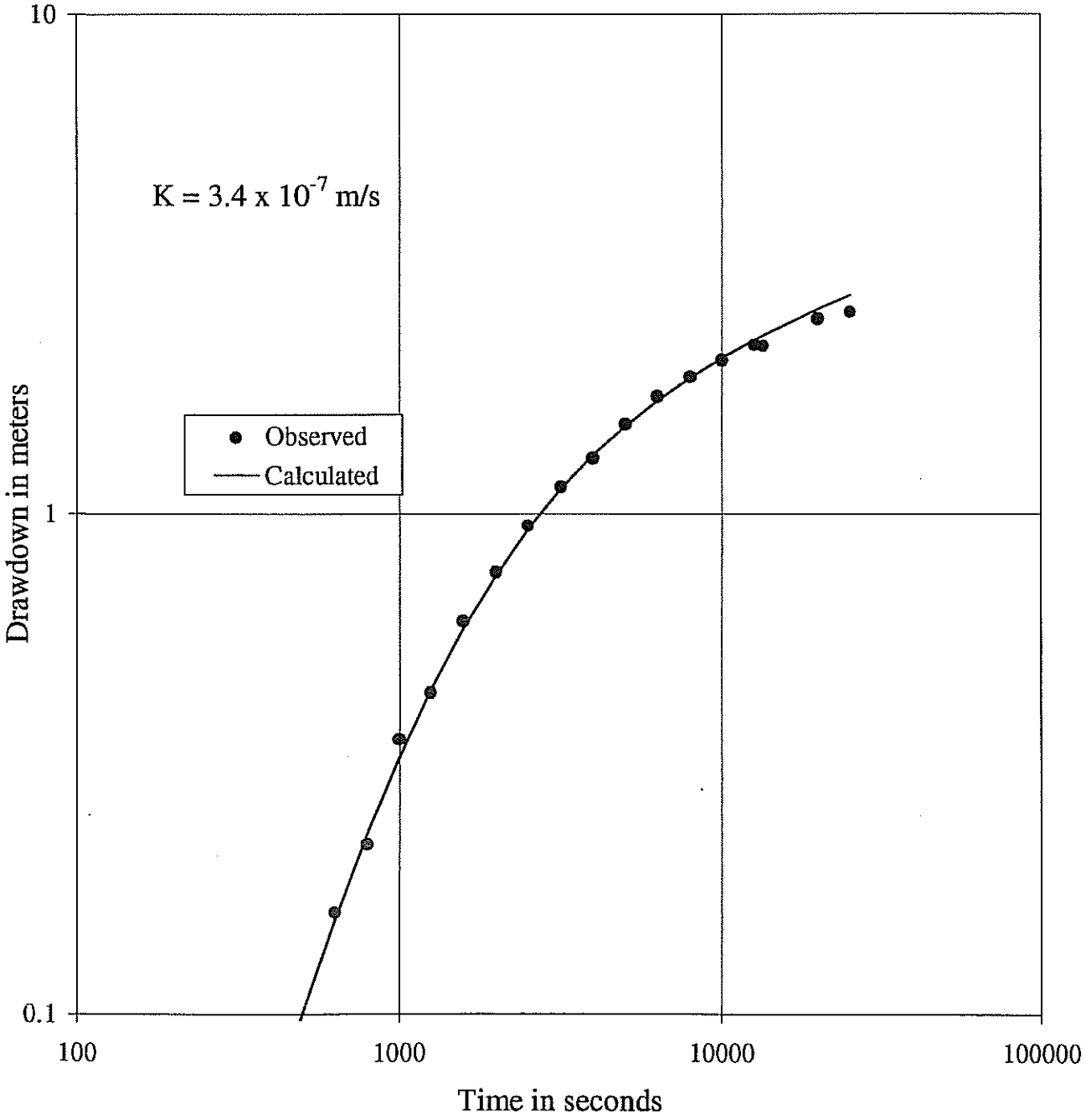
Drawdown for MW58-93-3 for Pumping Test from SB58-95-1



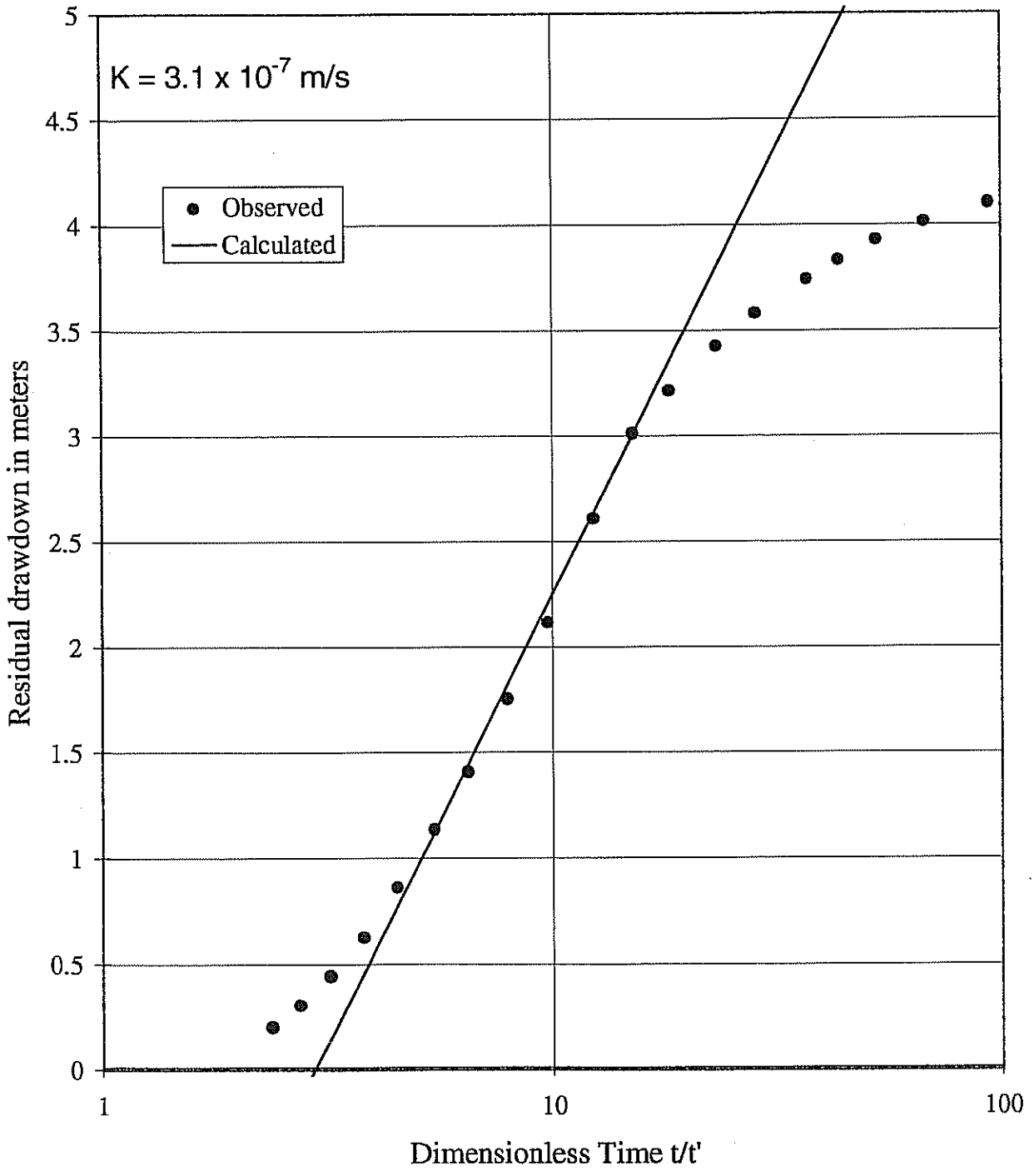
Drawdown for MW58-95-11 for Pumping Test from SB58-95-1



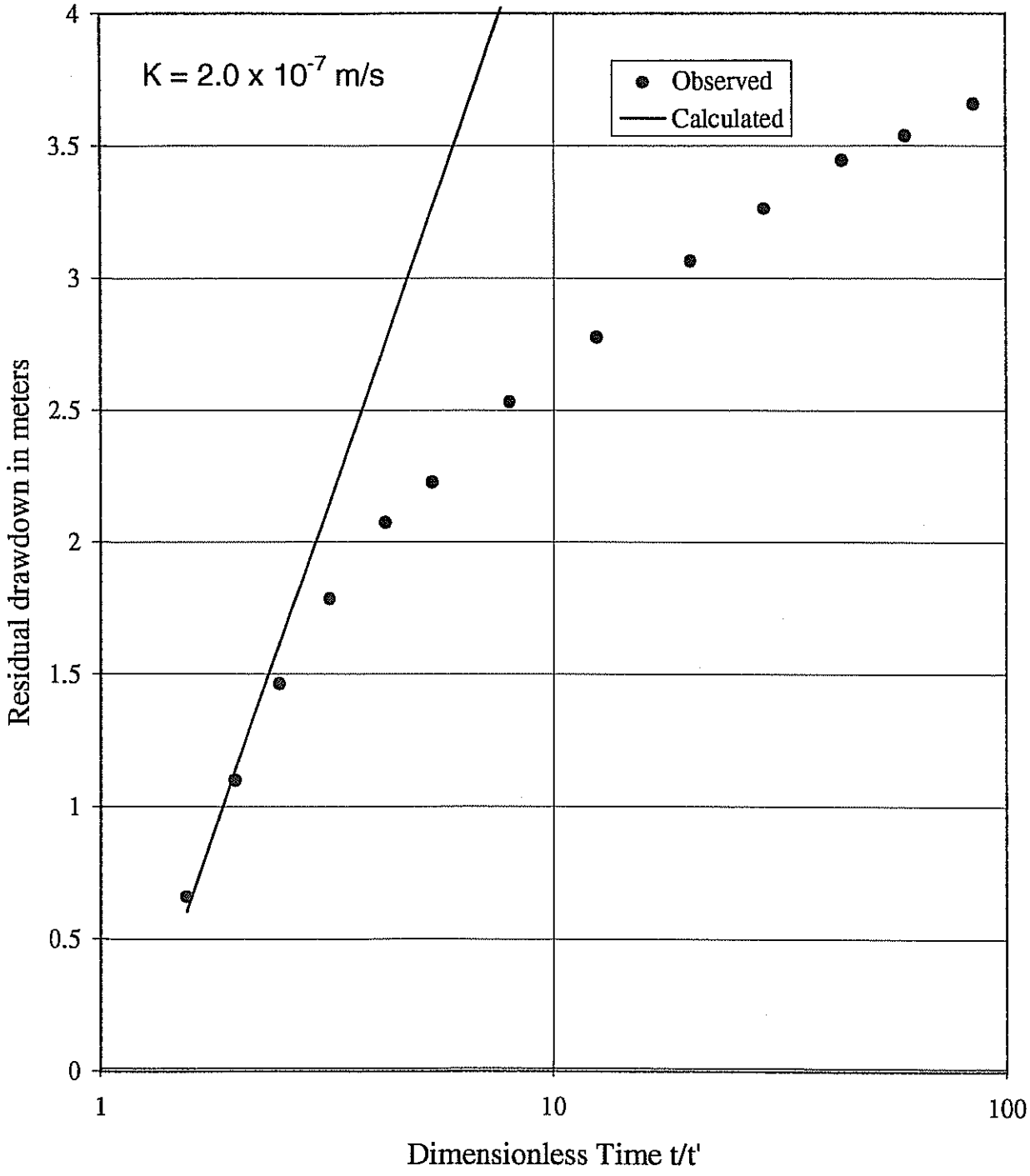
Drawdown for SB58-95-2 for Pumping Test from SB58-95-1



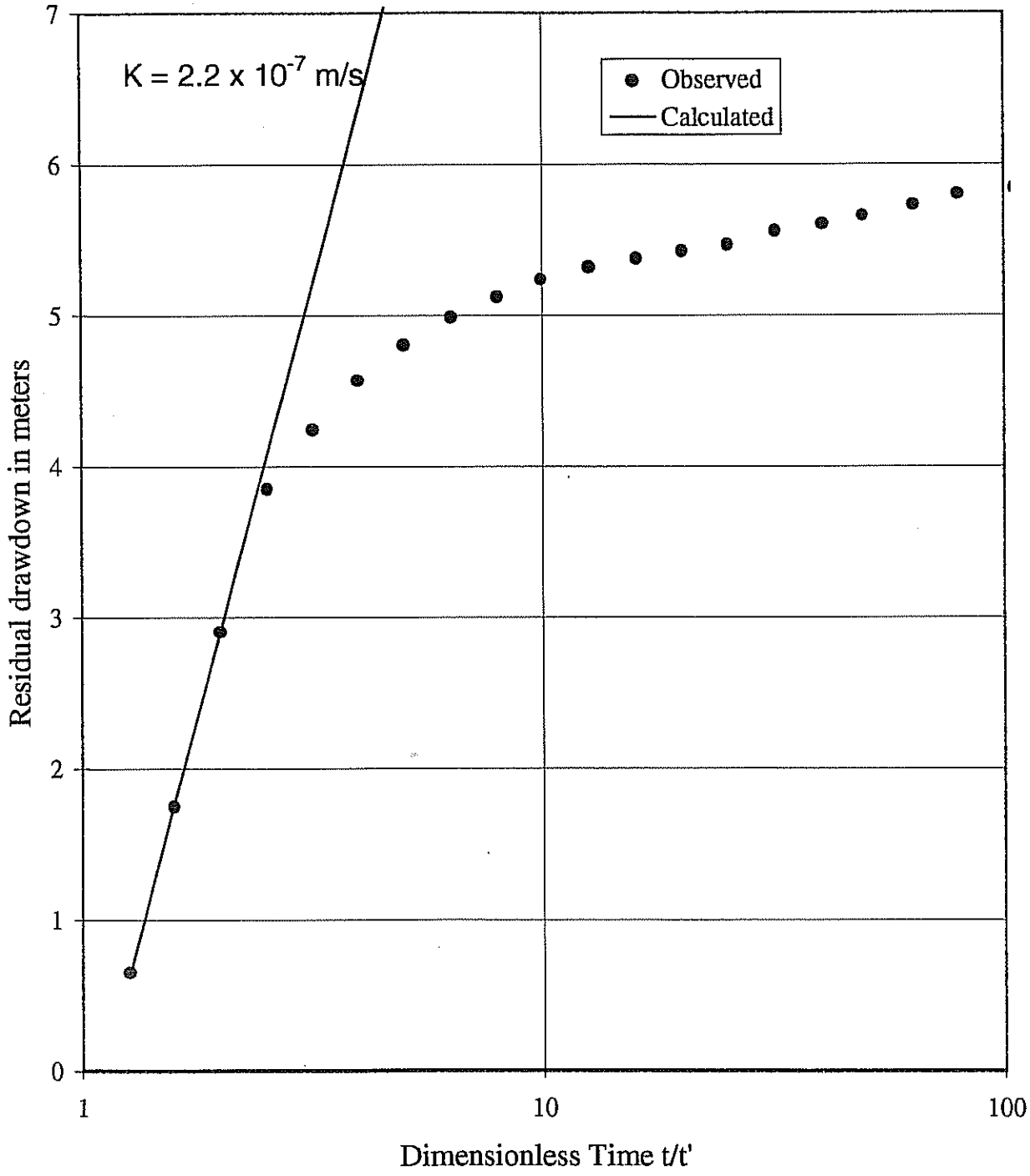
Recovery of SB58-95-1 for Pumping Test from SB58-95-1



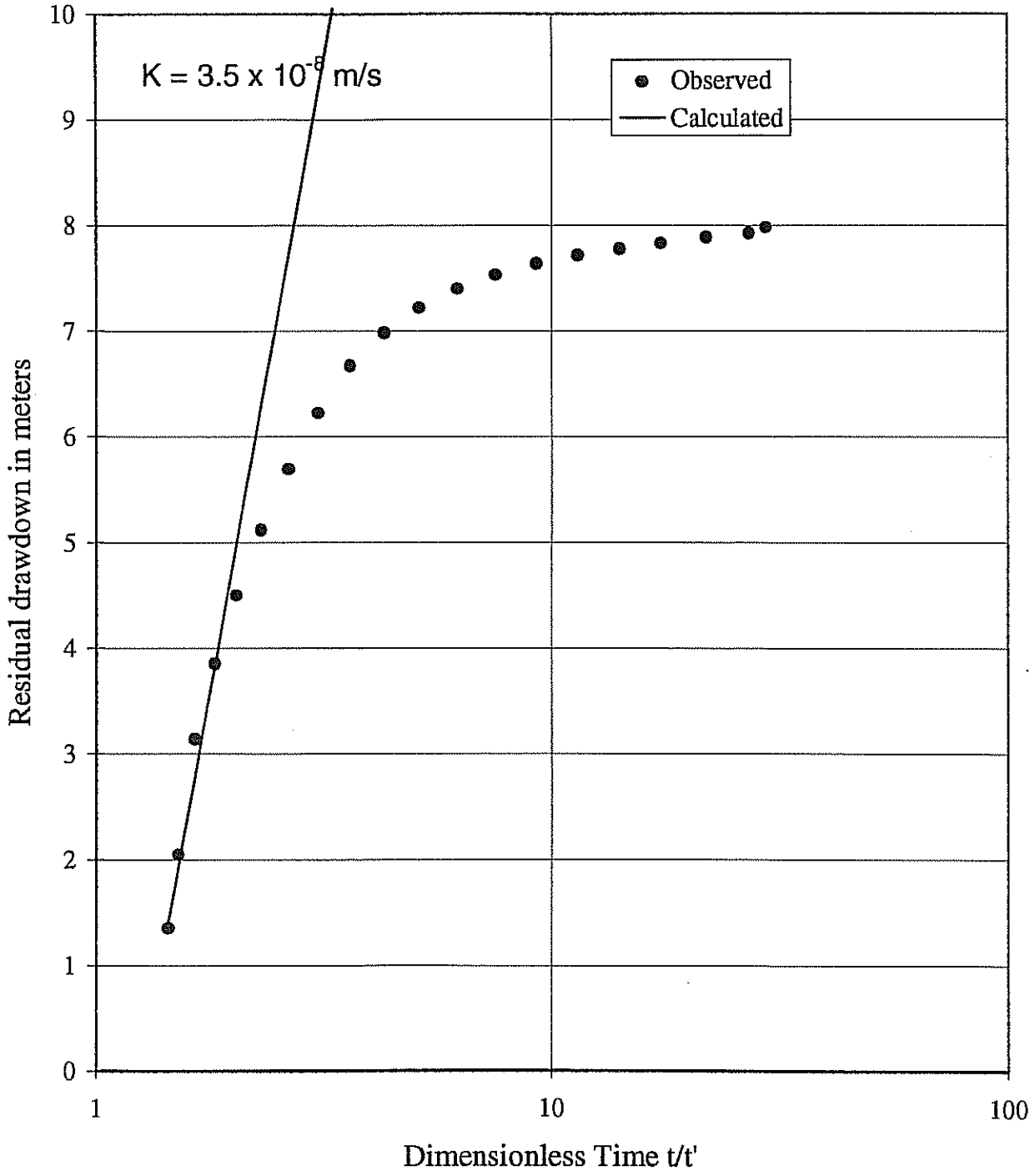
Recovery of SB58-95-2 for Pumping Test from SB58-95-2



Recovery of MW58-93-3 for Pumping Test from MW58-93-3



Recovery of MW58-95-11 for Pumping Test from MW58-95-11



Appendix B

Groundwater Parameters

Appendix B
Table 1
Changes in Groundwater Elevations in LBNL Monitoring Wells

Area	Well No.	Depth to water (ft) Qtr 3 FY 2000	FY 1993 Elevation ft MSL Qtr 1	FY 1993 Qtr 2 Change (feet)	FY 1993 Qtr 3 Change (feet)	FY 1993 Qtr 4 Change (feet)	FY 1994 Qtr 1 Change (feet)	FY 1994 Qtr 2 Change (feet)	FY 1994 Qtr 3 Change (feet)	FY 1994 Qtr 4 Change (feet)	FY 1995 Qtr 1 Change (feet)	FY 1995 Qtr 2 Change (feet)	FY 1995 Qtr 3 Change (feet)	FY 1995 Qtr 4 Change (feet)	FY 1996 Qtr 1 Change (feet)	FY 1996 Qtr 2 Change (feet)	FY 1996 Qtr 3 Change (feet)	FY 1996 Qtr 4 Change (feet)	FY 1997 Qtr 1 Change (feet)	FY 1997 Qtr 2 Change (feet)	FY 1997 Qtr 3 Change (feet)	FY 1997 Qtr 4 Change (feet)	FY 1998 Qtr 1 Change (feet)	FY 1998 Qtr 2 Change (feet)	FY 1998 Qtr 3 Change (feet)	FY 1998 Qtr 4 Change (feet)	FY 1999 Qtr 1 Change (feet)	FY 1999 Qtr 2 Change (feet)	FY 1999 Qtr 3 Change (feet)	FY 1999 Qtr 4 Change (feet)	FY 2000 Qtr 1 Change (feet)	FY 2000 Qtr 2 Change (feet)	FY 2000 Qtr 3 Change (feet)	FY 2000 Qtr 3 Elevation
1	MW90-3	41.44	777.73	0.85	-0.74	-0.02	-0.55	0.59	0.04	-0.17	-0.09	1.29	-0.13	-0.57	-0.13	-0.82	0.12	-0.50	-0.08	6.19	-5.71	-0.26	0.00	1.66	-0.94	-0.55	0.09	0.31	0.80	-1.20	0.10	7.17	-6.95	779.16
	MW90-4	6.60	738.33	0.04	2.53	-11.54	-1.85	10.01	2.38	-3.72	-8.75	13.42	-0.16	-3.38	1.61	1.41	-0.47	-0.96	-0.90	NR	-2.99	0.84	2.64	1.95	-0.59	-12.25	12.43	0.22	-0.62	-1.20	0.56	1.19	-0.63	739.55
	MW90-5	17.11	725.20	-0.85	-1.80	-0.50	0.10	-0.20											Extraction Well													3.19	-0.85	728.64
	MW90-6	14.72	729.21	-1.40	-0.17	0.10	-0.42	0.47	-0.53	0.24	0.15	-1.77	2.03	0.13	-0.87	0.58	0.38	-0.78	0.13	NR	-0.37	0.20	-1.89	2.78	0.36	-1.29	1.30	0.54	-0.68	-0.54	-0.67	1.71	-0.40	731.28
	46A-92-15	13.88	809.69	6.52	-4.01	-1.74	-0.46	3.02	-1.27	-2.49	1.82	5.66	-0.31	-2.73	-1.30	4.77	-0.59	-3.00	-0.38	NR	2.33	-2.55	-1.52	7.43	-4.19	-0.50	-1.37	3.55	0.70	-4.67	-1.02	6.26	-1.43	816.22
	71-93-1	36.12				832.24	0.73	-4.67	-3.29	-0.43	1.22	1.04	-0.76	-1.18	-0.58	5.62	-2.86	-2.33	-0.40	3.00	-1.82	-1.12	3.49	5.04	-6.81	-1.39	0.49	1.94	-1.05	-1.41	-0.39	9.35	-6.74	836.27
	71-93-2	37.08				805.92	-1.00	0.87	-1.50	0.42	1.93	4.13	-3.15	-0.31	-1.10	-3.26	0.74	-2.20	-0.18	NR	1.70	-0.62	1.88	3.93	-2.01	-1.10	-1.15	0.98	1.30	-4.18	0.27	6.84	-4.24	807.31
	46A-93-19	49.09						760.68	-0.02	0.02	0.01	-0.02	0.02	0.06	-0.02	0.01	0.01	-0.01	0.03	NR	-0.05	0.01	0.02	-0.06	0.08	-0.20	0.16	-0.59	0.54	-0.01	0.06	0.04	-0.11	760.68
	71-94-1	38.52								806.89	2.13	3.96	-2.27	-0.98	-1.15	-3.29	0.68	-2.15	-0.14	NR	1.60	-0.64	1.68	4.62	-2.48	-1.12	-1.22	1.03	1.28	-4.24	0.38	6.67	-4.10	807.32
	51-94-11	10.15								748.02	-0.54	-0.89	-0.44		-0.10	0.20	-0.53	-4.40	1.08	NR	3.20	-3.27	2.12	3.56	-0.58	-0.90	-0.03	0.03	-0.03	-0.44	0.00	1.39	-0.77	746.68
	71-95-1	39.75											809.88	-0.28	-1.16	-0.19	-2.33	-2.17	-0.17	NR	1.61	-0.49	1.90	4.57	-2.40	-1.36	-0.57	0.40	1.28	-4.72	0.82	6.79	-4.22	807.19
	71-95-8	18.45											821.65	-2.29	-1.47	6.18	-1.68	-3.80	-0.68	NR	3.60	-3.42	-0.25	7.25	-2.13	-3.53	-1.46	4.75	-0.38	-4.37	-0.08	9.97	-5.42	822.64
	71-95-9	22.86											831.11	-1.40	-1.31	2.91	-1.38	-1.08	-0.44	NR	2.14	-1.40	-0.25	4.84	-1.95	-2.12	-0.99	4.28	-1.58	-3.27	0.38	5.18	-2.43	831.32
	71-97-23	43.46																					793.13	9.76	-2.86	-1.87	-0.54	1.34	3.41	-4.18	-0.16	4.71	-4.77	800.99
	46A-98-11	71.65																											740.28	-4.59	3.91	3.17	-9.95	742.01
	71B-98-13	14.69																										822.13	-5.33	-2.35	0.03	4.71	-1.55	817.64
	71B-99-3	21.02																												816.55	-0.69	9.81	-5.46	822.19
	71B-00-2	52.86																																NS
2	MW90-2	28.97	852.32	0.99	-7.16	-4.15	-0.91	9.04	-4.69	-3.33	4.72	2.13	-1.54	-3.94	-1.35	11.02	-7.95	-4.64	0.37	12.17	-7.85	-2.41	4.02	6.30	-2.94	-3.12	-1.36	1.32	-4.38	-1.00	-0.90	8.90	-5.87	851.61
	MW91-7	Redrilled	829.83	10.97	-5.35	-4.25	-1.30	5.07	-0.46	-1.84	0.34	6.74	-0.14	-5.90	-3.12	7.21																		
	MW91-8	53.27	827.64	9.13	-5.05	-3.01	-0.88	3.07	0.37	-2.10	1.21	7.09	-2.40	-4.89	-2.34	6.77	-0.53	-4.50	-0.30	7.62	-2.74	-5.55	1.91	6.46	-2.72	-4.44	-0.52	2.89	1.38	-4.15	-0.92	3.52	1.63	833.75
	MW7-1	15.25	867.49	3.29	-3.12	-0.21	-1.32	3.67	4.11	-6.19	4.50	-0.94	-2.48	-0.65	0.20	3.83	-2.35	-2.32	3.29	-2.54	-0.70	1.87	1.18	-1.58	-0.56	-1.13	16.79	-15.62	0.33	-1.10	-0.04	0.63	0.75	868.88
	MW1-220	79.07	809.75	0.90	1.01	2.04	-2.18	5.74	-2.23	-3.41	2.95	4.97	-5.11	4.16	-2.34	5.07	-8.43	1.79	1.89	4.97	-6.02	2.77	4.65	1.98	-1.98	0.79	-6.71	5.57	-4.22	5.29	0.93	0.05	-0.53	822.57
	7-92-16	38.48	853.36	7.30	-5.24	-4.65	-0.92	6.30	-1.65	-0.75	1.26	6.35	-3.18	-2.07	-2.75	6.52	0.58	-5.28	1.41	8.97	-4.48	-1.59	0.42	6.74	-2.19	-3.07	-25.79	1.27	Extraction Well		-26.08	5.67	10.17	843.92
	7-92-19	26.32	858.32	4.43	-2.70	-3.68	-0.36	9.57	-1.66	-3.44	0.26	4.07	-1.00	-3.70	-0.12	7.91	-4.62	-9.50	-2.46	6.59	-1.97	-0.84	1.40	2.77	-1.35	-2.24	0.68	3.69	-1.66	-3.33	-0.91	6.13	-1.60	858.48
	27-92-20	48.19	827.32	8.08	-4.72	-2.35	-0.86	3.76	-0.54	-2.01	1.20	5.74	-1.71	-4.27	-2.16	6.09	-1.94	-2.47	-0.32	6.40	-5.29	-1.73	1.64	5.49	-2.04	-3.96	-0.53	2.73	1.25	-3.80	-0.78	7.81	-3.14	832.91
	53-92-21-130'	73.46			774.20	2.06	5.50	4.16	3.29	2.23	-30.35	3.68	-0.63	3.89	4.00	5.34	5.46	4.22	2.60	4.20	2.58	2.22	2.45	2.68	1.37	0.98	1.66	1.38	0.50	1.32	1.06	0.77	0.69	813.51
	53-92-21-147'	69.43			766.71	4.46	6.39	5.85	4.69	3.07	5.34	2.98	2.67	1.59	1.69	1.84	1.56	1.41	0.84	1.22	0.07	0.66	0.70	0.85	0.50	0.02	0.45	0.46	-0.17	0.65	-0.41	0.21	0.42	817.56
	53-92-21-167'	69.47			816.18	-0.44	-0.25	-0.47	-0.27	-0.01	-0.21	0.14	-0.41	0.63	0.15	1.08	-1.09	0.29	0.13	-0.10	0.01	0.25	0.10	0.40	0.32	-0.07	0.49	0.02	-0.21	0.54	0.29	-0.42	0.43	817.50
	53-92-21-193'	99.72			711.67	3.47	5.09	4.97	4.22	3.02	5.11	3.63	3.02	2.27	2.62	3.33	3.51	3.07	1.91	3.57	1.20	2.67	2.49	2.52	1.59	1.43	1.76	2.24	0.69	1.80	1.61	1.30	1.48	787.26
	6-93-4	41.45				847.99	-0.70	5.48	-2.27	-1.87	0.30	5.60	-2.51	-1.66	-2.64	5.73	-6.93	2.78	1.23	9.82	-3.66	-3.13	0.00	6.28	-1.60	-2.90	-18.60	1.66	-3.71	17.25	-18.67	7.40	-0.50	840.15
	53-93-9	62.24				832.26	-1.17	4.59	-0.39	-2.49	0.72	9.01	-2.60	-5.93	-2.33	6.26	-0.62	-3.31	-1.96	10.14	-3.28	-6.61	-0.36	13.89	-6.95	-4.53	-1.41	8.45	-2.96	-4.49	-1.86	5.61	0.76	838.44
	53-93-16-42'	38.67						849.12	-0.67	-1.81	1.45	0.26	-0.39	-0.61	-1.80	3.76	-1.16	-1.79	-0.81	2.74	-0.92	-1.42	-0.55	5.83	-3.60	-1.62	-0.48	3.68	-0.86	-2.25	-0.54	4.39	-1.27	848.78
	53-93-16-69'	52.10						833.60	-0.73	-2.34	1.20	7.19	-2.21	-5.04	-2.39	6.86	-1.86	-4.64	0.85	7.97	-2.88	-5.78	3.25	9.01	-5.90	-4.68	-0.76	7.09	-2.61	-4.30	-1.26	10.46	-4.80	835.30
	53-93-17	66.93					827.20	5.21	0.48	-2.80	0.71	9.82	-7.50	-1.75	-3.21	6.93	1.10	-6.00	-1.73	11.49	-8.63	-3.23	1.18	10.91	-2.54	-7.17	-0.94	3.67	2.29	-5.44	-1.34	12.96	-5.98	835.69
	7-94-3	11.09							868.34	-3.70	5.36	2.38	-3.65	-4.69	3.28	7.16	-2.81	-7.91	8.08	-2.92	2.28	-0.07	1.80	0.55	0.58	-2.40	2.69	-0.62	-0.47	-1.36	-4.38	7.01	-2.74	871.79
	53-95-12	33.17												830.40	-3.59	8.69	-2.61	-2.92	-3.12	10.00	-5.74	-2.82	-1.32	13.03	-4.89	-0.72	-4.50	3.25	1.06	-4.18	-7.38	9.61	1.83	834.28
	52B-95-13	17.55												866.79	-4.49	9.92	-3.30	-4.84	6.95	-0.94	-2.09	-0.62	3.84	1.48	-0.71	-10.73	5.86	4.58	-2.17	-4.07	-3.62	9.61	-1.60	869.85
	6-95-14	Not recorded													850.50	1.50	5.49	-5.32	2.76	7.65	-4.47	-1.55	0.12	9.09	-4.26	-3.24	-31.56	Extraction Well							
	7B-95-21	14.46													864.53	6.32	-4.00	-15.83	16.60	6.61	-5.05	-2.07	3.90	-1.16	-0.22	-6.18	5.58	1.64	-1.11	-2.08	-0.97	3.34	-0.70	869.15
	7-95-22	35.21													858.36	3.19	-0.51	-12.25	0.36	-4.33	-3.48	-1.69	1.70	4.05	-2.82	-1.28	0.94	-4.70	4.01	-2.16	-1.11	18.40	-18.31	846.95
	7-95-23	49.43													851.12	7.60	-1.10	-13.55	-3.26	11.33	-3.82	-4.93	1.36	3.07	-1.50	-0.57	-3.28	3.68	-5.68	0.80	-6.80	3.15	-4.68	832.94
	7B-95-24	43.43													840.62	6.81	-3.74	-8.18	-2.72	11.08	-7.09	-2.21	-0.89	12.35	-2.40	-6.67	-2.69	9.36	-2.94	-5.23	-3.04	12.11	-4.08	840.45
	7B-95-25	30.87														858.33	-5.22	-5.03	7.95	10.22	-14.38	-1.02	7.48	0.06	-0.58	-5.16	-0.32	3.50	-5.75	-1.09	0.10	16.74	-14.67	851.16
	53-96-1	51.12															836.02	-5.00	-2.11	9.96	-3.10	-6.13	2.49	10.55	-6.47	-5.06	-0.60	3.30	2.20	-5.01	-1.63	10.89	-4.62	836.52
	58-96-11	33.28																	819.38	5.85	1.88	-2.88	-4.70	16.28	-5.68	-3.13	-12.93	2.23	-1.59	-0.38	-3.87	5.14	-0.65	814.94
	7-00-4	97.70																																NS
3	MW91-3	13.89	960.59	9.18	-5.28	1.94	-2.44	4.15	-2.37	1.61	-4.09	0.44	-1.33	-0.73	-1.33	2.93	-0.26	-0.70	-0.74	2.22	-1.77	-0.31	-0.70	2.98	-1.17	-1.09	-0.68	0.99	0.49	-1.65	-0.01	1.39	0.14	967.80
	MW91-4	94.25	867.83	13.73	-4.39	-23.26	8.95	9.84	-9.60	3.71	4.53	-3.10	-5.51	12.77	-14.26	-4.19	11.15	-10.94	6.14	-7.61	15.01	-8.11	3.95	-0.30	5.22	-5.93	-14.17	11.41	8.53	-7.40	11.54	-18.38	23.13	884.30
	MW91-5	20.67	947.07	12.35	-5.10	-1.15	-5.79	8.06	-1.84	2.01	1.46	2.20	-1.97	-5.04	3.30	1.62	-1.13	0.52	-0.27	2.43	-2.65	0.42	-0.21	4.01	-2.19	-1.33	-0.82	0.65	0.77	-1.66	-0.74	2.70	-0.27	957.61
	MW91-6	28.15	944.35	6.34	-3.70	-2.47	-0.65	3.95	-0.11	-1.10	0.03	1.93	-1.91	-0.89	-0.85	1.16	0.57	-0.75	0.28	4.22	-4.05	-0.33	-0.03	5.44	-3.84	-1.29	-0.70	2.14	-0.62	-1.91	-0.01	5.45	-3.70	947.07
	69A-92-22	19.77		914.60	4.03	38.63	0.78	-0.49	-2.04	-0.33	-1.83	-1.69	1.60	-0.14	0.43	0.04	0.23	0.74	0.53	-0.13	0.30	0.10	-5.31	6.39	0.28	-0.52	-0.16	1.12	-0.32	-0.62	-0.01	0.56	0.52	957.29
	75-92-23	29.83	940.62	1.74	-0.97	-0.49	-0.18	0.19	-0.45	0.78	-0.16	1.97	-0.78	-1.25	-0.19	0.14	-0.18	0.27	-0.10	3.41	-2.51	-0.97	-0.20	2.16	-0.52	-0.90	-0.32	2.51	-1.39	-1.48	-0.39	1.89	-0.48	942.47
	75B-92-24	36.90	911.75	6.70	-1.13	-2.48	-4.08	3.96	0.07	0.21	0.54	4.49	-2.12	-0.84	-3.45	5.76	-1.28	-0.98	-2.45	6.11	-3.54	-1.71	2.15	8.60	-2.12	-6.58	0.60	6.02	-5.44	-1.97	-0.05	6.08	-2.84	920.00
	75-96-20	23.26																			963.09	2.93	0.08	-1.68	1.03	1.07	-5.29	5.92	-4.85	3.07	0.50	-6.20	-1.86	955.81
	75-97-5	45.57																				897.75	8.66	15.75	-1.19	-6.77	-5.85	11.46	-4.70	-6.56	-1.98	1.94	9.63	918.16
	75-97-6	54.27																			898.34	2.01	-0.70	8.36	2.09	2.04	-1.23	0.18	-1.40	2.65	-0.01	-0.24	0.83	913.62
	75-97-7	54.52																			900.60	11.14	2.46	-2.44	3.73	0.56	-0.78	-0.91	-1.83	3.97	-0.50	-0.52	0.70	916.18
	69-97-8	41.38																					938.73	-2.77	2.82	-0.62	-0.37	1.08	-0.43	-0.82	-0.70	0.15	0.87	938.14
	69-97-21	22.69																					971.49	10.76	-1.08	-2.72	-1.82	6.58	-3.29	-2.12	-2.40	6.74	-3.83	980.71
	75-98-14	23.27																										967.44	-11.66	6.23	-6.57	-0.88	0.11	954.67
	75-98-15	11.73																										981.17	5.74	-5.50	-0.09	2.45	2.47	966.24
	75-98-16	Dry																											Dry	Dry	Dry	Dry	Dry	Dry
	75-99-4	11.64																												958.83	1.97	2.93	2.53	966.26

Appendix B
Table 1 (Cont'd)
Changes in Groundwater Elevations in LBNL Monitoring Wells

			FY 1993				FY 1994				FY 1995				FY 1996				FY 1997				FY 1998				FY 1999				FY 2000			
		Depth to water (ft)	Elevation ft MSL	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	
Area	Well No.	Qtr 3 FY 2000	Qtr 1	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Change (feet)	Elevation Qtr 3
3	76-99-6	18.57																													Dry	5.42	3.01	961.37
	76-99-7	17.86																													957.17	7.01	-4.12	960.06
	76-99-8	15.33																													951.84	1.93	10.24	964.01
4	MW76-1	18.46	902.34	3.76	-1.04	-2.02	-0.85	2.27	-1.28	-0.37	1.42	5.46	-0.76	-0.45	-0.14	0.69	-3.96	-2.29	1.50	3.05	-2.30	-1.33	0.14	3.25	-1.74	-1.57	-1.16	3.88	-1.04	-2.10	-1.16	5.61	-2.31	905.22
	76-92-25	16.42	898.46	0.93	2.27	-1.23	-1.58	0.58	-5.94	5.37	-1.60	1.39	3.52	-0.15	-1.44	-0.08	2.84	-3.42	-0.32	-0.59	2.57	-1.09	-1.70	0.37	4.31	-2.52	-0.90	2.51	0.91	-3.05	-1.02	0.60	3.26	912.28
	76-93-6	15.82				928.91	-0.61	5.72	-2.74	-1.58	-1.56	5.41	-0.07	-2.90	-1.69	4.89	-0.76	-2.90	-1.70	6.00	-4.14	-0.79	-1.51	6.45	-1.39	-1.87	-2.13	5.56	-2.73	-2.11	-1.62	6.65	-2.01	932.79
	76-93-7	18.28				924.85	-92.77	6.84	3.29	-6.11	3.09	5.91	1.18	-1.60	-0.85	-0.63	2.93	-2.12	-0.91	-1.03	-3.21	4.20	-0.61	3.68	0.41	-1.71	-0.36	2.40	-1.22	-8.42	7.92	-1.25	2.66	906.57
	78-97-20	17.48																						933.44	-1.07	-1.61	-1.02	3.30	-0.94	-1.85	-1.31	4.39	-1.27	932.06
	76-97-22	43.56																								895.08	-0.64	-0.13	0.27	0.27	-0.43	-0.16	0.07	894.33
	76-98-21	18.95																										907.50	-2.57	-2.32	-7.12	4.26	4.50	904.25
	76-98-22	14.02																										892.07	-1.26	-3.28	-1.93	7.05	-2.10	890.55
5	MW91-1	24.12	839.11	14.71	-14.11	12.75	-6.47	6.93	-1.38	2.13	3.20	-1.33	-0.15	-2.18	0.79	0.26	0.34	-0.44	-0.40	-2.81	1.90	1.08	0.31	-0.41	1.10	-0.29	-0.35	-1.10	1.13	0.12	-0.33	-0.42	0.68	853.86
	MW91-2	43.46	829.56	4.53	1.29	-3.69	-0.99	2.71	-3.93	4.23	-3.07	-2.18	6.47	0.46	-1.50	0.20	0.49	-2.39	0.82	-2.24	3.34	-0.13	-0.91	0.87	0.81	0.92	-2.25	0.19	1.11	-0.45	-1.18	0.10	0.52	833.81
	MWP-9	32.11	782.12	4.86	-2.03	-2.66	-0.50	-1.10	-0.43	0.46	-1.59	0.35	-2.86	-1.37	-1.06	3.10	-0.68	-2.07	-0.63	6.71	-3.35	0.07	-0.74	4.27	-2.97	-1.90	-0.82	3.87	-0.87	-1.76	-0.26	7.40	-4.83	786.72
	MWP-10	53.63	754.30	2.95	-2.30	-0.91	0.29	0.83	-0.15	-1.53	0.07	2.95	-0.76	-0.68	-0.70	0.58	0.99	-1.83	0.67	2.98	-2.19	-0.86	-0.40	2.46	0.24	-1.10	-0.75	1.67	-0.63	-1.01	-0.28	2.35	-1.08	756.11
	77-92-10	19.74	813.71	0.45	-0.97	5.42	-2.40	12.55	-1.63	-3.74	-7.20	10.72	-0.86	-1.18	8.20	12.28	-17.56	-5.68	11.15	-10.94	0.51	4.94	5.22	-6.66	11.13	11.21	-16.98	-3.44	13.22	11.46	-17.60	14.41	9.51	859.37
	61-92-12	95.88	755.13	-0.98	-1.22	-3.64	-1.61	3.97	-2.85	-1.56	-1.46	1.12	-1.75	0.74	0.10	0.32	-1.11	0.26	0.32	-0.53	-0.01	0.04	-0.13	0.20	0.15	-0.02	0.11	-1.09	-0.54	0.73	-0.38	0.73	0.80	748.02
	77-93-8	11.64				862.96	-1.14	4.17	-0.64	-1.17	-1.73	2.14	0.37	-0.85	2.38	0.55	-0.48	-2.47	-0.79	2.49	0.08	-0.14	-0.25	3.13	-0.27	-1.84	-3.67	NR	4.55	-4.04	-0.73	3.01	1.75	867.37
	77-94-5	35.01							830.03	9.67	-0.24	-0.65	4.81	-0.17	-1.44	0.65	2.10	-2.54	-0.48	0.25	2.10	-1.40	-0.23	3.70	0.08	-2.18	-2.00	0.88	0.72	-0.59	-1.52	-0.10	2.50	843.95
	77-94-6	45.85							826.05	-2.03	-0.79	4.65	1.09	-2.77	-2.21	0.95	3.60	-3.88	-1.02	2.46	-0.73	-1.31	-0.54	7.71	0.43	-3.93	-3.25	2.98	-0.25	-2.61	-1.00	2.42	4.89	830.91
	77-97-9	21.70																			864.55	-0.40	-1.30	4.84	1.37	-0.97	-2.85	0.43	1.96	-2.22	-2.03	0.77	2.84	866.99
	77-97-10	Dry																			Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
	77-97-11	32.28																				780.02	0.03	5.04	-2.79	-1.46	-0.90	1.89	-0.58	-0.69	-1.13	3.71	-1.44	782.39
	31-97-17	20.03																					726.42	1.03	-0.69	-1.42	-0.52	2.62	-1.89	-2.87	2.51	3.36	-2.43	726.12
	31-97-18	21.68																					724.73	2.65	-0.56	-1.40	-0.58	2.56	-1.27	-1.73	0.37	2.95	-1.60	726.12
	31-98-17	22.05																										688.60	-11.98	3.53	-6.48	-0.26	-1.98	671.42
6	88-92-4	41.68	541.93	1.12	2.77	-0.47	3.78	1.58	-2.84	-1.52	-1.91	3.88	0.61	-2.01	-1.18	1.45	0.41	-1.10	-0.83	0.43	0.67	-0.57	-0.36	5.66	-5.24	2.06	-0.87	2.12	-0.64	-0.68	-0.31	0.60	0.80	549.14
	88-93-11A	60.38							473.22	0.13	-0.45	-0.25	0.79	2.82	0.31	-0.17	-1.69	-0.66	-0.48	-0.26	1.60	-1.34	-0.27	7.57	-4.85	-2.19	-0.30	-0.12	0.19	-0.55	-0.13	-0.21	0.88	476.97
	88-93-13	109.18						465.45	0.26	-0.30	-0.41	0.72	2.79	-0.27	-0.34	-0.44	1.68	-0.11	-0.73	0.02	1.90	-0.44	-0.66	6.32	-0.56	-1.26	-1.43	0.36	0.14	-1.09	-0.53	-0.26	1.53	472.34
	88-96-4	45.02															547.37	-0.72	-0.90	-0.40	3.14	-2.20	-0.38	5.28	-1.87	-0.77	-0.93	2.13	-0.69	-0.73	-0.30	0.83	0.36	549.23
7	46-92-9	74.52	729.59	-0.51	-0.91	-0.88	-0.53	0.15	-0.77	0.71	0.11	0.86	-2.54	-0.14	1.24	0.74	-1.79	0.37	0.74	0.61	-1.81	0.85	0.60	1.20	-0.68	1.33	-1.68	-0.34	1.53	-2.39	1.17	0.86	1.43	730.78
	58-93-3	4.75							827.57	-0.01	-0.46	0.06	-0.61	-0.01	0.27	-0.10	-0.08	-1.37	0.86	0.57	-0.45	0.14	0.04	0.44	0.10	-0.60	-1.32	-0.11	-1.11	1.89	-0.72	0.05	0.27	825.31
	46-93-12	7.61				799.96	-0.01	0.16	-0.09	-0.01	-0.05	0.26	-0.13	-0.10	-0.10	0.53	-0.33	-0.12	-0.03	0.29	-0.27	-0.07	-0.02	0.45	-0.28	-0.09	-0.06	0.15	-0.07	-0.07	0.00	0.31	-0.25	799.96
	58A-94-14	23.26									798.11	0.27	0.28	0.08	0.05	-0.19	0.13	-0.60	0.87	-0.49	-0.28	0.55	-5.63	6.50	-0.60	-0.25	0.98	0.45	-1.50	0.20	-0.21	1.49	-1.52	798.47
	51-94-15	33.18									736.84	-2.16	0.64	-4.34	-1.09	5.68	-2.01	-2.43	-1.94	6.88	-2.09	-3.33	-0.27	5.58	-1.15	-1.77	1.65	1.18	-1.43	-2.11	1.89	1.51	-0.58	737.99
	58-95-11	1.08												831.62	0.00	0.00	0.00	-2.36	1.47	0.89	0.00	0.00	0.00	0.00	-0.20	0.80	-1.43	1.29	-1.98	2.22	-2.09	2.19	-1.08	830.54
	58-95-18	11.26												788.61									Extraction Well						777.78	-0.44	0.25	4.15	-4.39	777.35
	58-95-19	20.22													802.79	0.20	10.46	-7.20	-2.41	-1.20	9.48	-4.10	-3.61	4.66	5.61	-2.95	-1.11	4.96	-1.14	-2.59	-4.50	1.66	5.10	814.11
	58-95-20	20.31												787.27	-0.59	18.35	-3.46	-3.88	5.26	2.39	-4.50	-0.43	10.68	4.46	-2.74	-5.27	1.46	4.27	-6.32	-1.07	1.71	6.66	-6.76	798.50
	51-96-3	9.26															756.52	-3.18	-1.13	5.81	-0.88	-3.15	-0.17	4.93	-0.21	-2.90	-2.20	4.86	-0.81	-3.29	-0.07	4.89	-1.46	757.18
	46-96-10	33.44																		757.69	-0.84	-0.11	-0.35	0.96	-0.40	-0.53	0.27	0.81	-0.92	-0.24	0.50	5.56	-5.69	756.91
	58-96-12	2.40																			829.84	0.01	-0.01	0.35	-0.19	-0.12	-0.57	0.40	-0.73	0.79	-0.62	0.78	-0.49	829.44
8	MWP-2	51.39	846.21	3.39	3.36	-1.10	-2.51	0.07	-0.77	-0.08	-3.73	5.35	5.24	-1.21	-1.51	-1.41	2.62	-0.76	-0.78	2.61	0.10	-0.63	-1.75	5.87	0.43	-2.22	-2.25	0.55	0.72	-1.27	-1.41	-0.06	5.33	858.94
	70-92-7	18.34	741.38	2.80	-0.83	-0.68	-0.61	-0.36	0.00	0.14	-0.67	2.86	-0.79	-0.43	-0.73	0.54	0.56	-0.80	-0.27	3.72	-3.35	-0.31	-0.55	3.76	-1.45	-1.10	-0.60	-2.75	-1.06	-1.11	-0.71	0.45	1.44	744.59
	70A-96-5	19.29															742.83	-0.55	-0.14	0.74	-0.38	-2.69	2.09	2.13	-1.23	-0.04	-6.43	7.97	-2.29	0.29	-0.21	1.85	-0.05	743.39
	70A-96-6	28.45															733.56	-0.09	0.04	0.19	-0.15	-0.04	0.02	0.35	-0.18	-0.08	-0.12	0.41	0.74	-1.08	-0.01	0.75	-0.09	734.22
	70A-96-13	113.88																	597.45	-0.06	0.06	-0.26	-0.06	-0.31	0.18	0.29	0.25	0.24	0.07	0.06	0.04	-0.04	0.08	597.99
	70A-96-14	121.12																	595.16	-0.16	-0.22	-0.06	0.00	-0.17	0.19	0.02	0.12	0.14	0.05	-0.24	0.19	-0.06	0.08	595.52
	58A-00-3	82.58																																NS
9	61-92-2	3.78	716.79	3.23	-4.93	1.64	-0.64	-1.11	4.38	-1.00	-1.39	1.53	-1.92	-2.05	2.86	2.77	-0.48	-3.68	1.38	1.24	-3.39	2.01	0.44	1.77	0.22	-0.34	-0.07	0.20	0.12	-0.57	-0.58	-8.11	7.48	720.91
	51B-93-18A	8.67							683.94	15.97	-2.39	-5.90	-4.38	-1.05	-1.41	0.79	1.90	-2.28	0.46	0.00	0.42	-1.04	-0.12	2.00	-0.10	-1.30	-0.33	-0.89	-1.23	1.30	-0.34	-3.64	7.14	701.28
	46-94-16	22.05									733.60	0.58	-0.19	0.18	-0.24	0.29	-0.09	-0.23	-0.53	0.83	-0.11	-0.01	0.04	0.06	-0.10	-0.02	-0.03	0.04	-0.12	-0.07	0.07	0.06	-0.08	734.11
	51-95-17	31.91														707.70	4.12	-0.83	0.62	2.36	-1.50	-0.55	-0.15	1.64	-0.50	0.11	-0.65	0.98	-0.39	-0.48	-0.21	3.06	-2.57	712.76
	51-96-15	21.06																	684.70	4.10	-1.57	0.18	1.37	1.20	-1.28	-1.29	-0.42	1.86	-1.36	-0.20	-0.24	2.47	-0.74	688.78
	51-96-16	17.42																	690.71	1.15	0.28	-1.08	-0.59	1.83	-0.16	-0.62	-0.73	0.63	0.39	0.21	-1.17	1.17	0.28	692.30
	51-96-17	10.77																	693.20	4.17	-0.26	-4.57	-1.48	7.20	-0.95	-3.20	-2.11	1.08	1.87	-2.11	-2.85	6.17	2.63	698.87
	51-96-18	5.70																	704.51	0.77	-0.50	-0.26	0.34	0.50	-0.50	-2.10	1.87	0.16	-0.23	-0.12	-0.08	0.59	0.01	705.06
	51-96-19	6.88																	702.26	0.36	-0.27	-0.05	-0.03	0.29	1.29	-1.45	-0.08	0.68	-0.57	-0.30	0.32	0.43	-0.36	702.52
	64-97-1	3.53																			690.03	2.51	13.42	0.80	-0.47	0.15	-0.83	-1.39	-0.58	NR	NR	NR	0.64	706.41
	64-97-2	9.64																			683.94	4.43	4.28	8.08	-0.43	-1.03	-4.72	1.85	-2.67	-0.01	-1.77	4.03	4.13	700.01
	51-97-3	33.32																			673.72	-0.24	-1.07	0.93	2.57	-0.85	-2.08	-0.32	1.45	-0.01	-1.09	1.55	2.53	676.49
	51-97-4	47.60																				637.42	17.50	3.99	1.18	-0.44	-21.31	10.42	-17.01	22.01	-2.10	-13.84	24.24	662.06
	51-97-12	31.32																					671.57	0.20	3.55	1.15	-3.40	-0.75	2.21	0.13	-0.09	0.67	2.81	678.05
	51-97-13	30.68																					673.50	3.44	1.12	-1.33	-1.37	0.72	-0.27	-1.00	-1.30	2.78	2.51	678.80

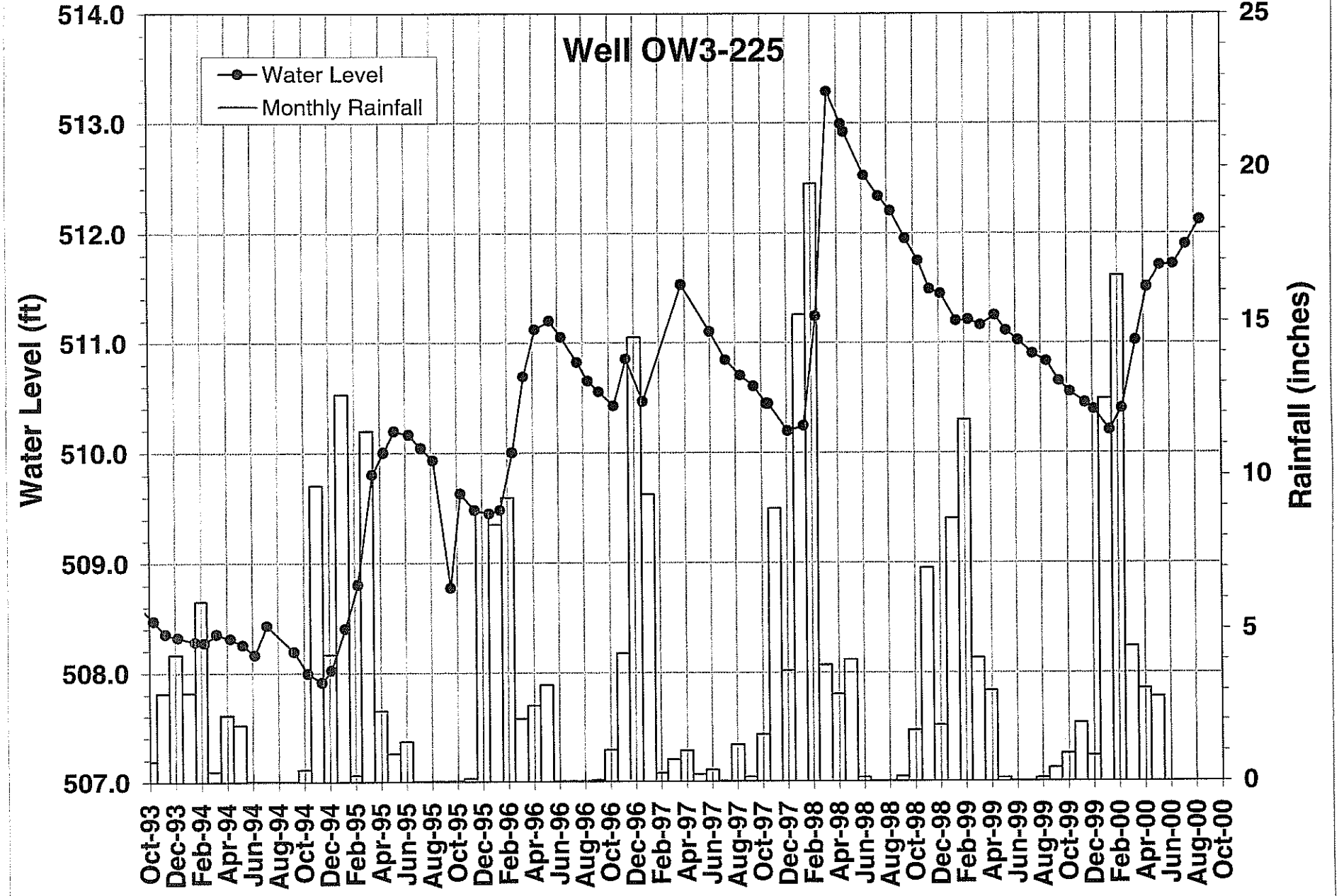
Appendix B
Table 1 (Cont'd)
Changes in Groundwater Elevations in LBNL Monitoring Wells

Area	Well No.	Depth to water (ft) Qtr 3 FY 2000	FY 1993 Elevation ft MSL Qtr 1	FY 1993 Qtr 2 Change (feet)	FY 1993 Qtr 3 Change (feet)	FY 1993 Qtr 4 Change (feet)	FY 1994 Qtr 1 Change (feet)	FY 1994 Qtr 2 Change (feet)	FY 1994 Qtr 3 Change (feet)	FY 1994 Qtr 4 Change (feet)	FY 1995 Qtr 1 Change (feet)	FY 1995 Qtr 2 Change (feet)	FY 1995 Qtr 3 Change (feet)	FY 1995 Qtr 4 Change (feet)	FY 1996 Qtr 1 Change (feet)	FY 1996 Qtr 2 Change (feet)	FY 1996 Qtr 3 Change (feet)	FY 1996 Qtr 4 Change (feet)	FY 1997 Qtr 1 Change (feet)	FY 1997 Qtr 2 Change (feet)	FY 1997 Qtr 3 Change (feet)	FY 1997 Qtr 4 Change (feet)	FY 1998 Qtr 1 Change (feet)	FY 1998 Qtr 2 Change (feet)	FY 1998 Qtr 3 Change (feet)	FY 1998 Qtr 4 Change (feet)	FY 1999 Qtr 1 Change (feet)	FY 1999 Qtr 2 Change (feet)	FY 1999 Qtr 3 Change (feet)	FY 1999 Qtr 4 Change (feet)	FY 2000 Qtr 1 Change (feet)	FY 2000 Qtr 2 Change (feet)	FY 2000 Qtr 3 Change (feet)	FY 2000 Qtr 3 Elevation
9	51-97-14	48.61																					659.09	2.30	-0.18	-1.07	-1.20	2.35	-0.83	-0.49	-0.58	1.12	-0.23	660.28
	51-97-15	70.66																					631.82	3.29	0.12	-1.62	0.90	0.15	-0.16	-0.20	-0.53	1.11	0.59	635.45
	51-97-16	13.76																					695.52	0.59	-0.23	-0.13	-0.03	0.28	-0.55	0.46	-0.16	0.03	0.06	695.82
	56-98-2	14.56																							692.72	-3.28	-3.00	6.74	-1.16	-2.26	-3.46	7.20	4.22	695.20
	64-98-4	Destroyed																							704.22	0.40	-0.20	-0.26	0.56	-0.65	-0.30	0.35		
	51-98-5	47.82																								660.87	1.61	3.15	0.24	-3.37	-1.07	4.45	-4.07	661.81
	64-98-19	Destroyed																										701.56	1.03	0.16	0.84	-0.43		
	64-98-20	10.22																											697.35	6.54	-0.11	-3.30	0.28	700.76
	51-99-1	10.07																											714.96	0.17	-1.44	0.57	0.11	714.37
	51-00-1	21.50																															-0.40	703.78
10	MW91-9	21.35	890.76	8.44	-6.54	-3.08	-0.42	9.71	-6.12	-2.17	6.02	-0.66	-2.28	-2.57	-2.22	7.32	-0.54	-5.21	1.13	9.00	-9.53	-0.75	4.28	6.30	-6.33	-4.05	2.90	3.83	-3.91	-3.76	1.49	10.56	-7.26	894.32
	MWP-8	25.92	844.65	3.53	-2.77	-1.28	0.16	1.91	-0.71	-0.75	0.66	0.21	0.07	-0.77	-0.60	2.09	-0.35	-1.30	-0.84	4.59	-3.34	-0.34	0.26	7.18	-5.90	-1.06	1.03	1.51	-1.82	-1.00	0.84	2.65	-2.07	846.42
	26-92-11	13.19	914.89	9.55	-3.88	-4.11	-1.74	0.95	2.91	-1.59	-3.16	9.27	-2.64	-2.18	-3.08	0.98	-4.78	-3.51	-3.13	10.22	-6.24	-2.48	-2.43	14.94	-6.23	-3.61	-2.87	1.98	-3.71	-3.86	-2.52	9.52	-0.94	923.00
	5-93-10	19.85				891.22	0.45	7.95	-4.88	-3.34	5.28	0.34	-2.39	-2.71	-0.72	6.22	-1.24	-4.88	2.22	8.15	-9.25	-0.25	1.56	8.49	-6.70	-3.86	2.40	3.77	-4.27	-2.60	3.38	8.70	-8.03	895.05
	52-93-14	39.28						863.25	-0.65	-0.39	0.06	1.31	-0.23	-1.37	-0.21	2.34	-1.82	-1.39	0.82	6.88	-6.06	-1.70	3.66	8.69	-11.05	-0.42	-0.29	5.19	-4.22	-0.58	-0.18	4.92	-5.74	860.75
	25-93-15	64.52						870.47	-0.98	1.76	0.03	2.00	-1.80	-0.30	-0.07	0.27	0.40	-1.40	0.71	2.72	-2.68	0.95	-0.75	6.10	-5.57	-0.57	-0.06	2.11	-1.81	-0.36	-0.01	2.17	-1.47	871.92
	52-94-10	56.92									849.11	3.50	-3.29	-0.24	0.13	0.58	-0.59	-0.06	0.00	5.90	-5.90	-0.02	0.00	8.72	-8.60	-0.02	0.04	2.14	-2.29	0.00	0.06	5.02	-5.07	849.12
	25-94-12	34.95									893.60	11.18	-3.11	-0.24	-0.06	0.96	-0.12	-1.56	0.81	4.15	-3.10	-1.12	3.00	5.65	-7.40	-1.20	-0.81	3.64	-2.28	-0.60	0.03	4.42	-3.20	902.64
	16-94-13	13.59									879.08	1.57	-2.36	-3.47	-1.85	6.41	1.03	-5.62	5.11	3.29	-6.24	-2.88	6.36	0.22	-0.28	-6.02	5.75	1.54	-6.30	-1.55	1.56	9.00	-5.44	878.91
	52-95-2A	40.07															-0.59	-0.71	-0.46	2.64	-2.14	-0.30	1.25	1.31	-1.64	-0.64	-0.48	1.90	-1.62	-0.20	-0.12	2.04	-1.07	867.20
	52-95-2B	62.35													938.45	5.90	3.63	-7.20	-3.20	15.75	-1.80	-13.58	-1.24	27.74	-16.62	-6.85	-2.83	4.63	4.97	-7.26	-3.43	4.77	6.05	847.88
	16-95-3	15.21											884.91	-1.40	-3.74	7.40	-0.81	-3.70	-4.44	10.57	-3.67	-1.70	4.72	0.88	-2.42	-3.29	2.56	2.25	-2.45	-3.08	0.67	1.66	1.39	886.31
	25A-95-4	22.37											907.74	7.63	-1.70	1.21	1.22	-1.97	-1.02	1.46	0.69	-2.62	-0.18	6.45	-1.91	-1.76	-1.05	4.47	-1.61	-1.77	-1.73	1.36	1.08	915.98
	25-95-5	75.60													856.00	1.60	0.61	-1.94	-1.09	5.65	-3.91	-1.03	-0.69	6.80	-4.64	-0.87	-0.72	2.23	-1.32	0.25	-1.57	5.40	-3.48	857.28
	25A-95-15	26.00													905.37	2.85	0.24	-1.58	1.85	-1.03	-5.26	6.67	2.32	2.65	-7.60	-1.34	3.38	2.78	-5.17	1.22	0.44	5.29	-7.40	905.66
	25-95-26	38.41															897.54	-1.13	-0.21	1.65	-0.40	-0.82	-0.04	1.17	-0.15	-0.72	-0.56	1.38	-0.62	-0.49	0.12	1.39	-0.71	897.40
	25-95-27	28.29															927.12	1.93	-0.97	6.25	-1.10	-5.00	-1.96	7.60	-1.11	-2.20	-1.62	5.12	-3.05	-1.25	-1.72	5.39	-1.89	931.54
	4-96-2	51.92															849.83	7.36	14.84	-11.34	0.07	7.58	6.12	2.86	-2.85	0.12	-0.81	-1.39	-6.07	-3.23	0.80	-1.17	-4.52	860.72
	25A-98-1	28.28																							907.00	0.67	1.98	1.15	-2.89	-0.59	0.99	4.72	-4.43	908.60
	25A-98-3	20.94																							919.64	-0.55	-1.76	3.47	-1.11	-2.37	-1.46	7.58	-4.24	919.20
	25A-98-6	31.68																										909.90	-2.07	-0.96	-0.03	3.96	-1.98	908.22
	25A-98-7	21.81																										924.71	-5.10	-3.60	0.02	10.93	-6.06	920.90
	52A-98-8A	32.32																										881.80	-0.51	-1.03	-0.20	1.85	-0.87	881.24
	52A-98-8B	67.87																										856.24	-6.10	-9.07	-3.56	4.40	3.73	845.64
	52-98-9	65.43																										857.66	-9.12	-7.74	-3.60	4.30	3.93	845.43
	25-98-10	75.25																										862.02	-3.15	-1.85	-0.85	6.90	-4.10	859.17
	25A-99-2	20.08																											919.06	-1.79	-1.52	7.90	-3.28	920.37
	25A-99-5	28.91																												912.32	-1.25	1.31	-1.13	911.25
	25A-00-5	75.70																																NS
	52A-00-6	66.31																																NS
11	74-92-13	13.64	805.84	0.64	1.89	0.61	-0.04	1.85	0.47	-1.21	-0.93	3.20	1.68	-4.83	-2.39	1.49	NR	2.21	-0.16	3.03	0.57	-0.32	0.72	3.70	0.83	-0.39	-1.29	1.13	0.35	-0.45	-0.07	1.51	1.32	821.26
	83-92-14	17.68	791.91	0.67	-10.20	6.41	-4.60	-11.66	-0.88	-4.68	6.82	-3.10	-5.14	1.10	5.67	1.70	-0.20	-2.49	1.56	2.76	-2.91	2.44	2.19	2.95	0.40	3.00	-0.75	-0.57	2.80	1.67	1.28	-0.77	2.51	812.41
	74-94-7	12.74							799.37	4.83	0.16	2.70	0.27	-0.82	0.47	1.33	-0.71	-4.72	3.19	-0.25	-0.05	0.90	-1.17	0.48	0.79	0.08	-0.11	0.70	-0.12	-0.58	-0.13	0.27	0.20	807.08
	74-94-8	20.68							792.26	-1.55	0.31	3.30	0.62	-0.17	-0.18	1.76	-0.16	-1.25	0.21	1.05	-0.81	-0.53	-1.84	2.78	-0.69	-0.30	-0.69	0.92	-0.39	-0.38	0.07	0.91	-0.41	794.86
	74-95-6	18.42												809.14	NR	NR	NR	-1.28	NR	NR	NR	6.27	-0.81	4.12	1.90	-1.45	-1.75	1.42	0.25	-0.43	0.08	1.89	0.87	820.24
	93-95-7	1.71												833.64	-0.54	4.08	0.76	-2.02	-0.72	2.98	-0.54	-1.56	0.07	2.54	0.10	-1.02	-0.82	1.68	-0.18	-1.07	-0.48	2.31	-0.17	839.04
13	MW62-B1A	13.89	738.16	9.96	-6.04	-3.03	-2.54	9.90	-2.76	-1.52	5.44	-0.92	-1.14	-3.32	-3.37	8.51	-2.15	-6.53	-2.50	9.02	-5.98	-2.29	-1.53	15.83	-5.38	-5.45	-2.86	10.71	-2.29	-6.50	-0.35	8.58	-3.85	743.81
	MW62-B2	13.88	737.11	9.95	-6.01	-3.05	-2.53	9.93	-2.78	-1.54	5.42	-1.44	-0.68	-3.26	-3.34	8.62	-0.47	-2.33	-2.48	9.23	-6.20	-1.69	-4.00	17.64	-5.60	-4.32	-3.78	10.72	-4.23	-4.48	-0.40	8.57	-3.86	742.72
	62-92-26	37.94	730.98	3.21	1.43	-1.23	-0.73	-0.27	-0.11	-1.61	-0.42	7.55	-0.16	-1.76	-1.54	0.02	2.58	-2.72	-0.57	4.17	-1.90	-1.80	-1.04	7.73	-1.35	-3.40	-1.45	1.16	0.29	-1.04	-1.82	-0.96	2.54	735.76
	62-92-27	33.02	715.49	1.11	3.36	-0.30	-0.59	-1.30	-0.62	-0.62	1.09	13.86	0.52	-2.28	-3.17	-1.25	1.80	-1.67	-1.51	2.10	0.22	4.14	-4.68	12.02	-1.96	-2.40	-3.10	7.47	-1.59	-3.11	-5.09	11.07	-2.15	736.88
	62-95-16	12.48												715.51	-3.12	-1.62	12.22	-6.95	-1.84	10.06	-1.59	-7.18	0.92	12.97	-2.19	-2.43	-2.10	5.44	-1.86	-2.35	0.93	3.91	-1.05	728.56
14	MWP-4	48.11	791.91	0.27	-0.05	-0.03	-0.07	0.10	-0.04	-0.62	0.46	0.19	0.14	0.16	-0.04	1.28	-1.05	1.03	-0.96	0.41	-0.41	0.06	-0.10	0.66	0.21	0.03	0.09	0.09	-0.07	-0.07	-0.30	0.31	-0.14	783.45
	MWP-5	96.63	749.35	-0.24	0.09	0.01	0.03	-0.18	0.00	-0.24	-0.11	-0.15	0.30	0.45	0.43	0.08	0.63	0.51	0.31	-0.08	0.37	0.43	-1.05	1.56	0.46	0.75	0.60	-0.14	0.40	0.20	0.12	0.11	0.51	755.74
	MWP-6	25.01	823.69	-1.47	-1.03	-1.44	-0.64	0.71	-1.11	-0.41	2.12	-0.10	0.39	-0.75	-1.08	0.91	0.34	-1.21	-0.50	5.40	-3.53	-1.95	-0.54	5.74	-2.17	-1.25	-0.82	1.93	-1.15	-0.74	-0.72	6.39	-4.58	820.43
	MWP-7	Not recorded	830.53	4.10	-6.54	0.00	0.33												Extraction Well															
	37-92-5	38.79	837.98	2.74	-10.07	5.11	-9.20	13.58	-4.34	4.26	1.63	1.64	-0.03	-1.33	-1.79	1.14	0.88	-1.81	-0.14	2.51	-1.78	-0.32	-0.58	3.76	0.30	-2.06	-1.11	2.44	-1.24	-0.94	-0.67	2.54	-0.01	842.77
	37-92-6	Not recorded	821.70	3.47	-2.46	-1.63	-0.56												Extraction Well															
	6-92-17	12.03	877.84	2.00	-1.91	-3.12	0.09	4.70	-1.01	-2.70	2.75	0.05	0.36	-2.16	-2.57	5.45	-0.59	-2.83	1.42	2.45	-2.75	-0.88	2.06	1.57	-1.35	-2.30	1.19	1.45	-1.32	-1.50	-0.16	3.54	-1.34	879.17
	37-92-18	20.55	832.39	3.17	-0.78	-0.47	-2.05	2.46	-1.77	-0.60	-0.63	2.82	2.66	-1.63	-3.51	1.30	2.72	-3.70	-0.92	6.66	-4.21	-1.52	-1.49	8.78	-3.40	-2.56	-2.24	6.96	-3.03	-3.49	-1.26	5.67	-1.12	839.75
	37-92-18A	46.13	807.99	-0.78	-2.69	1.36	-4.00	5.52	0.16	-0.10	0.70	1.49	1.58	0.87	-0.50	0.46	0.68	-0.84	1.71	-0.31	0.56	0.68	-0.25	-0.20	1.98	0.97	-1.04	-0.73	0.43	0.11	-0.30	-0.46	0.03	815.07
	37-93-5	34.29				814.64	0.70	1.61	-1.25	-1.38	2.97	-0.88	-0.98	-1.24	-0.70	3.62	-0.74	-2.13	1.75	2.07	-3.07	-0.71	0.93	3.90	-2.60	-2.02	3.05	0.56	-2.00	-2.07	0.03	4.38	-2.07	816.33
	37-94-9	23.48							832.56	-0.86	1.56	0.60	-0.50	-1.09	-0.56	2.69	-1.00	-1.58	1.42	1.12	-1.92	-0.70	0.33	3.21	-1.96	-1.11	-0.18	2.35	-1.83	-0.78	0.73	3.99	-3.65	833.03
16	MWP-1	42.80	697.51	2.37	-1.87	-0.46	-0.05	1.29	-0.32	0.08	-0.89	2.01	-1.71	0.08	-0.34	-0.21	0.09	-0.44	0.66	2.65	-3.24	0.46	-0.76	6.82	-5.80	-2.73	0.50	1.04	-1.00	0.14	-0.19	0.96	-0.40	697.05
	63-98-18	15.32																									685.85	2.24	1.00	-2.02	-0.58	3.45	4.73	694.67
OS	CD-92-28	15.42		470.55	1.02	-5.75	1.55	3.42	0.80	-5.26	4.03	1.79	0.13	-0.60	-5.18	3.83	2.35	-6.86	2.42	2.15	0.30	-3.37	-1.81	4.16	1.24	-2.39	0.25	1.77	0.49	-2.35	-0.07	0.70	1.36	470.87

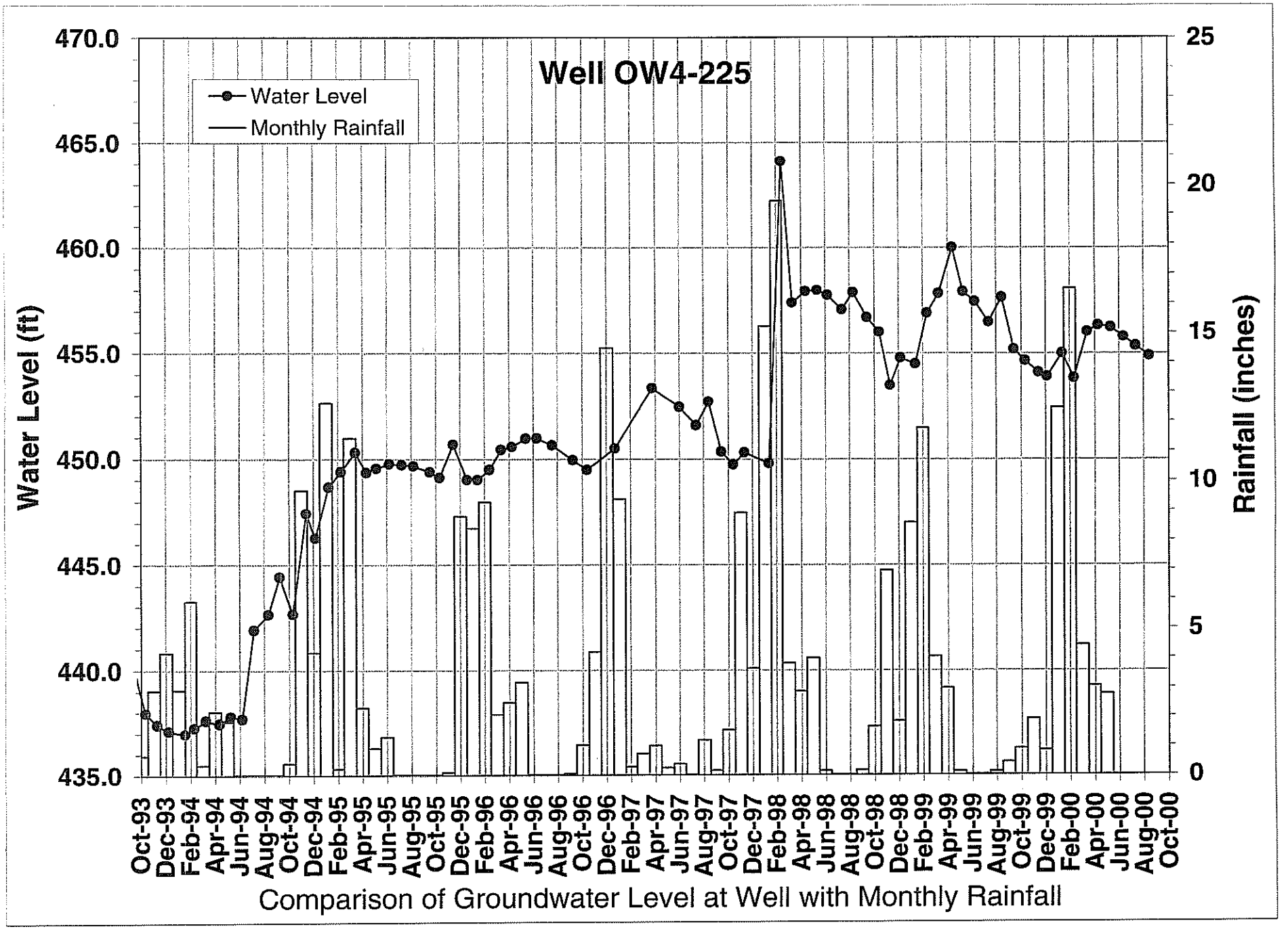
TOC = top of casing

NR = Not recorded

NS = Not surveyed



Comparison of Groundwater Level at Well with Monthly Rainfall



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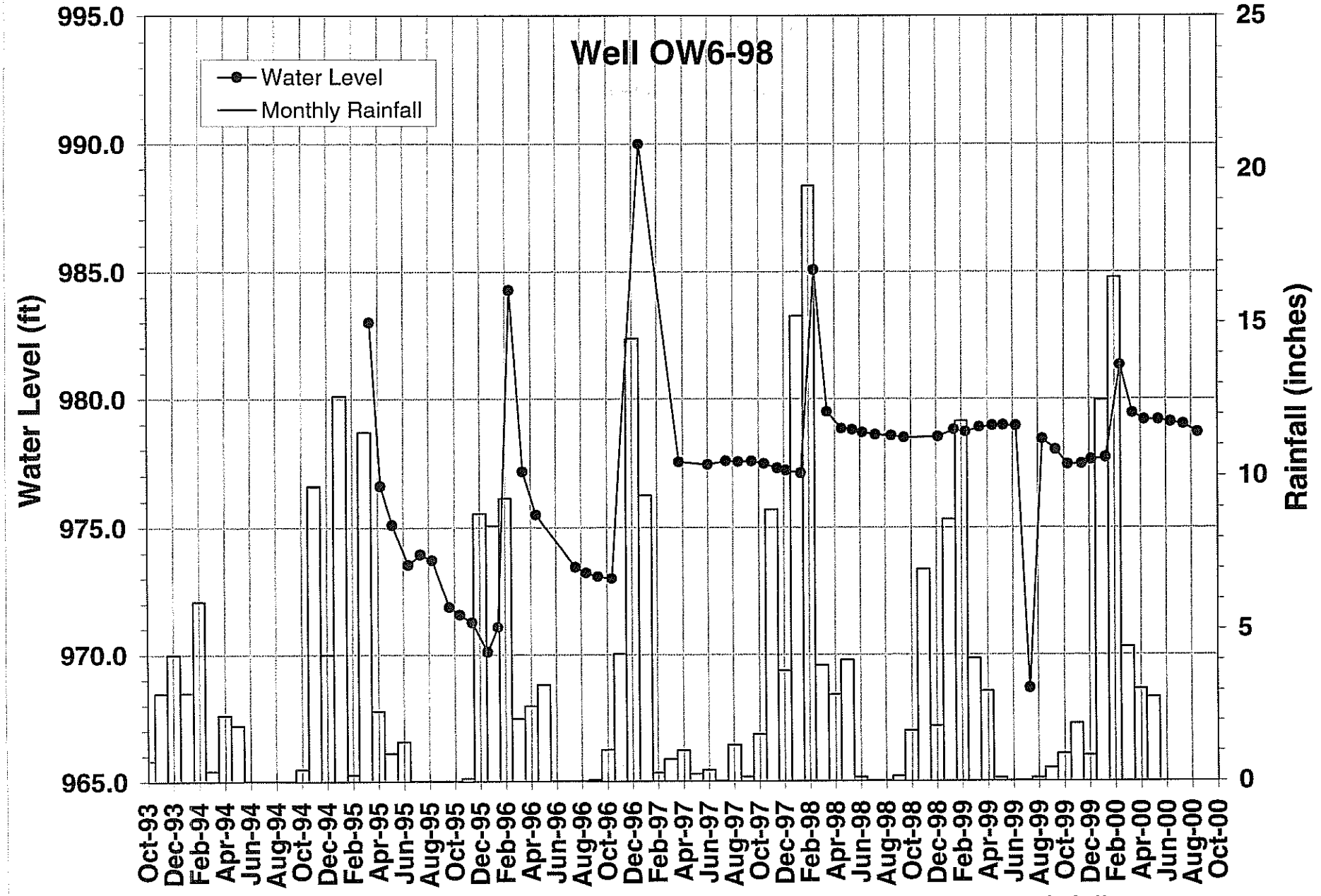

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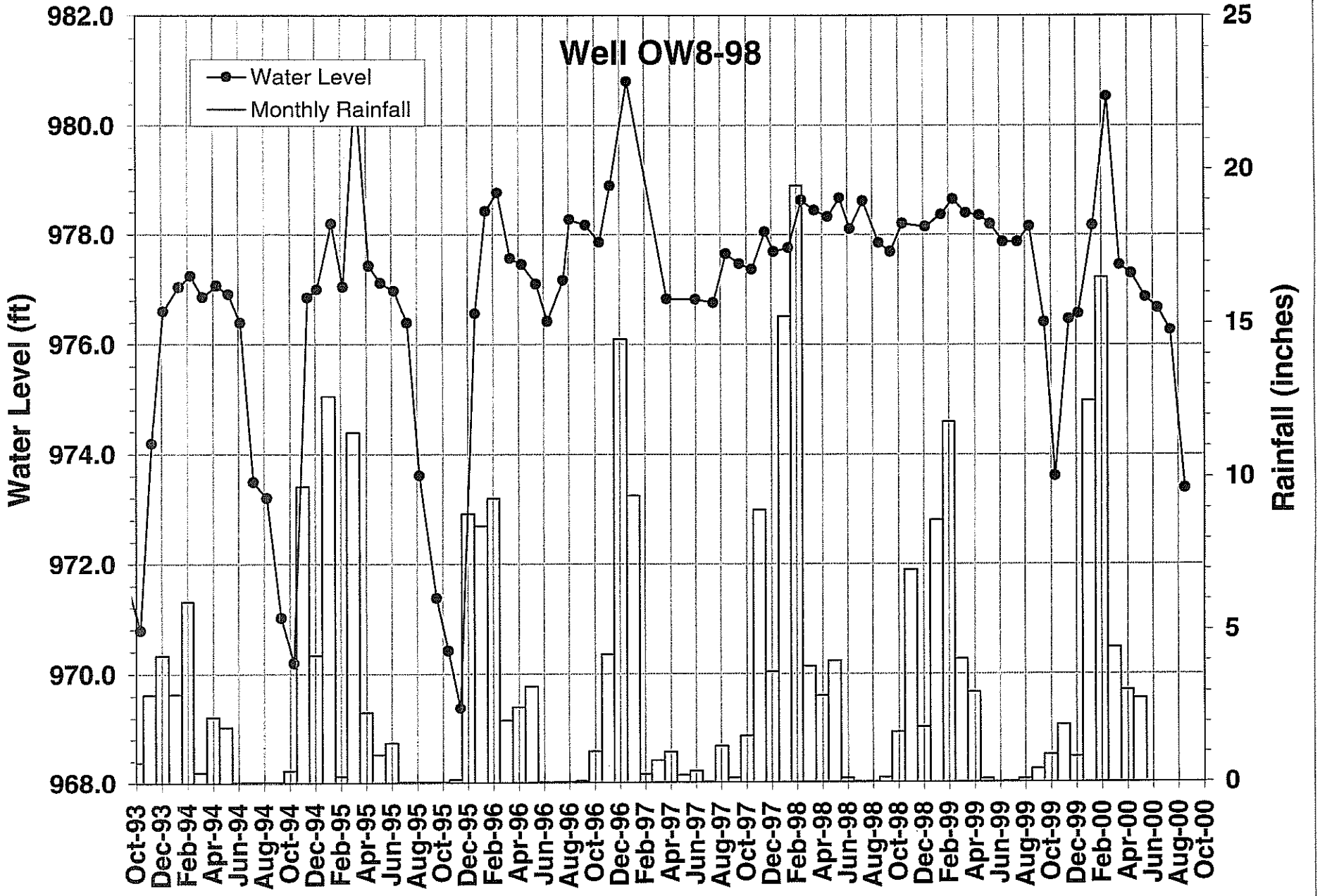

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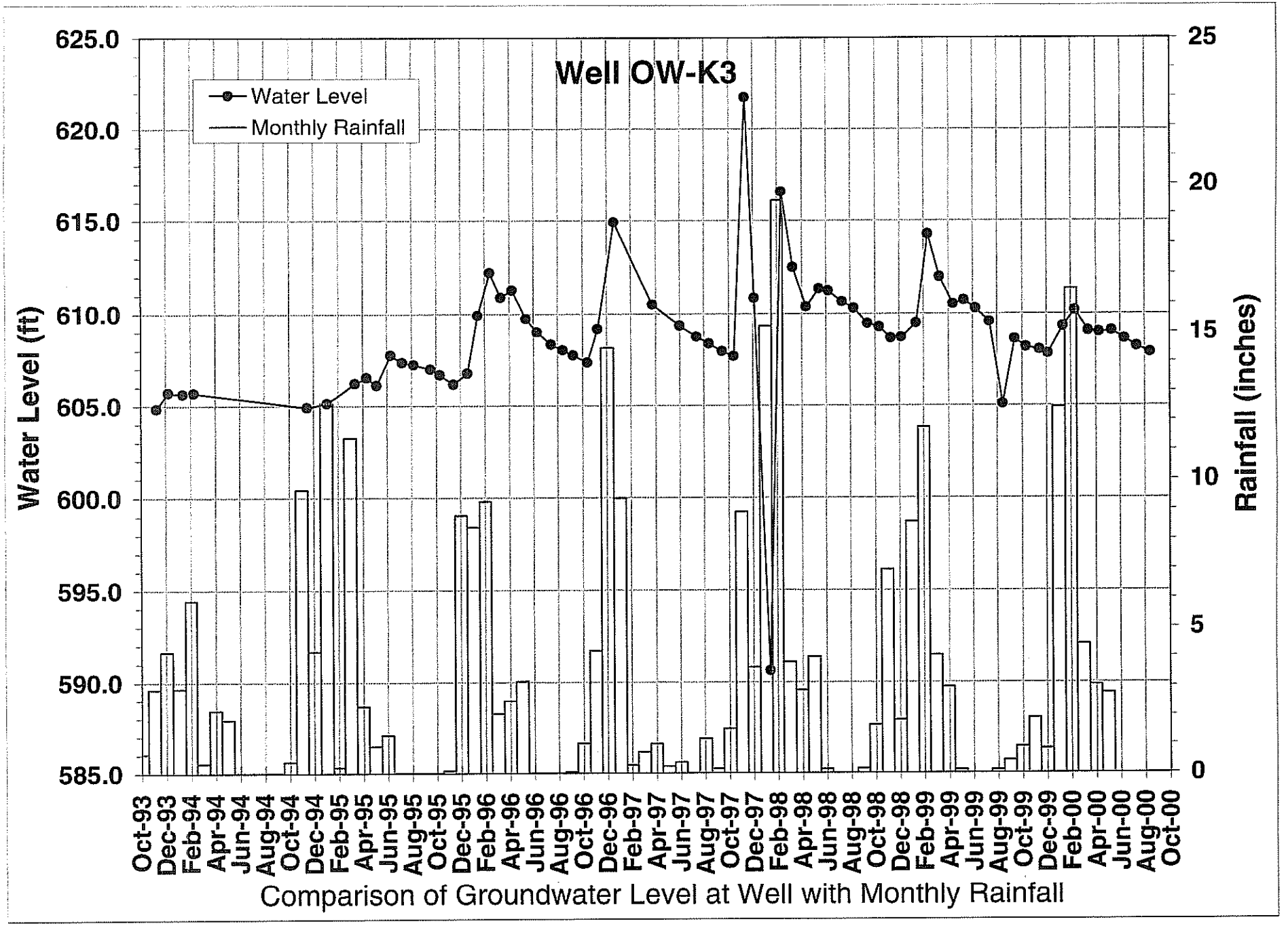

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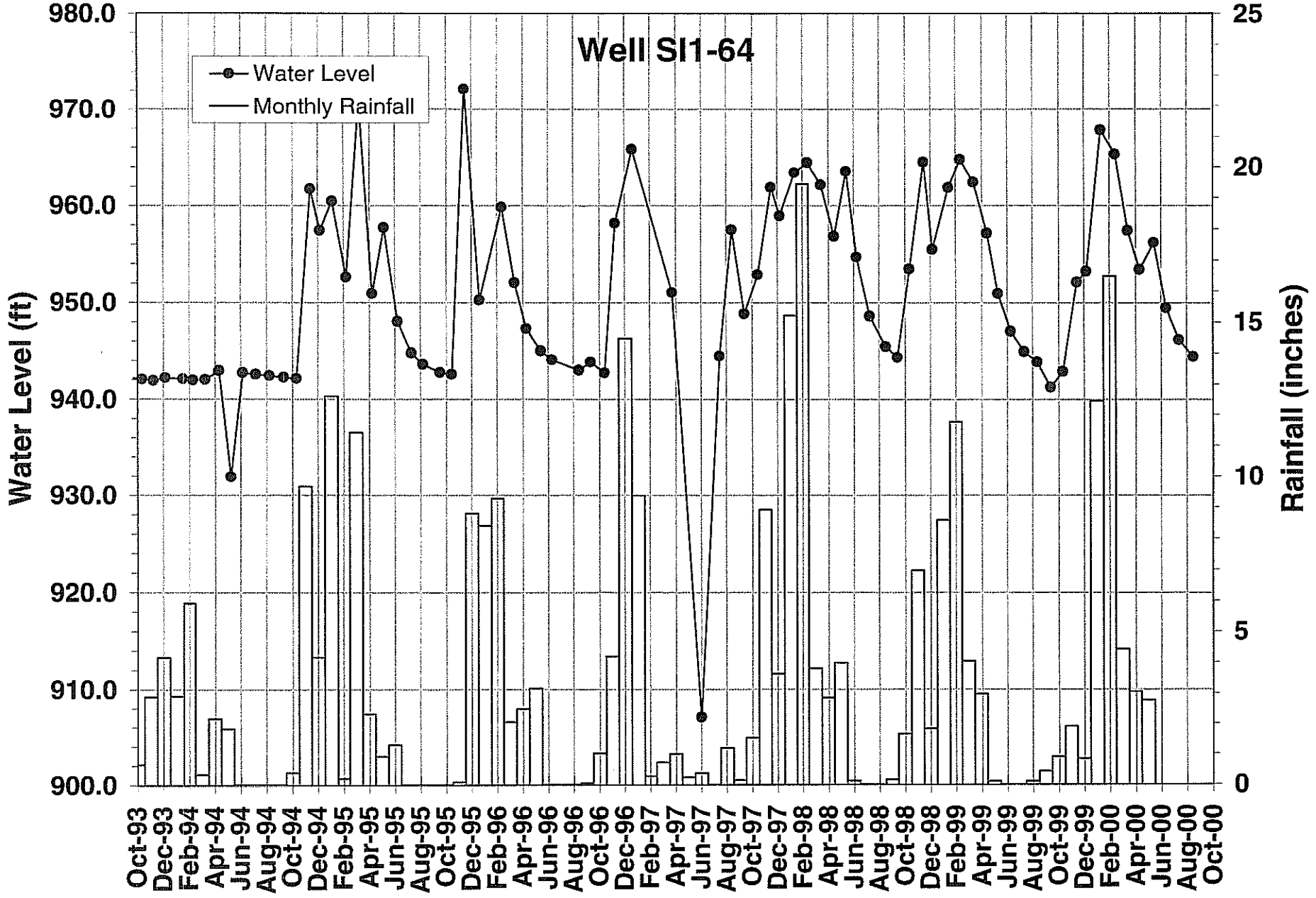

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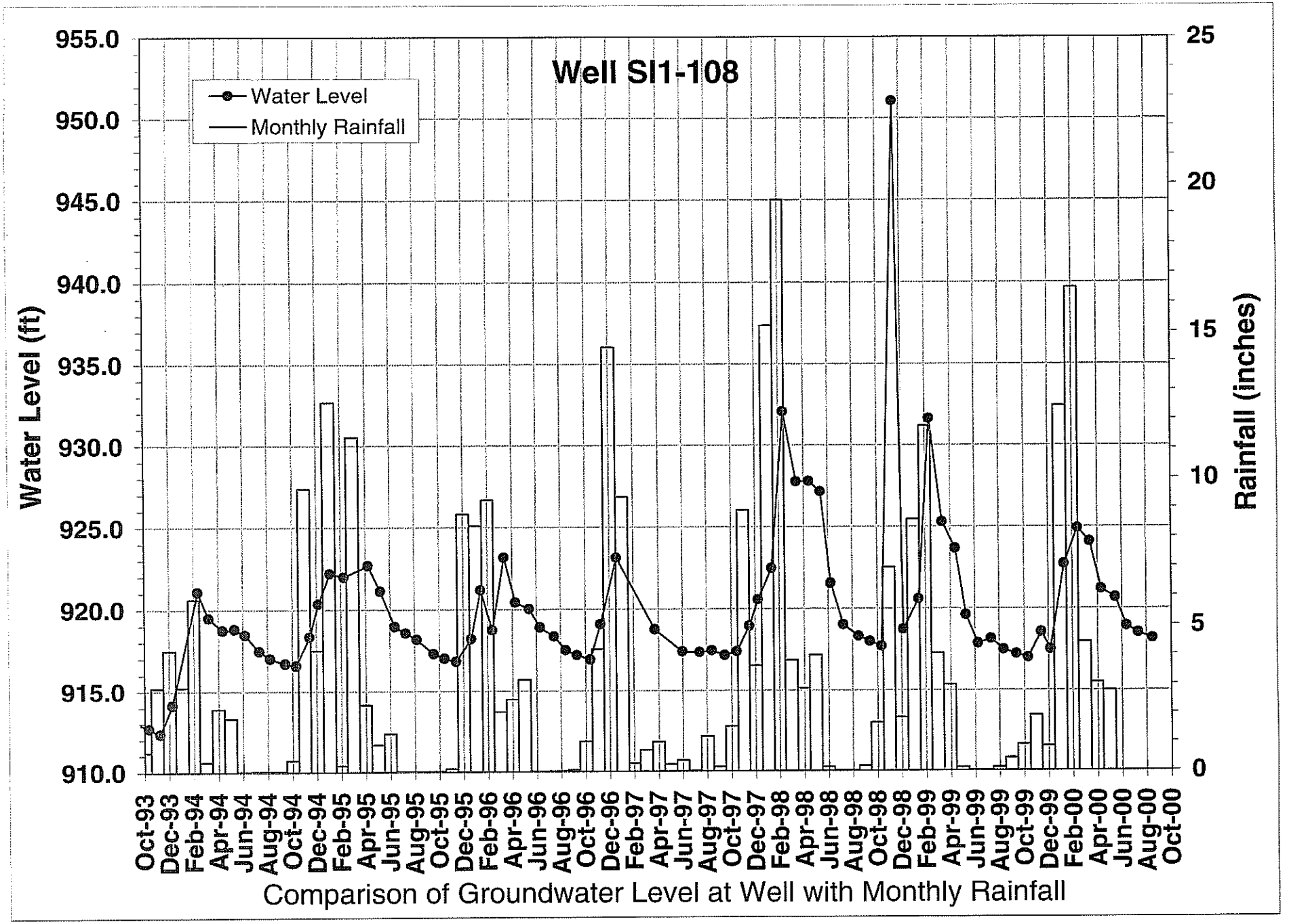

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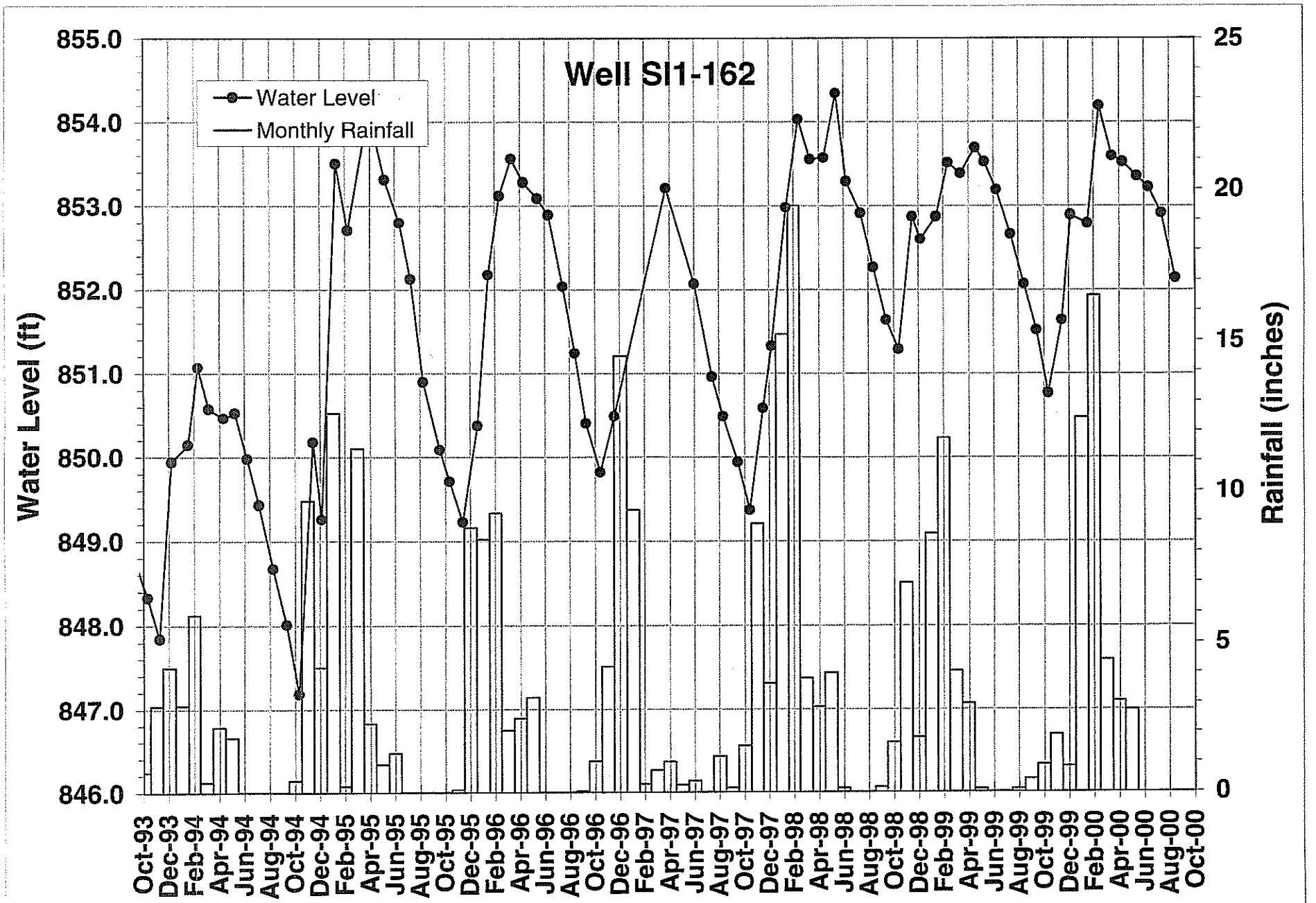

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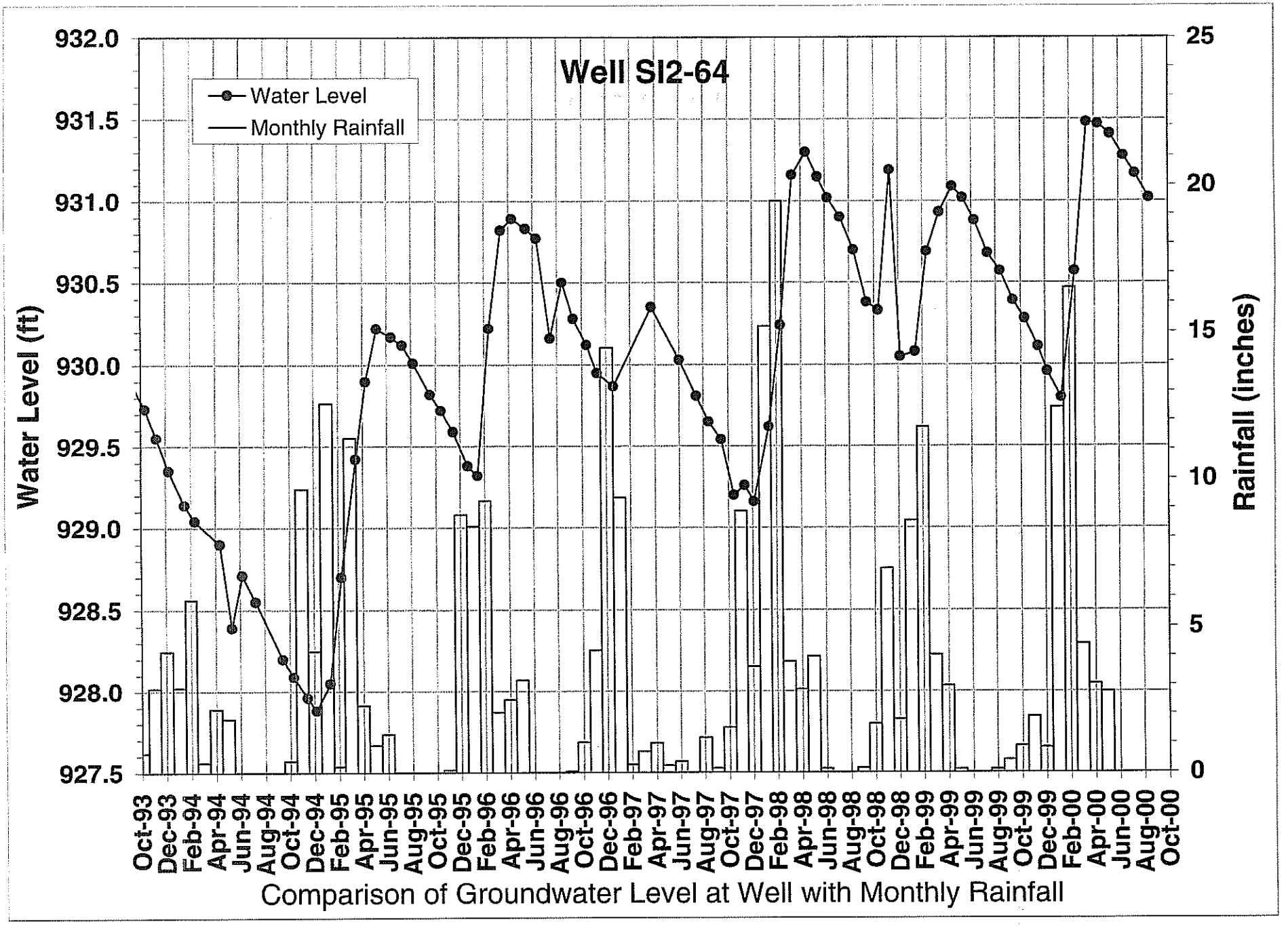

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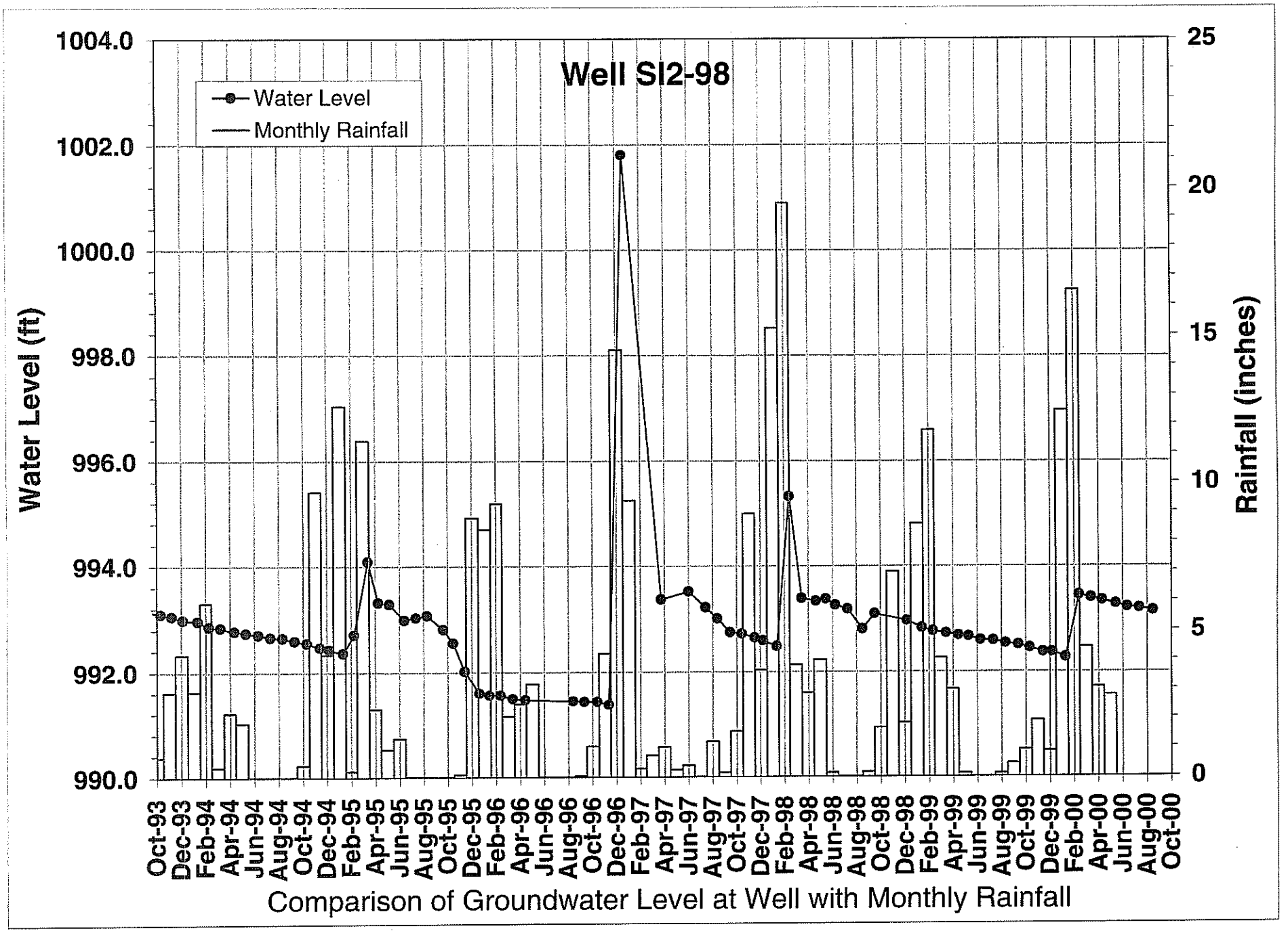

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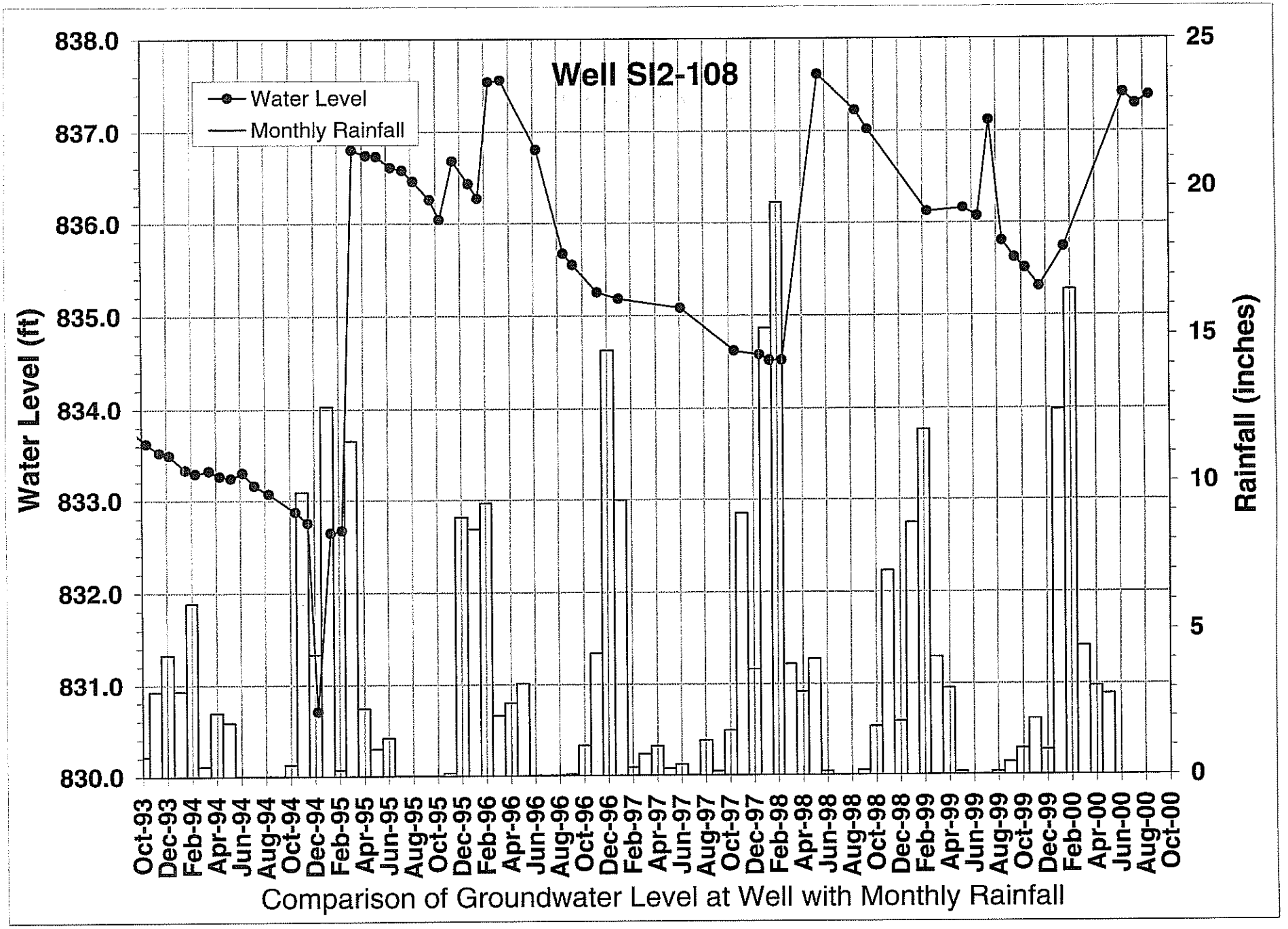

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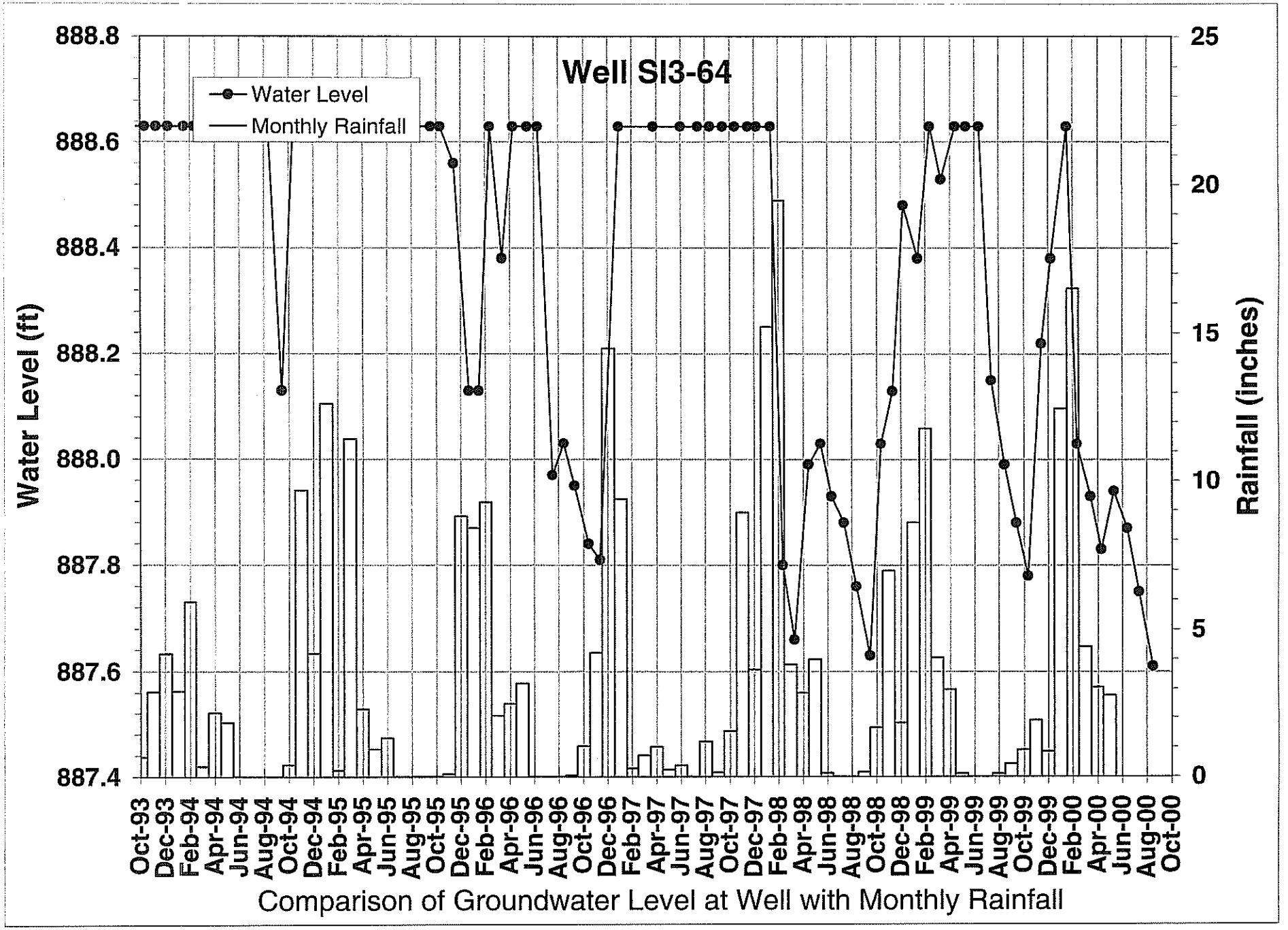

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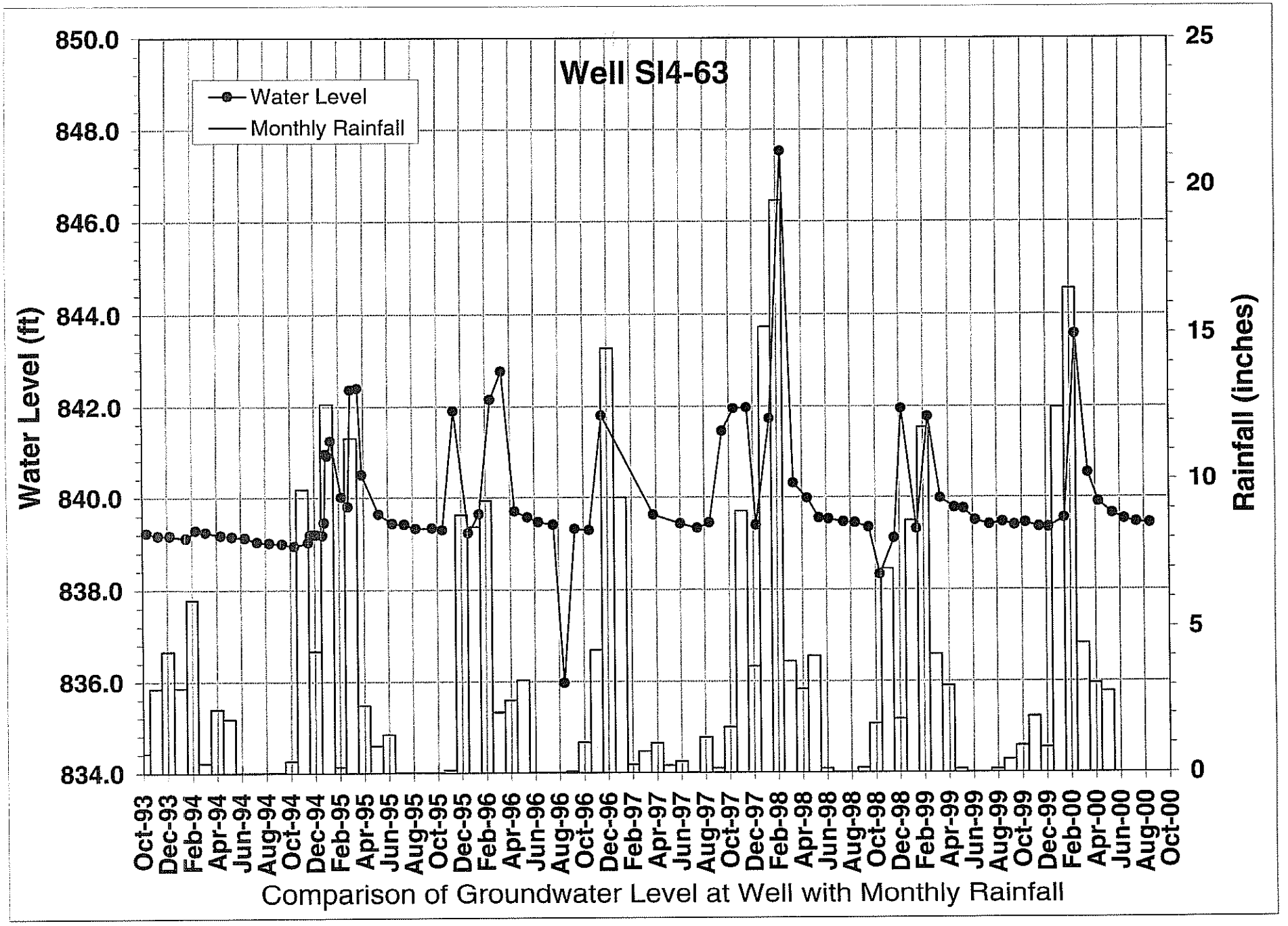

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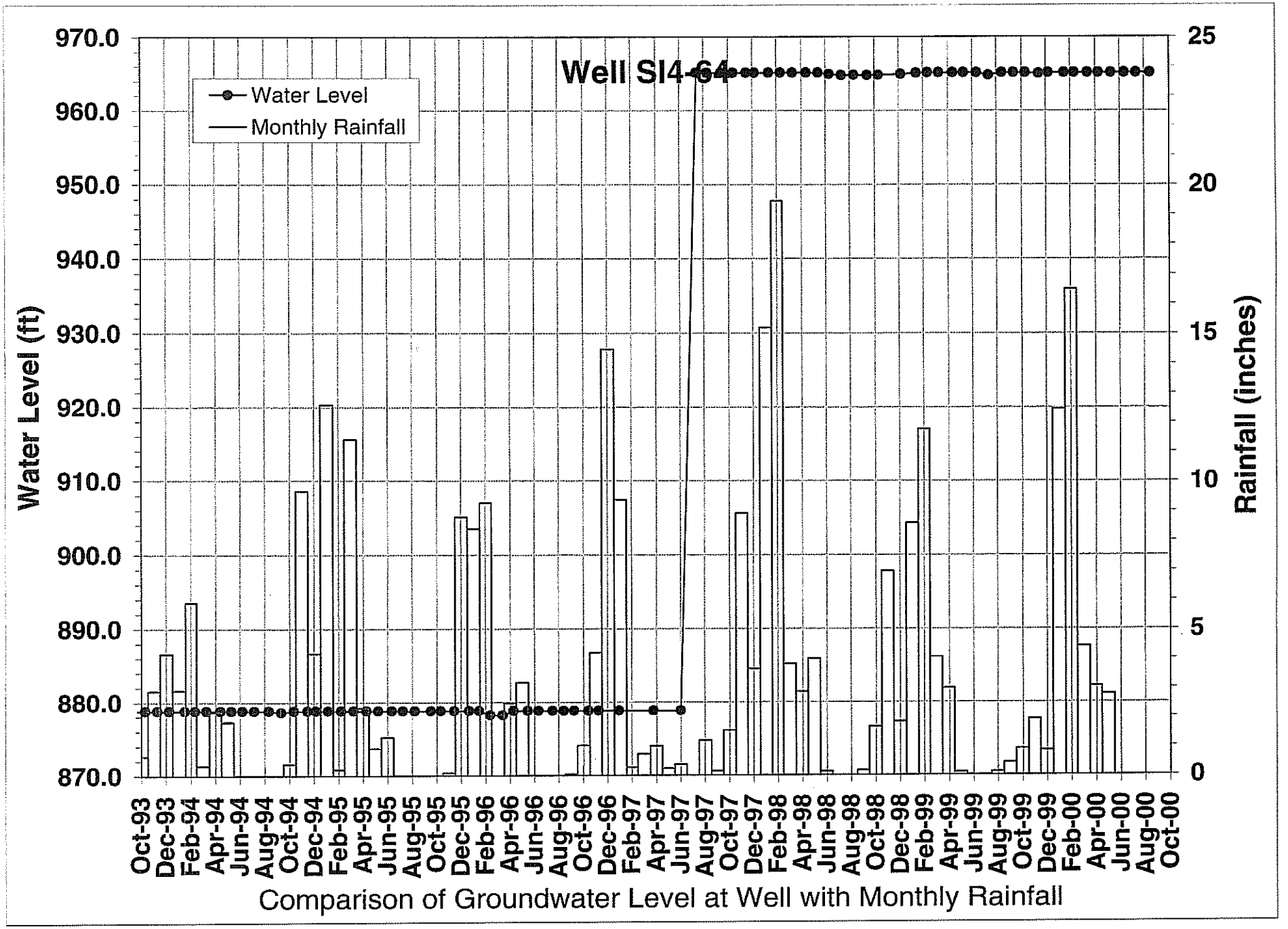

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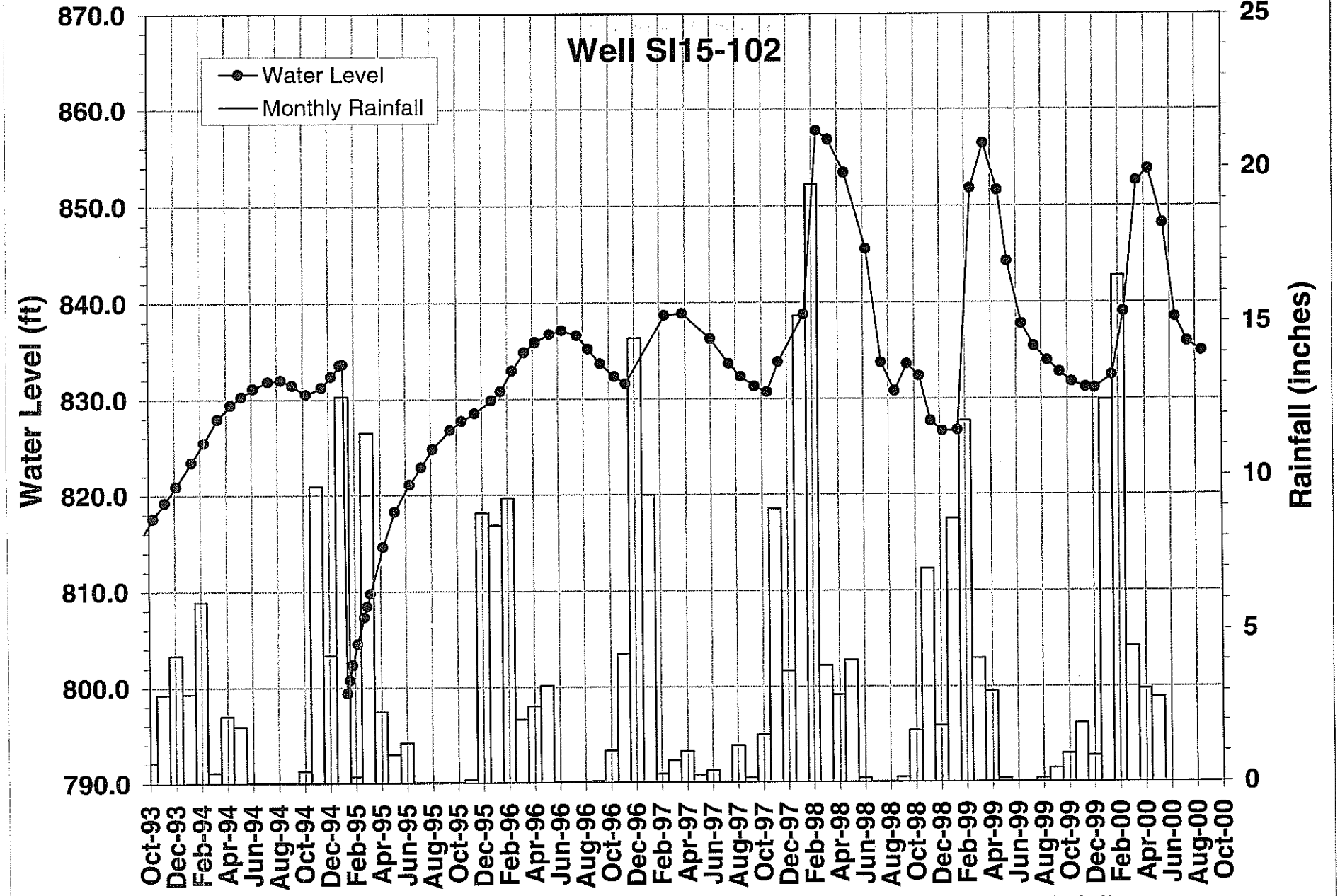

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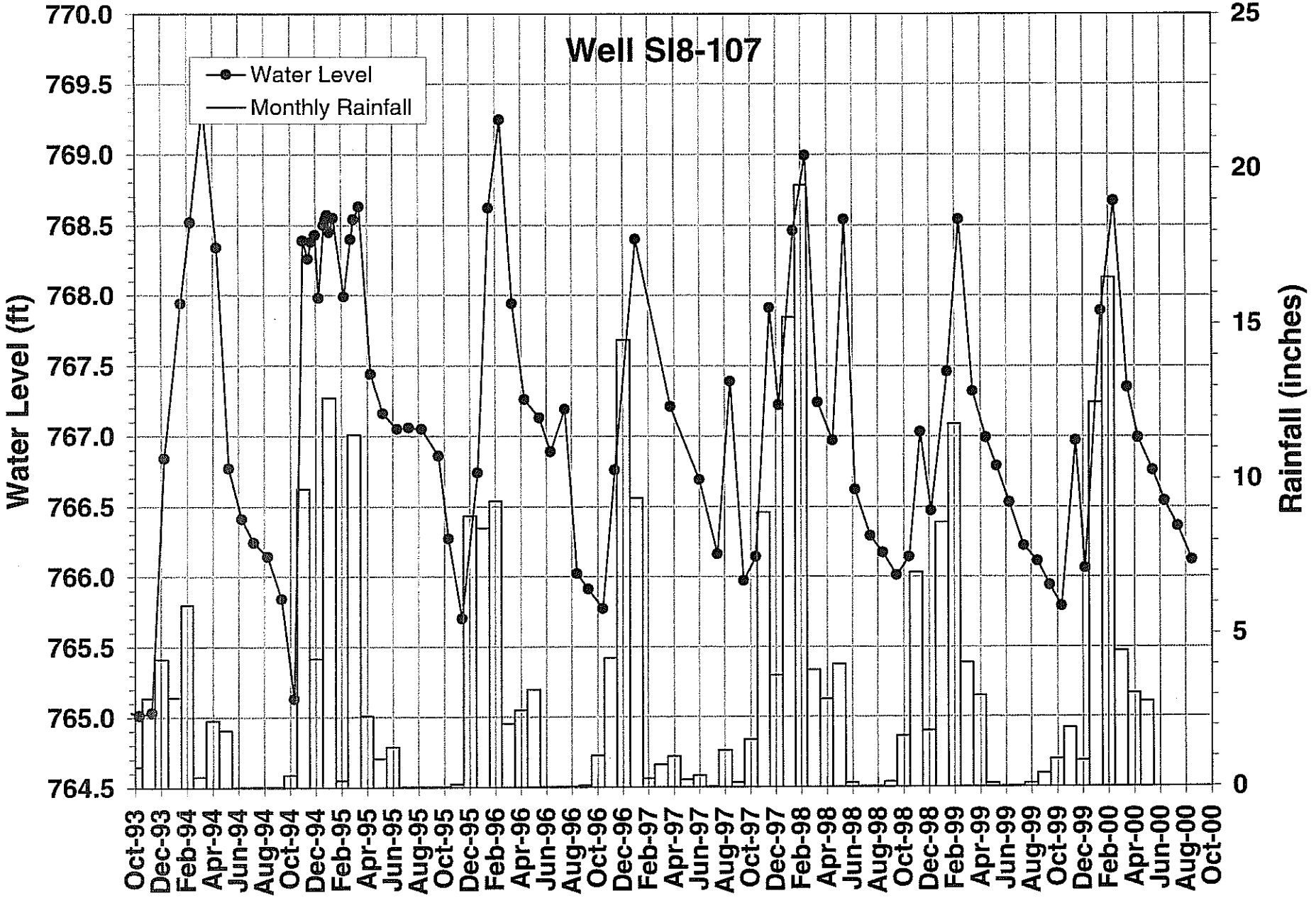

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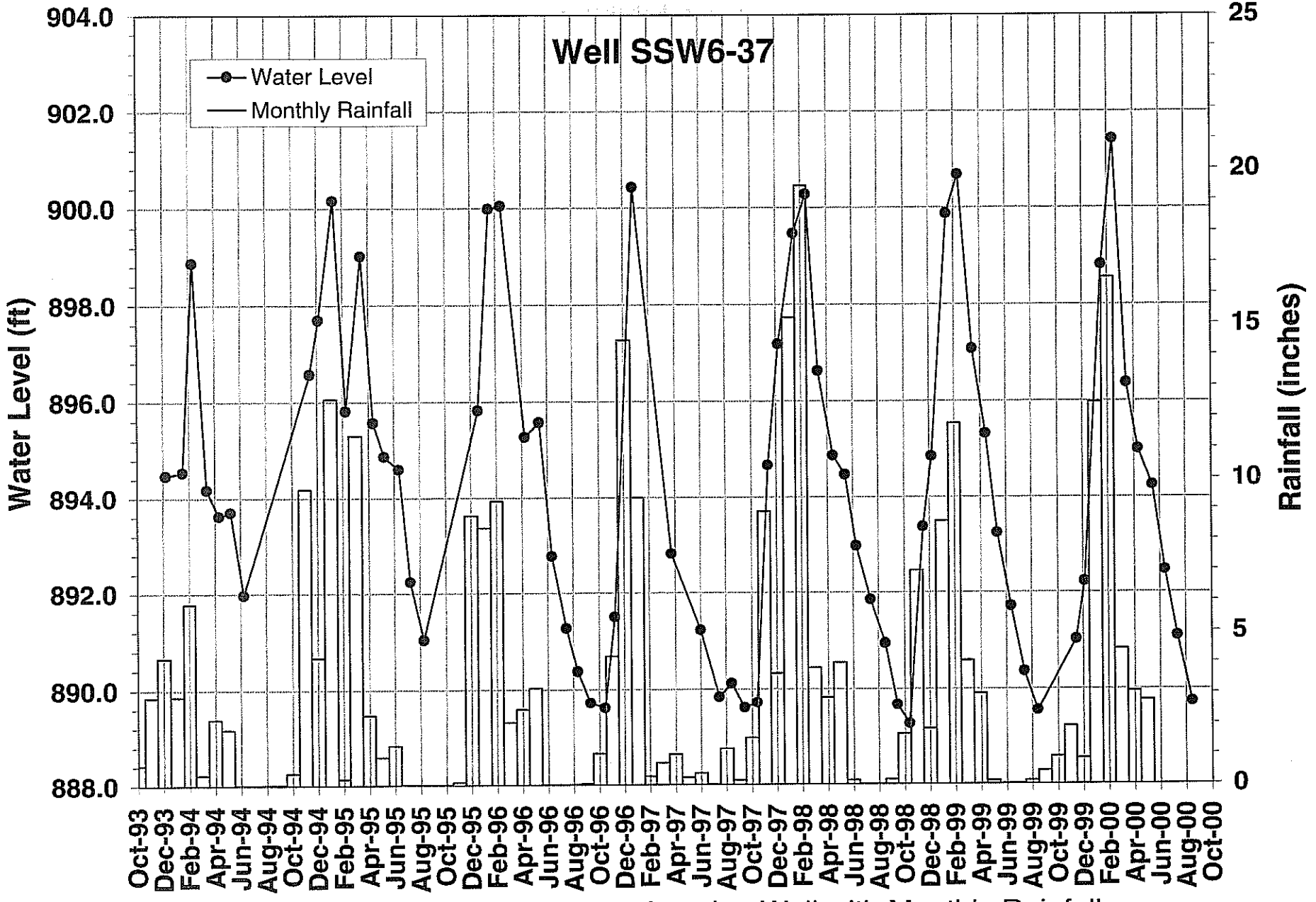

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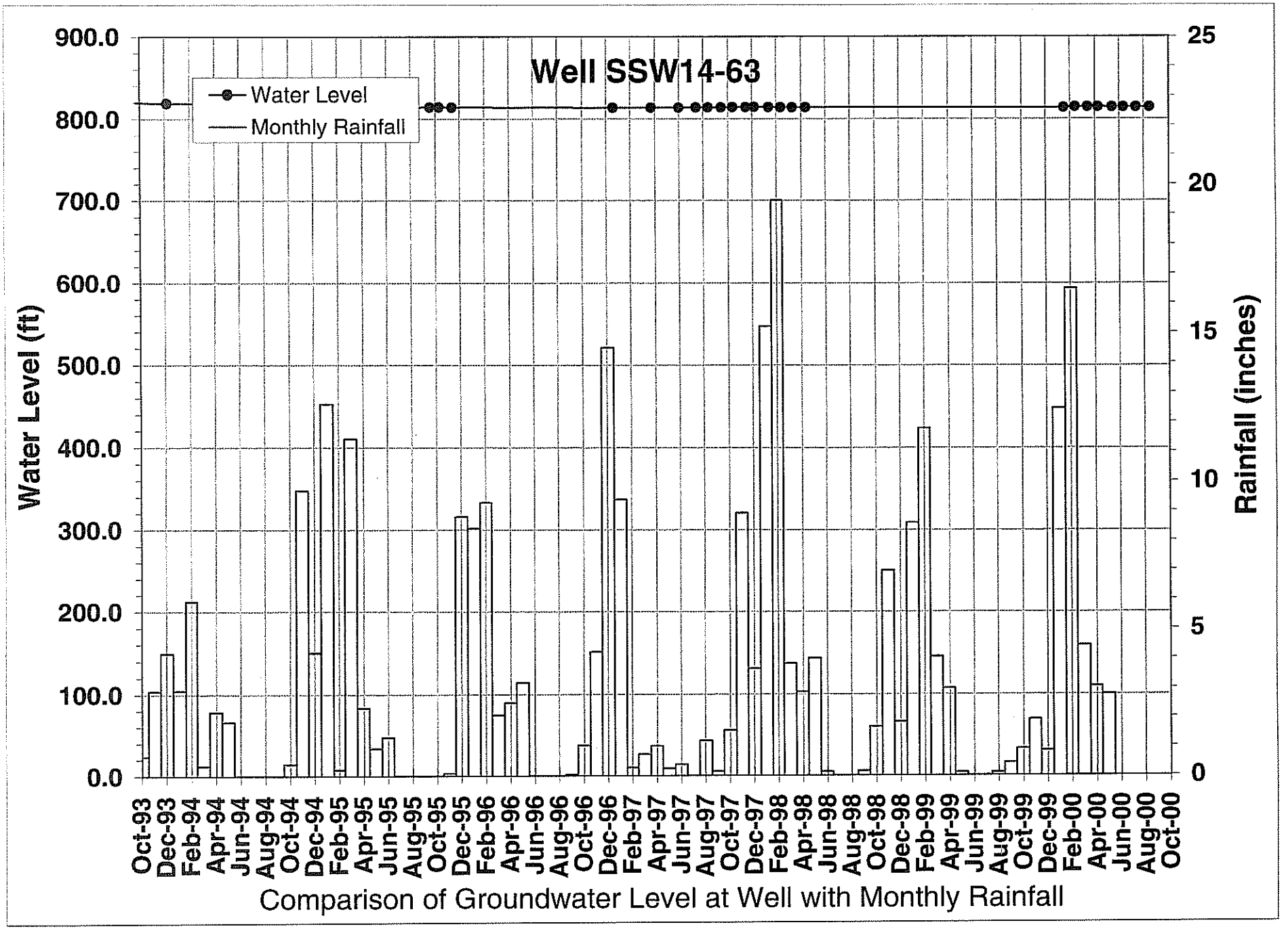

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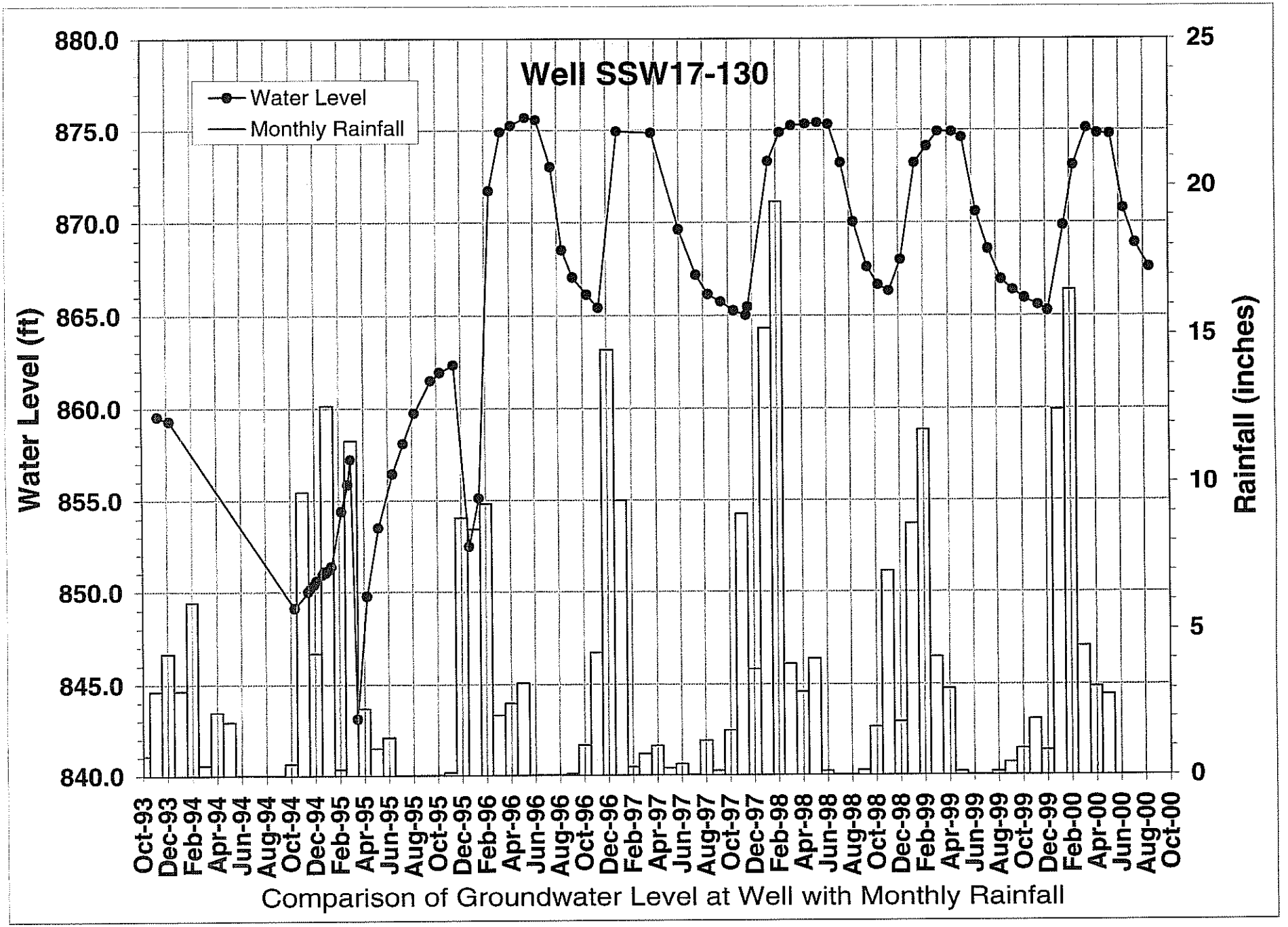

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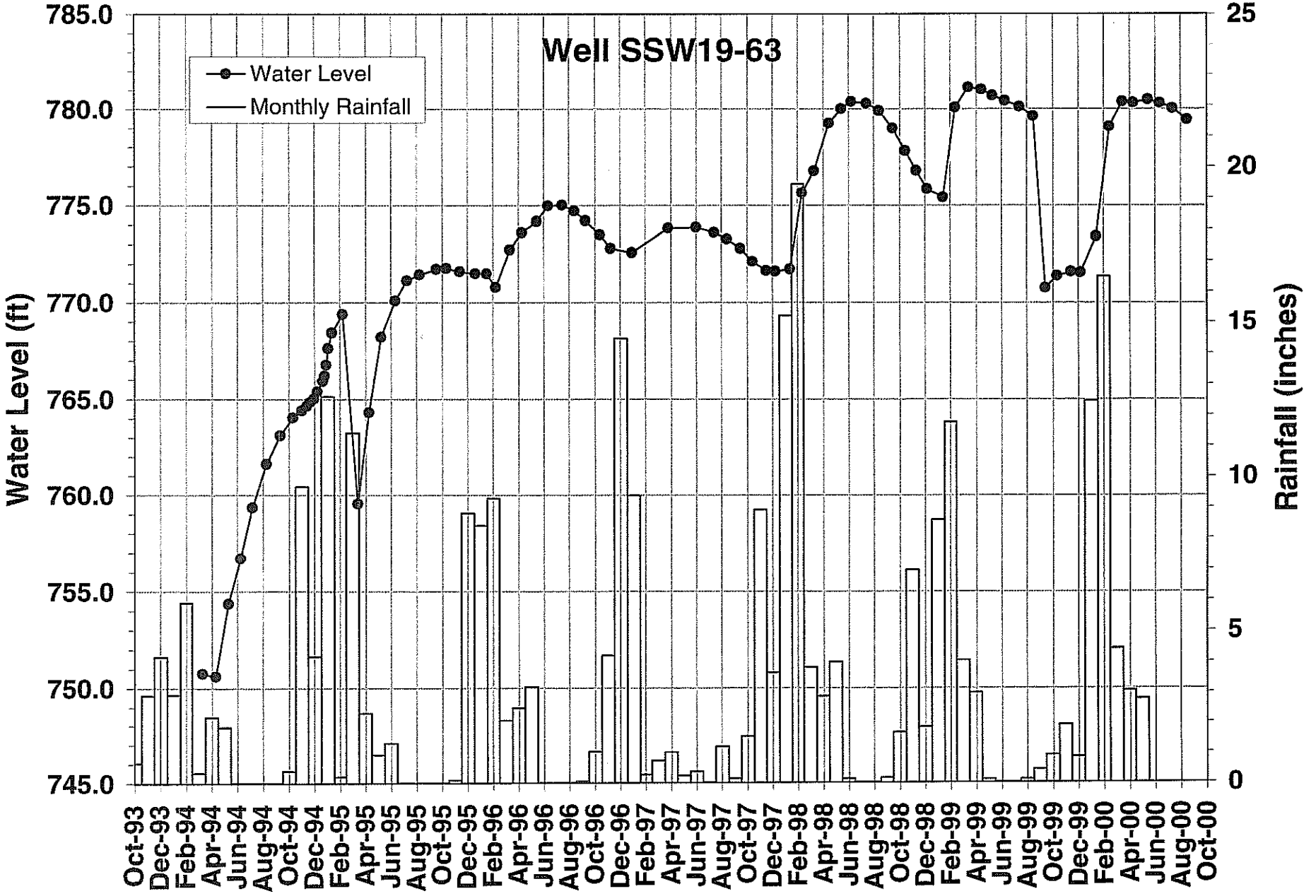

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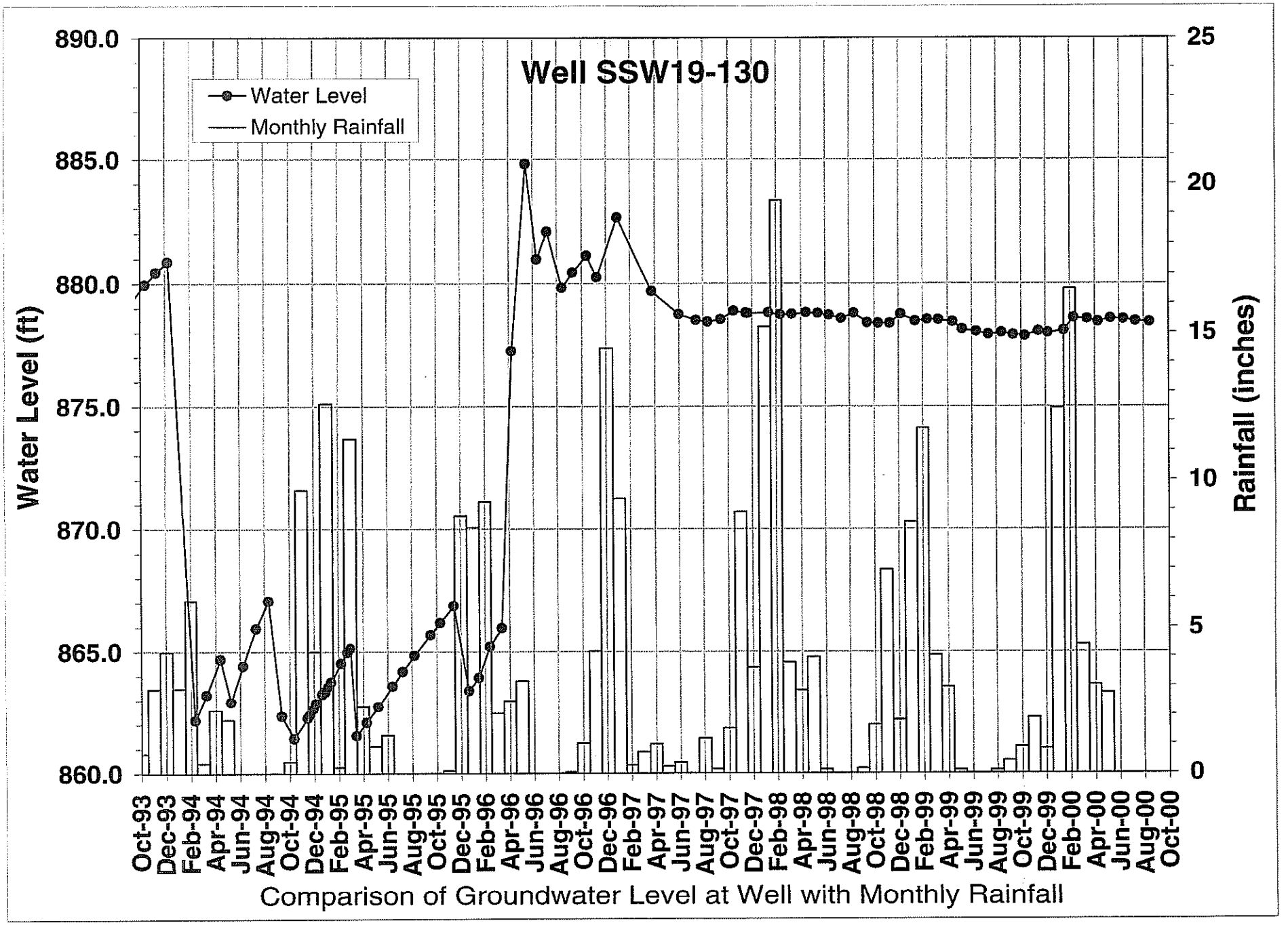

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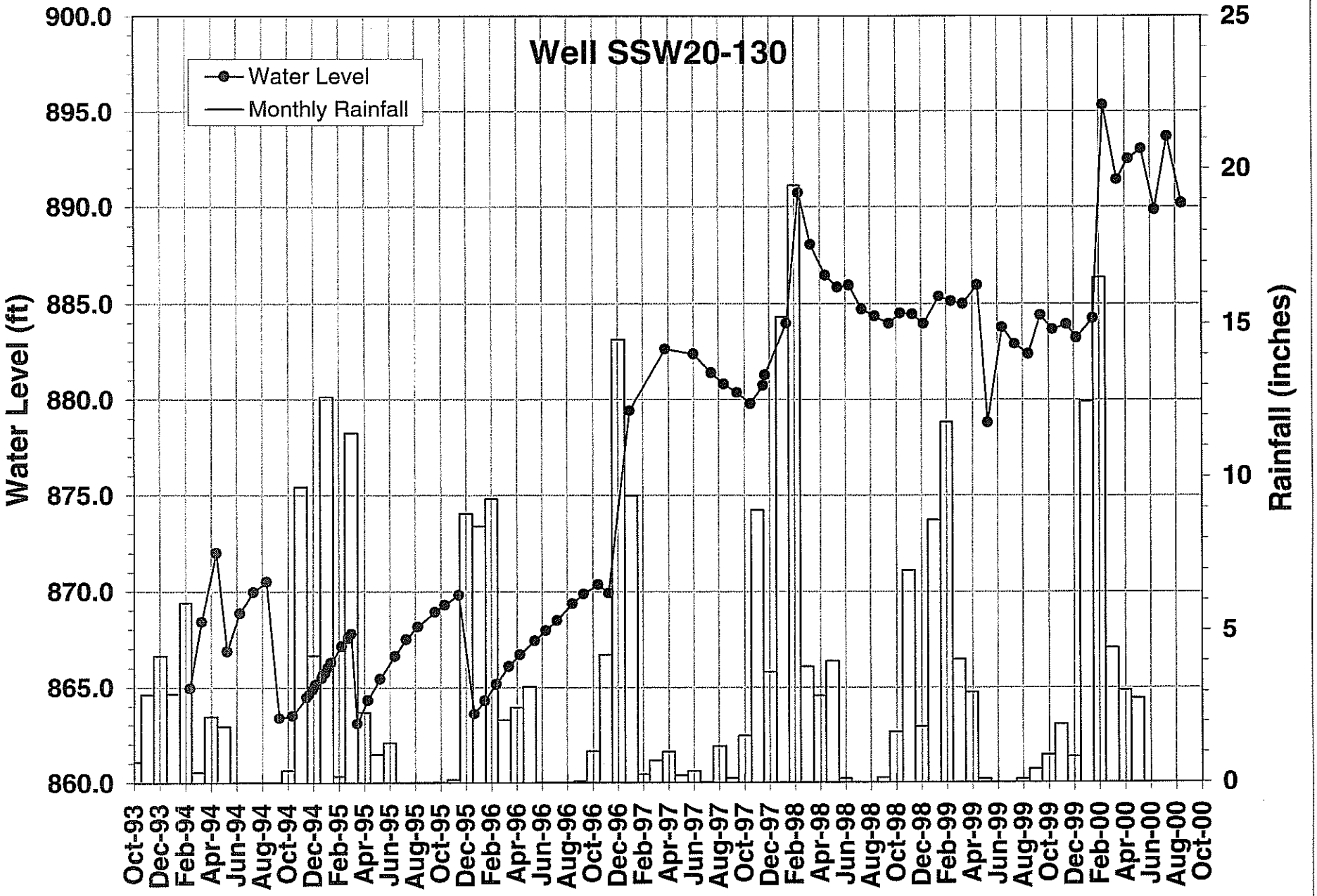

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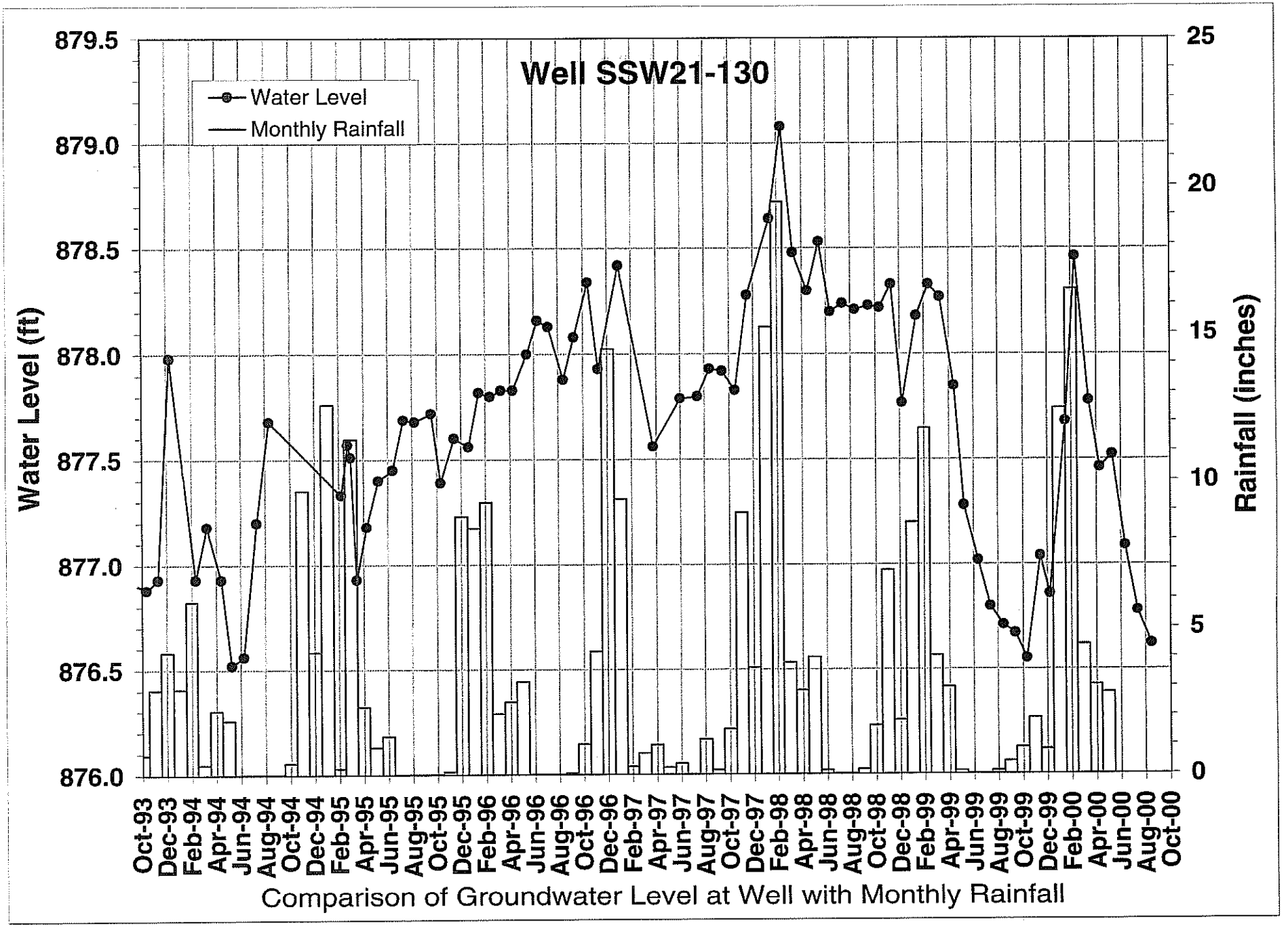

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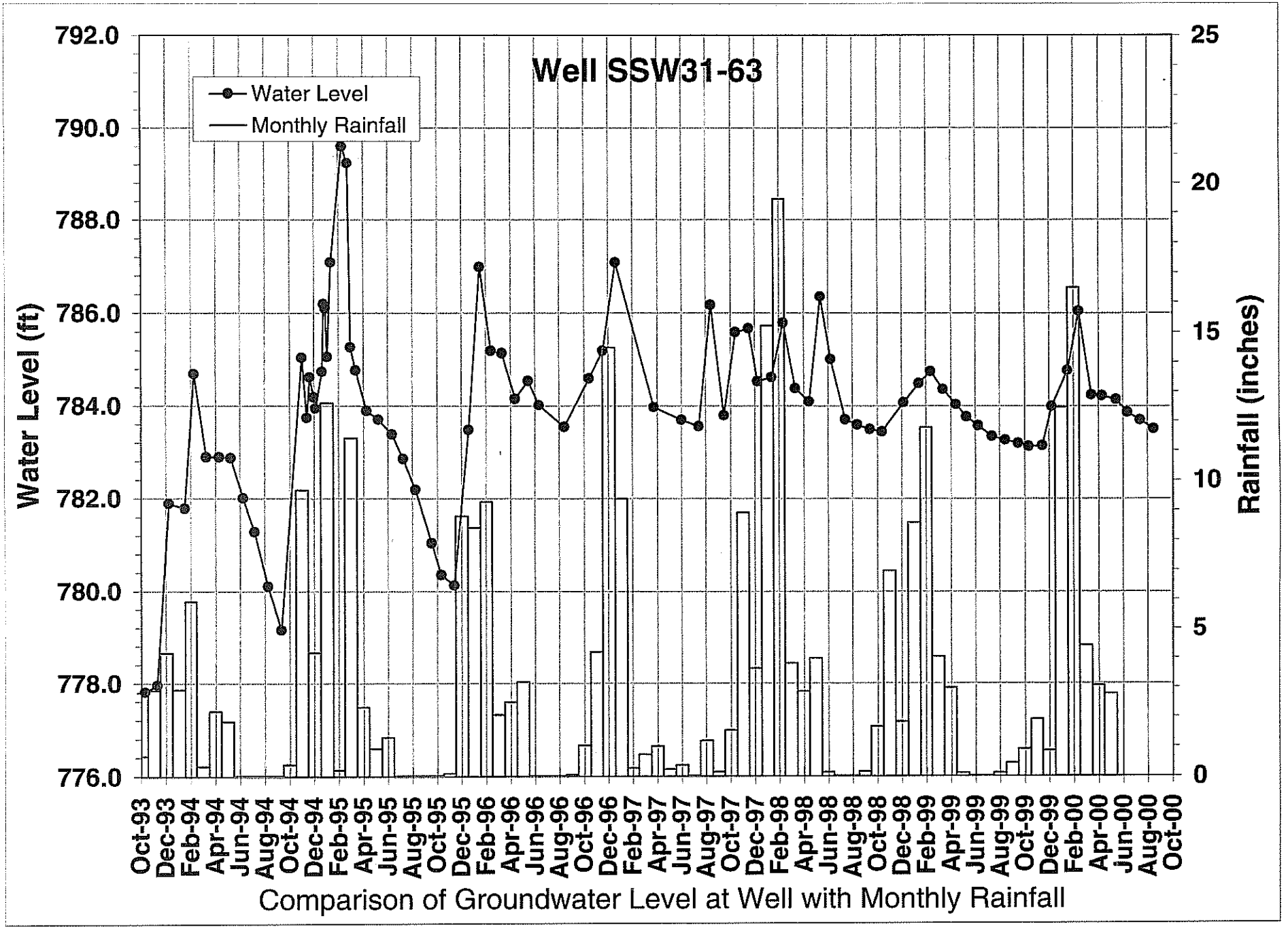

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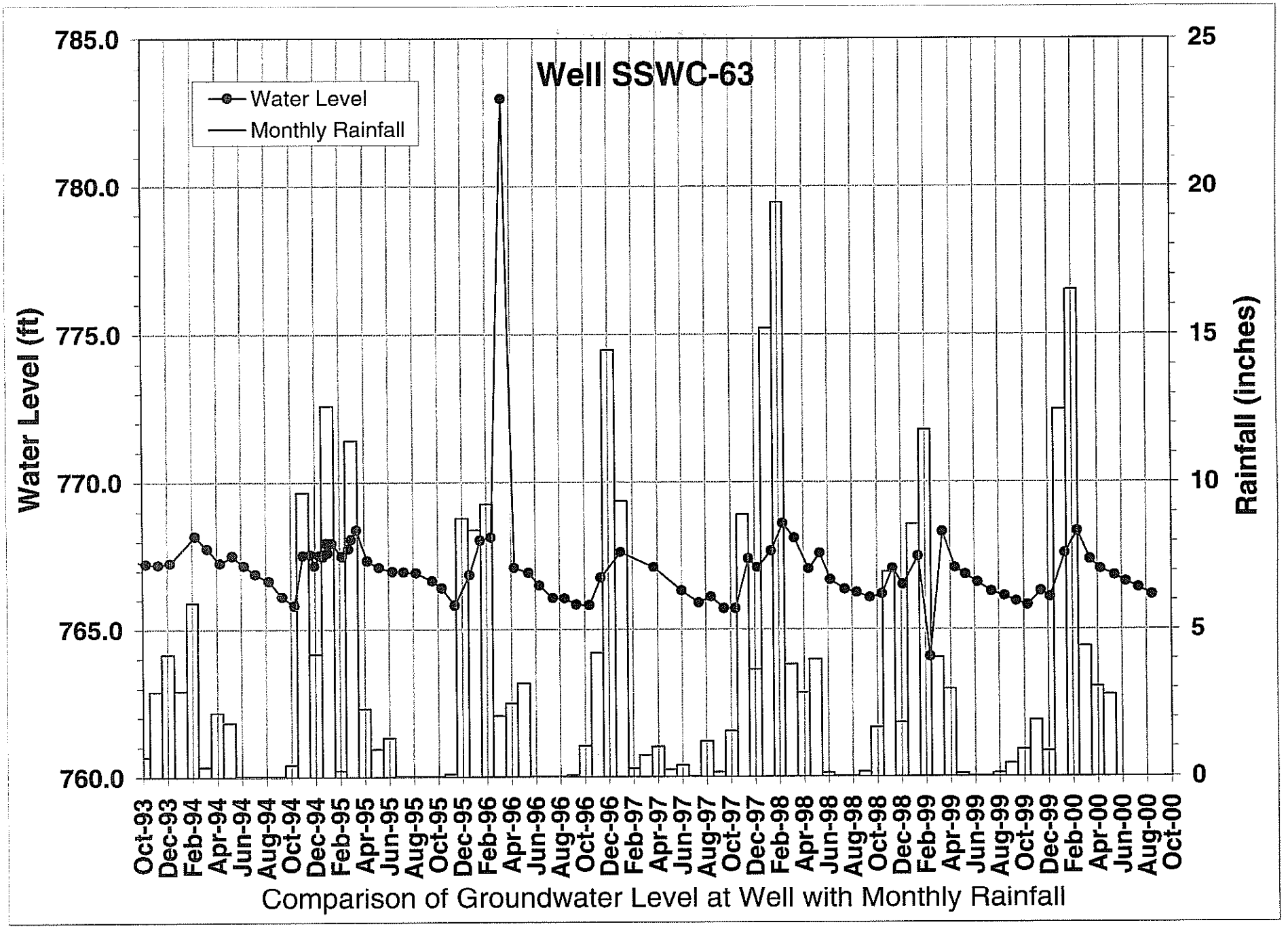

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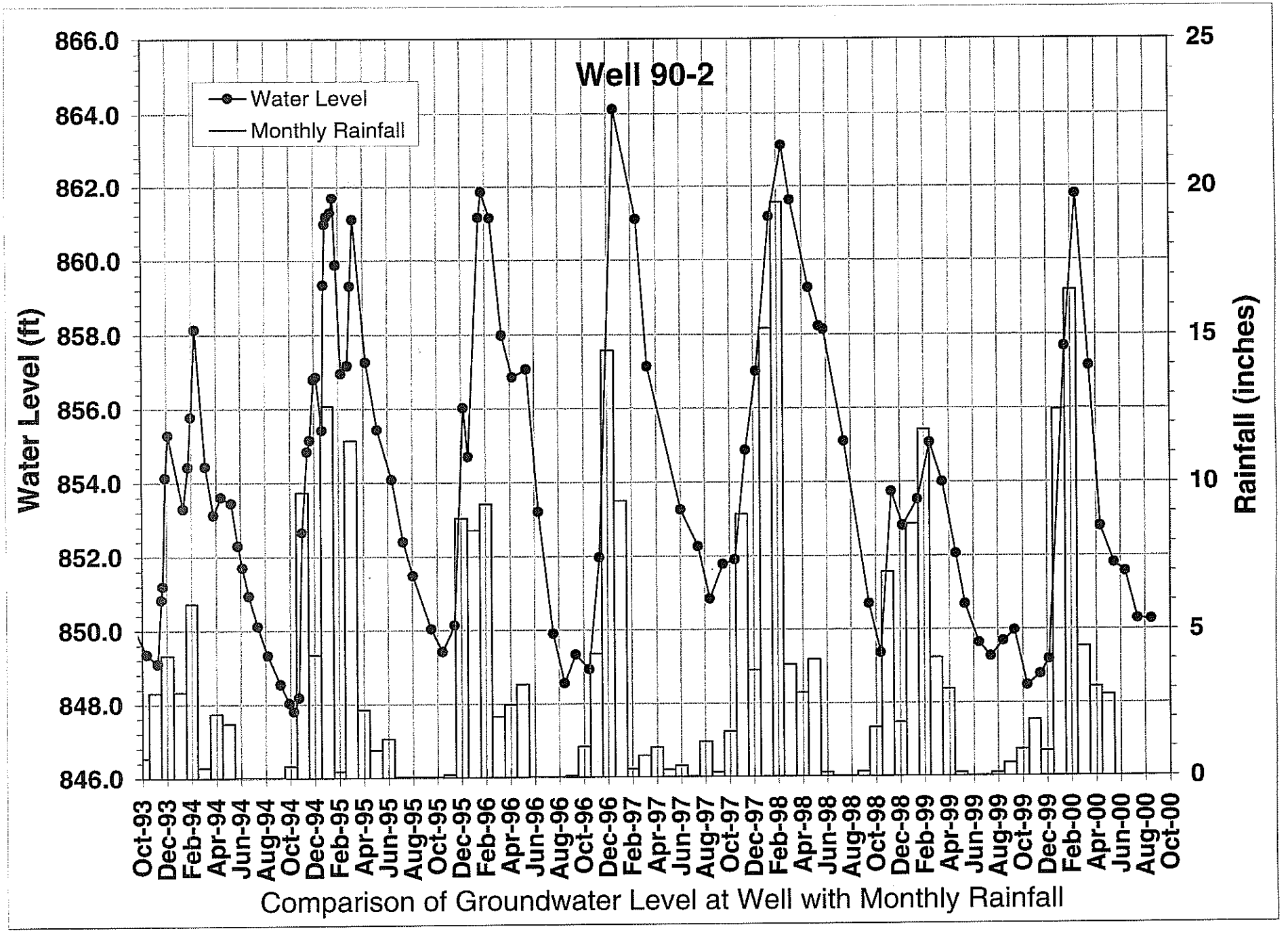

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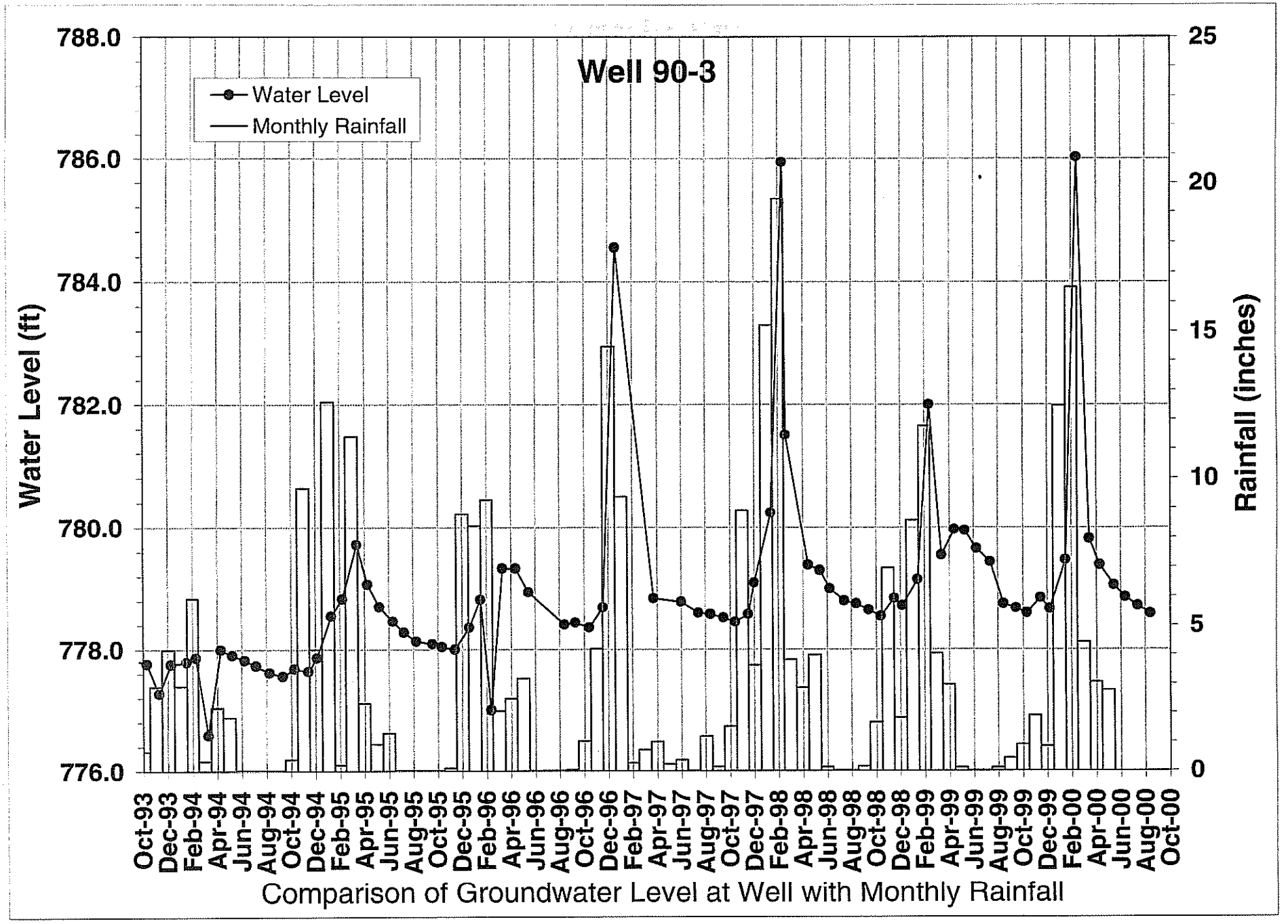

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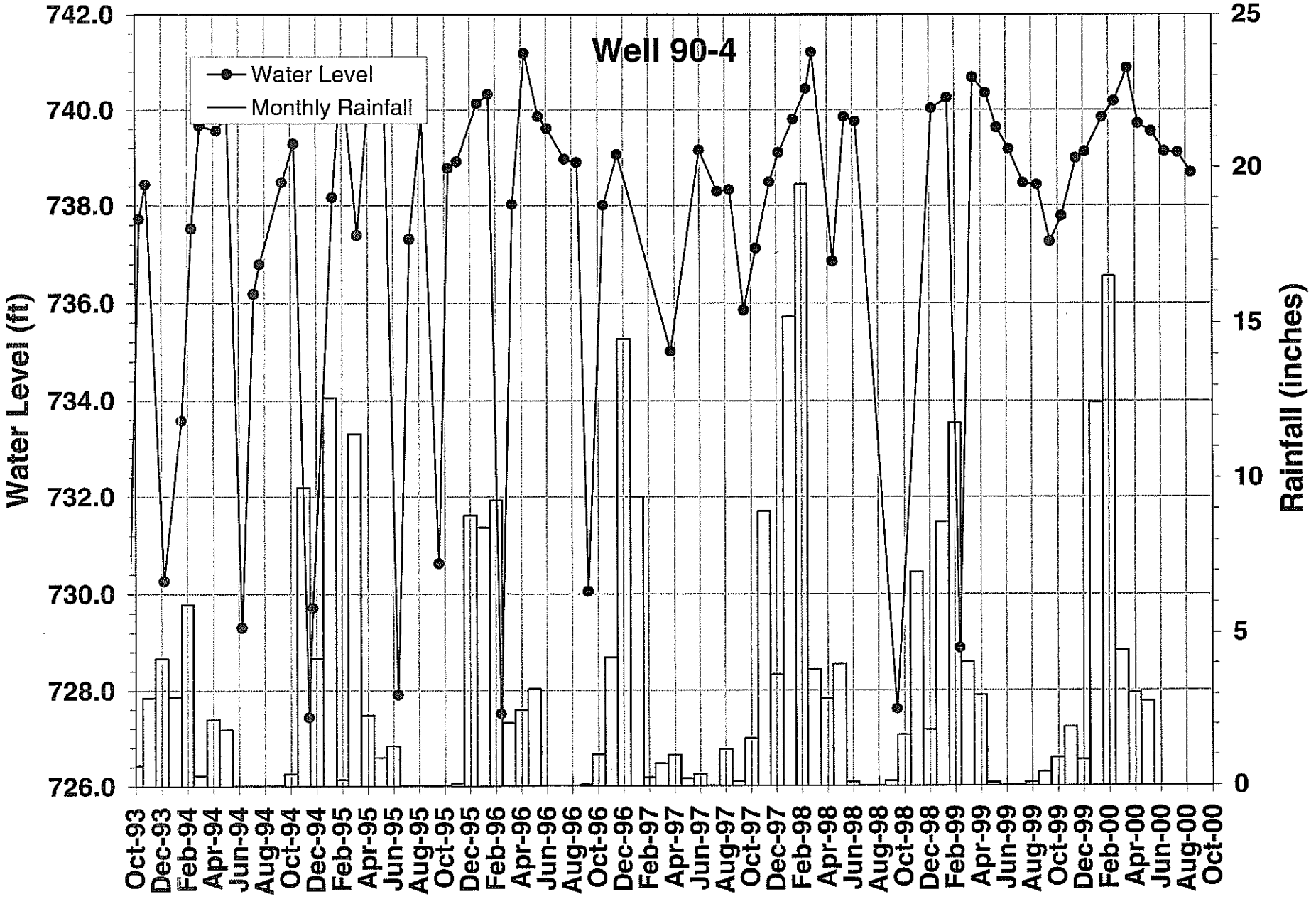

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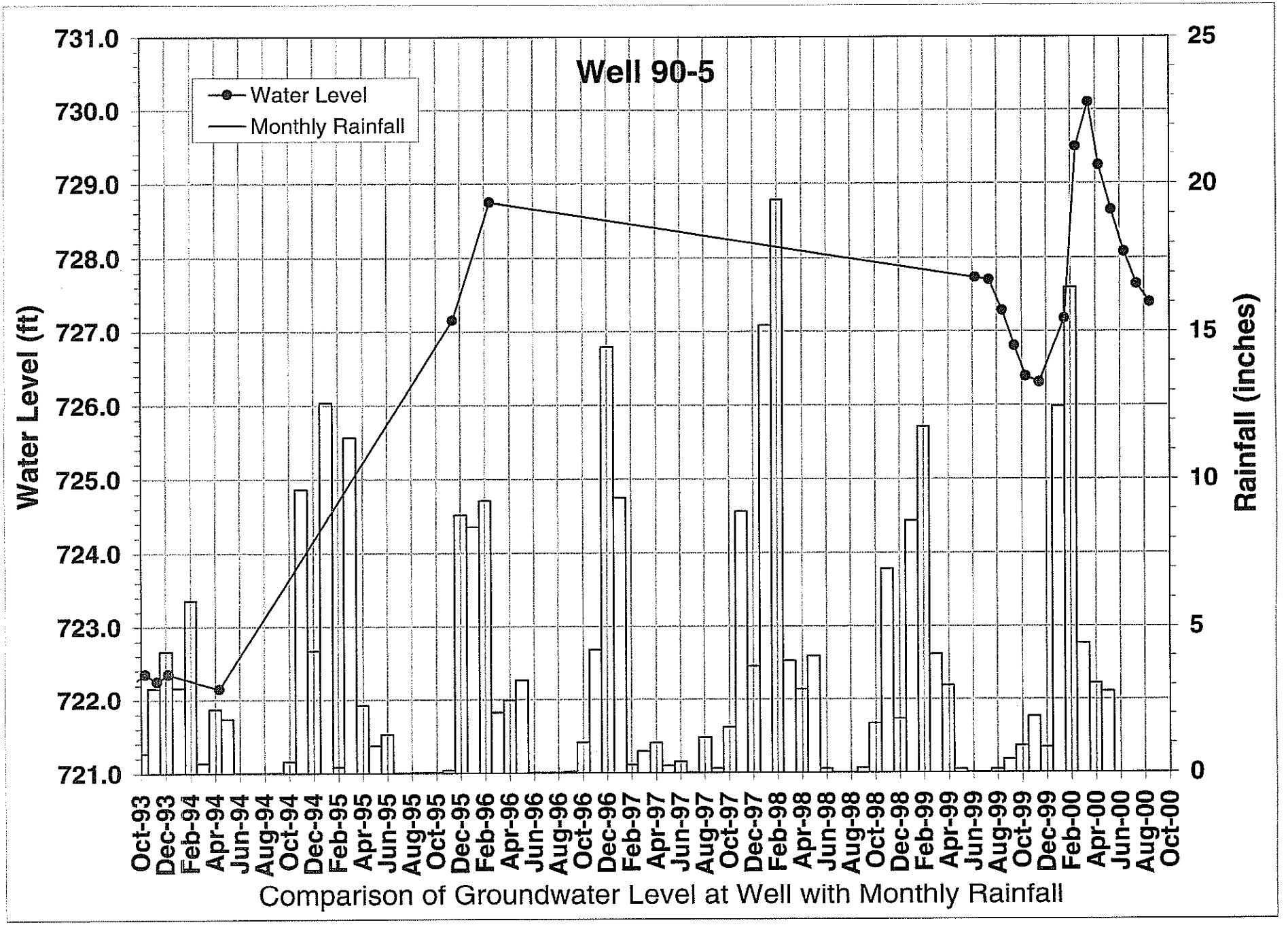

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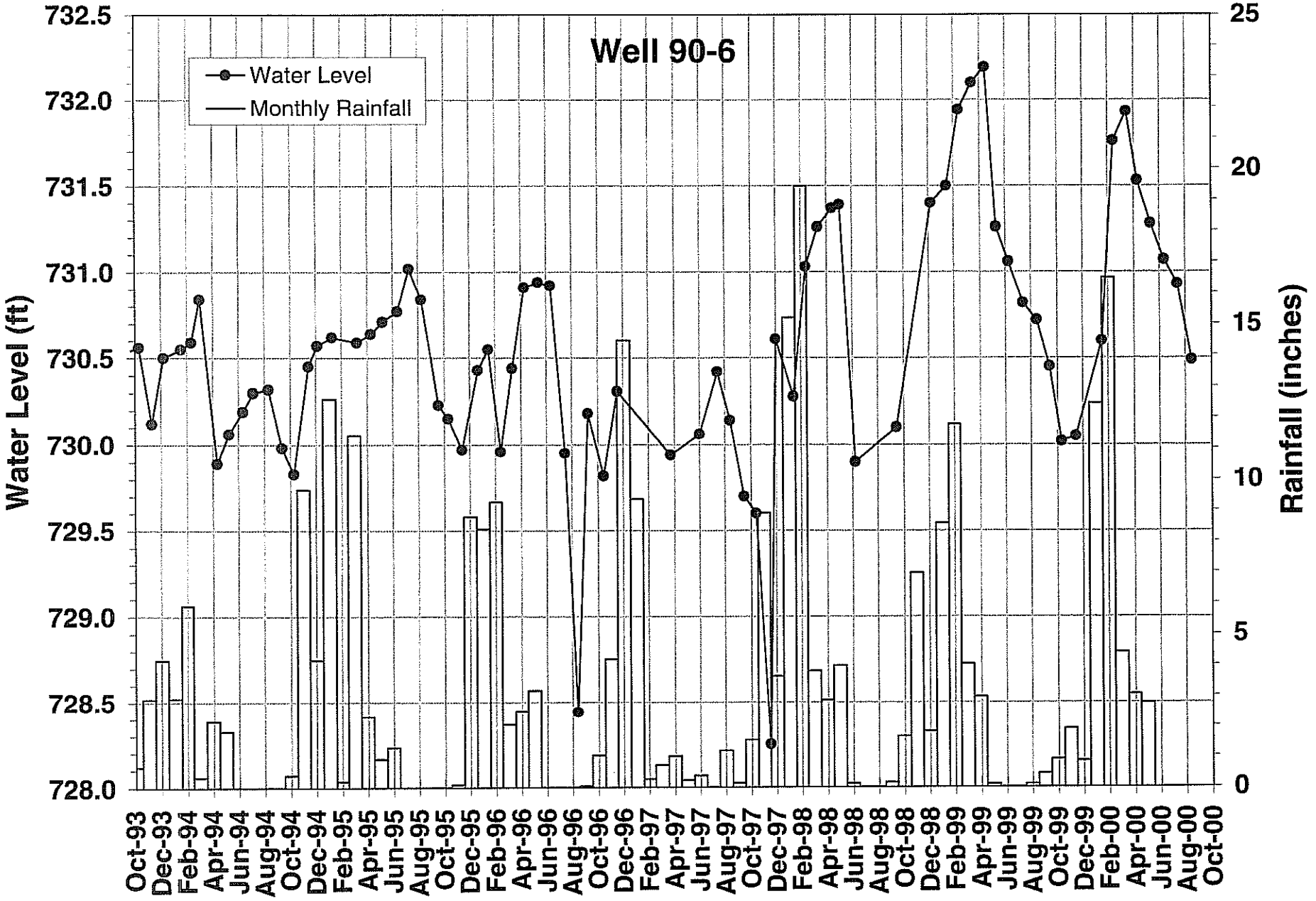

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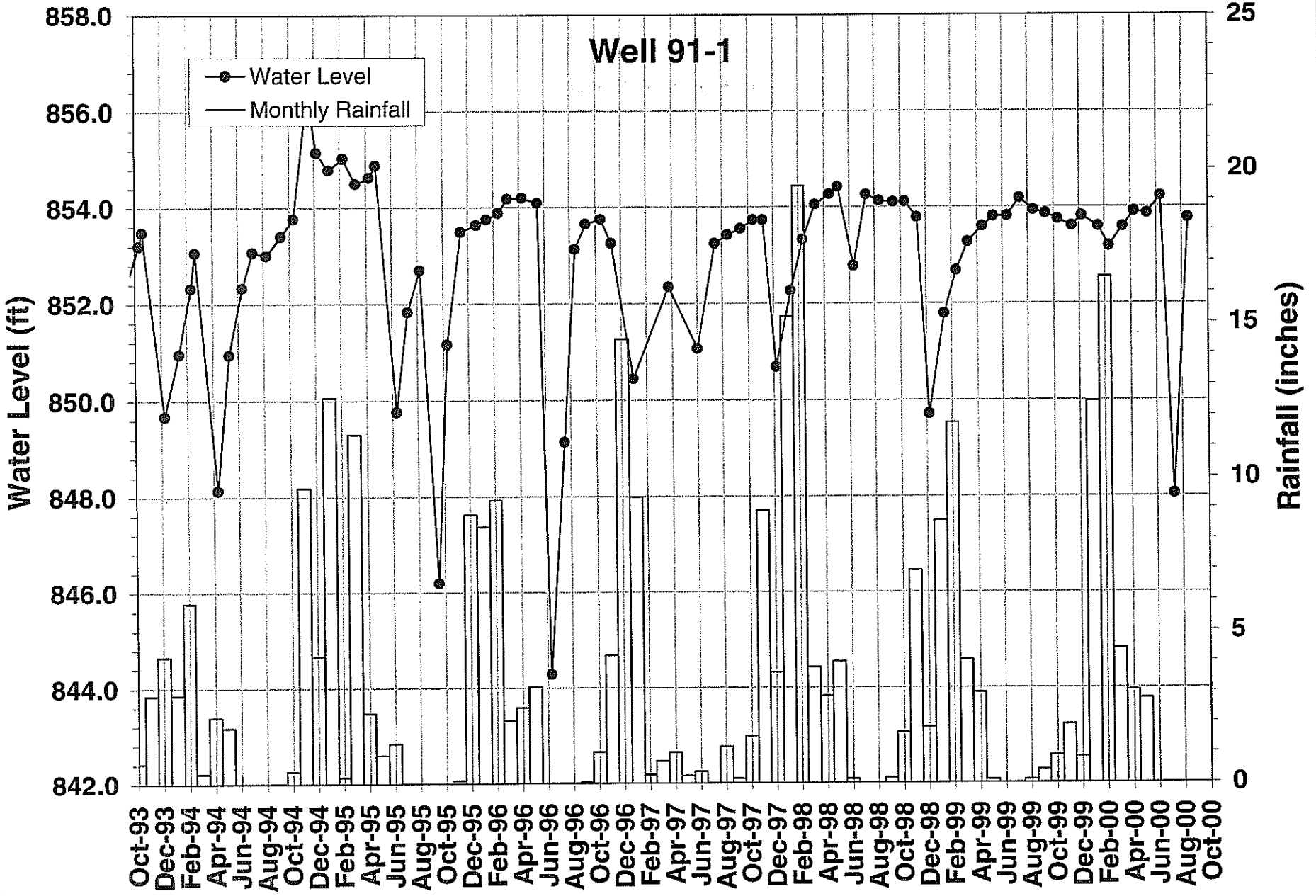

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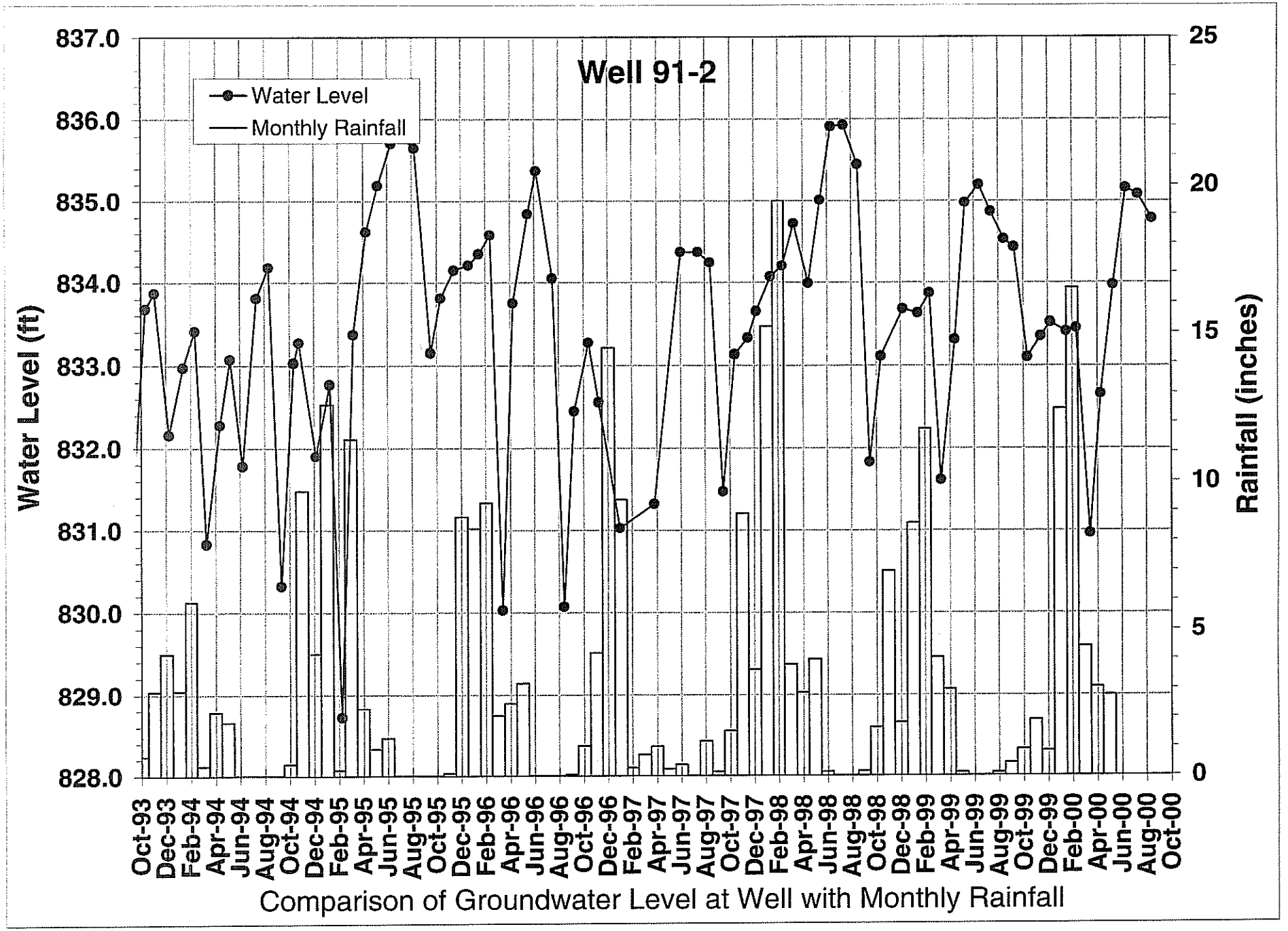

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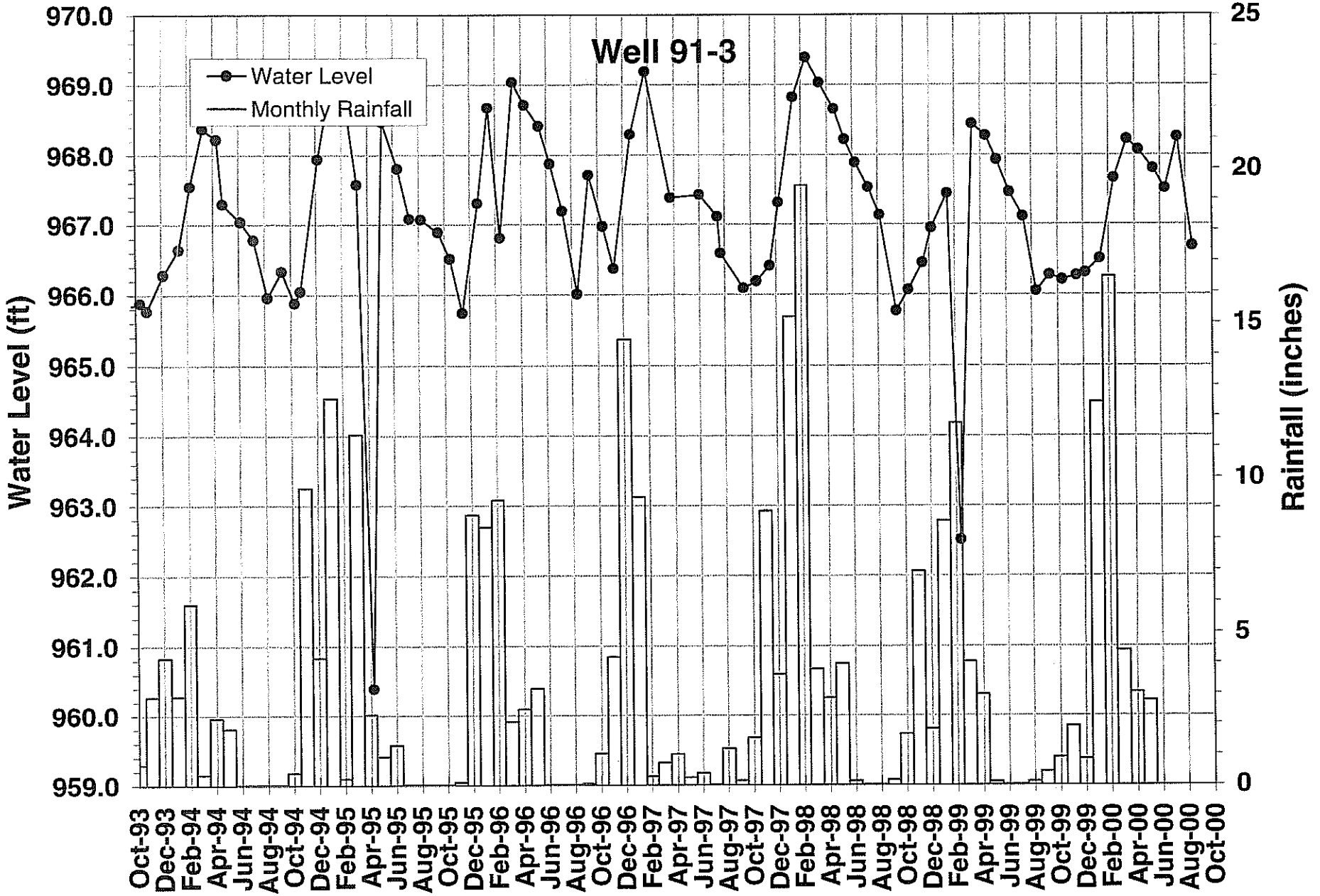

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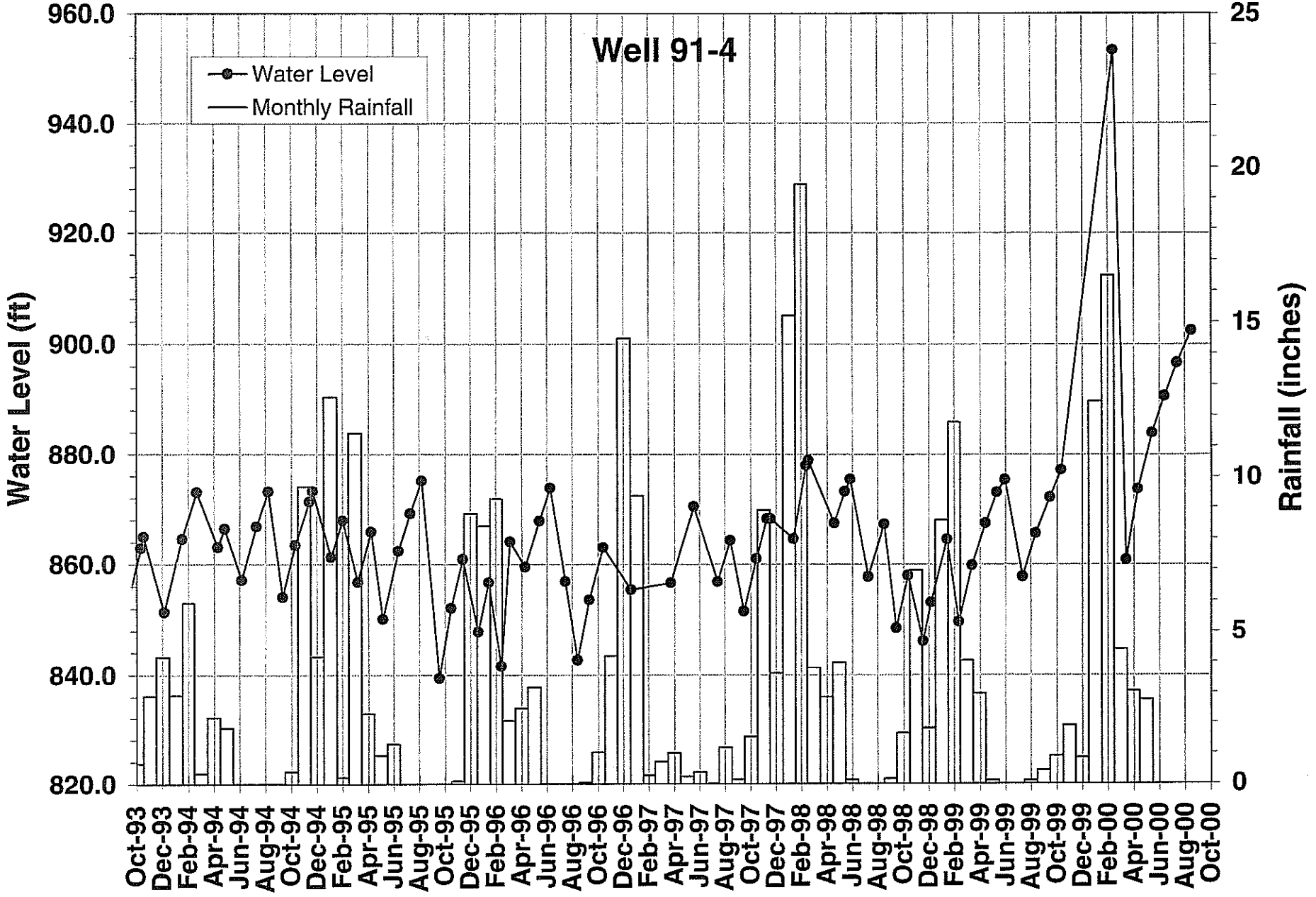

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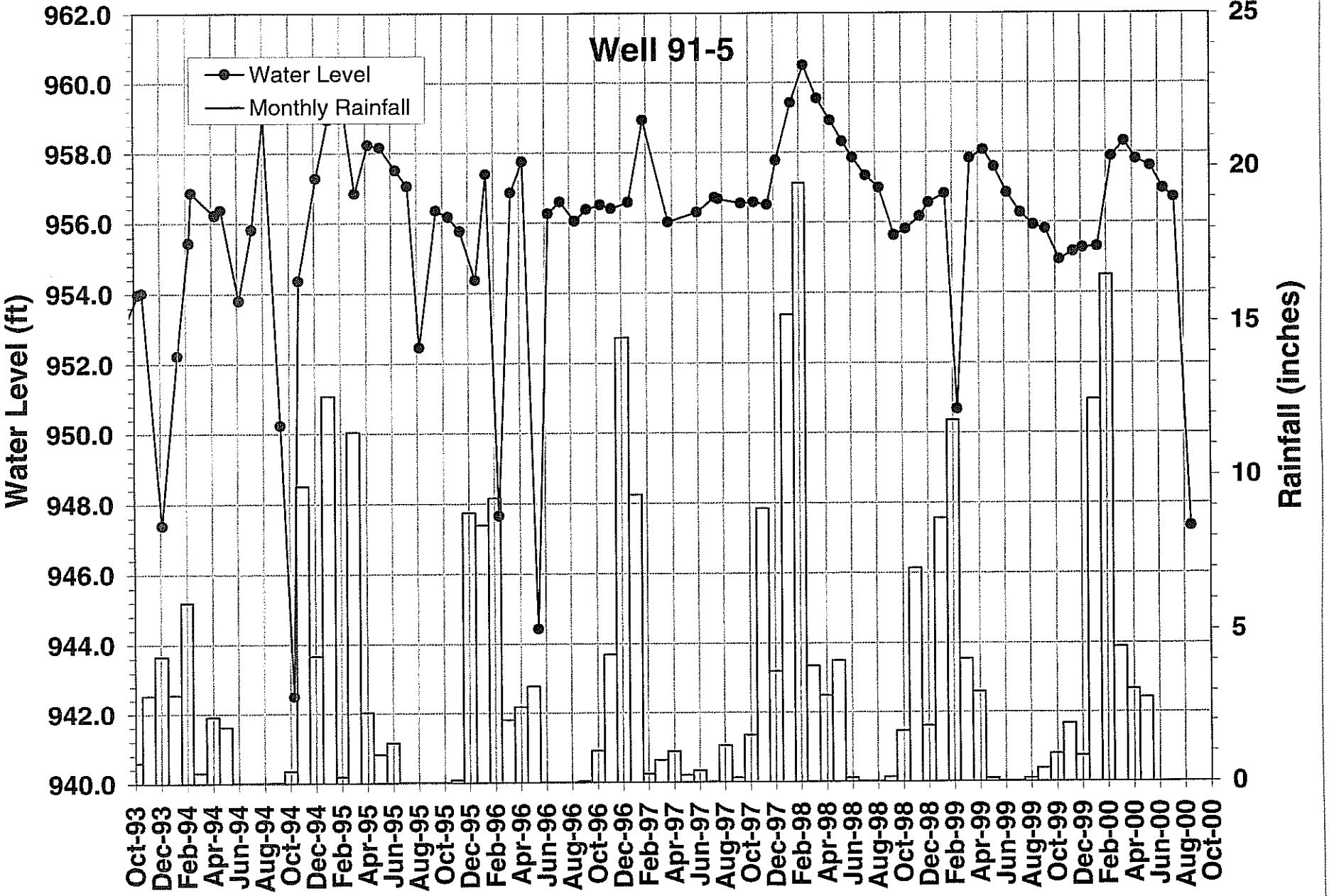

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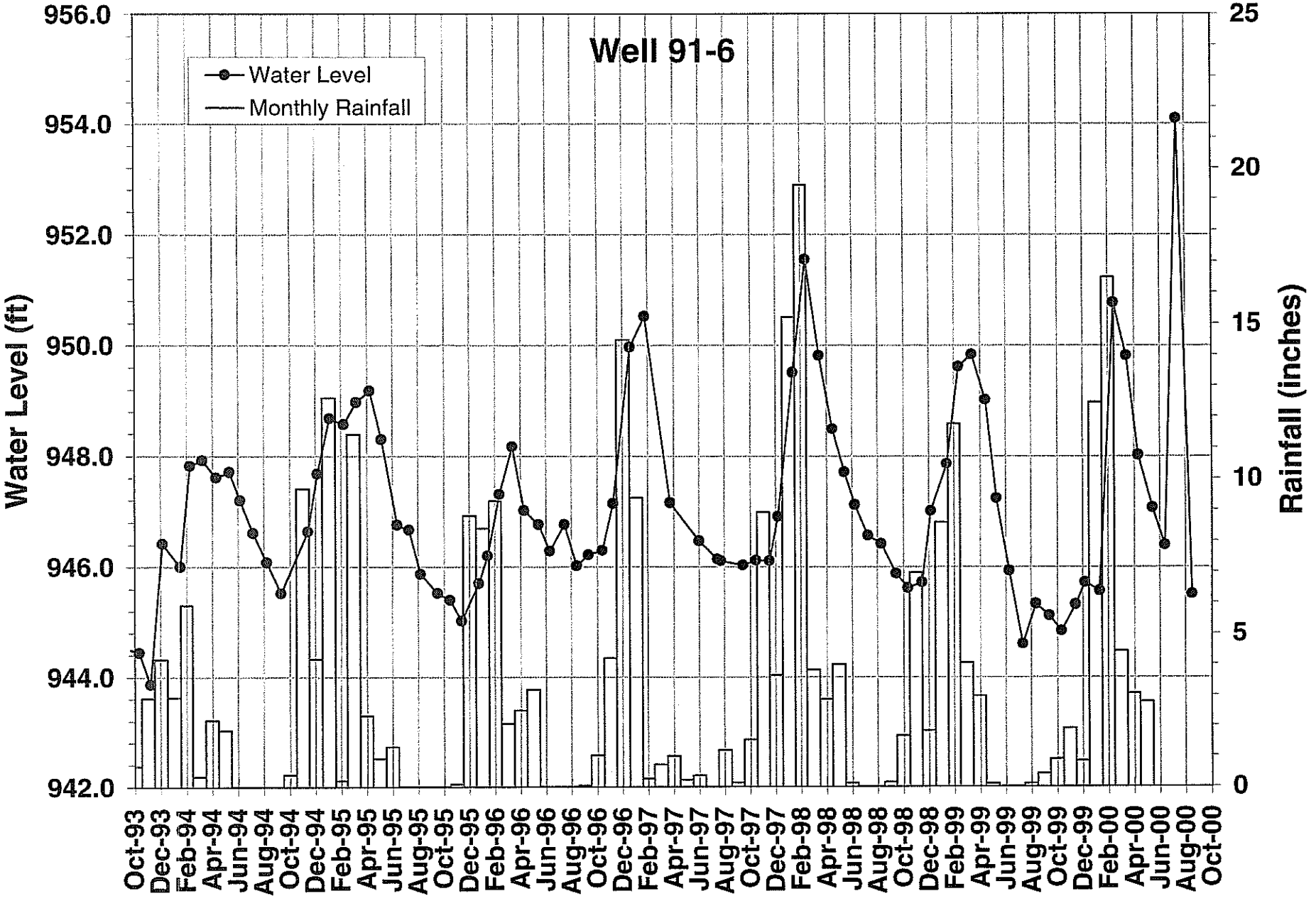

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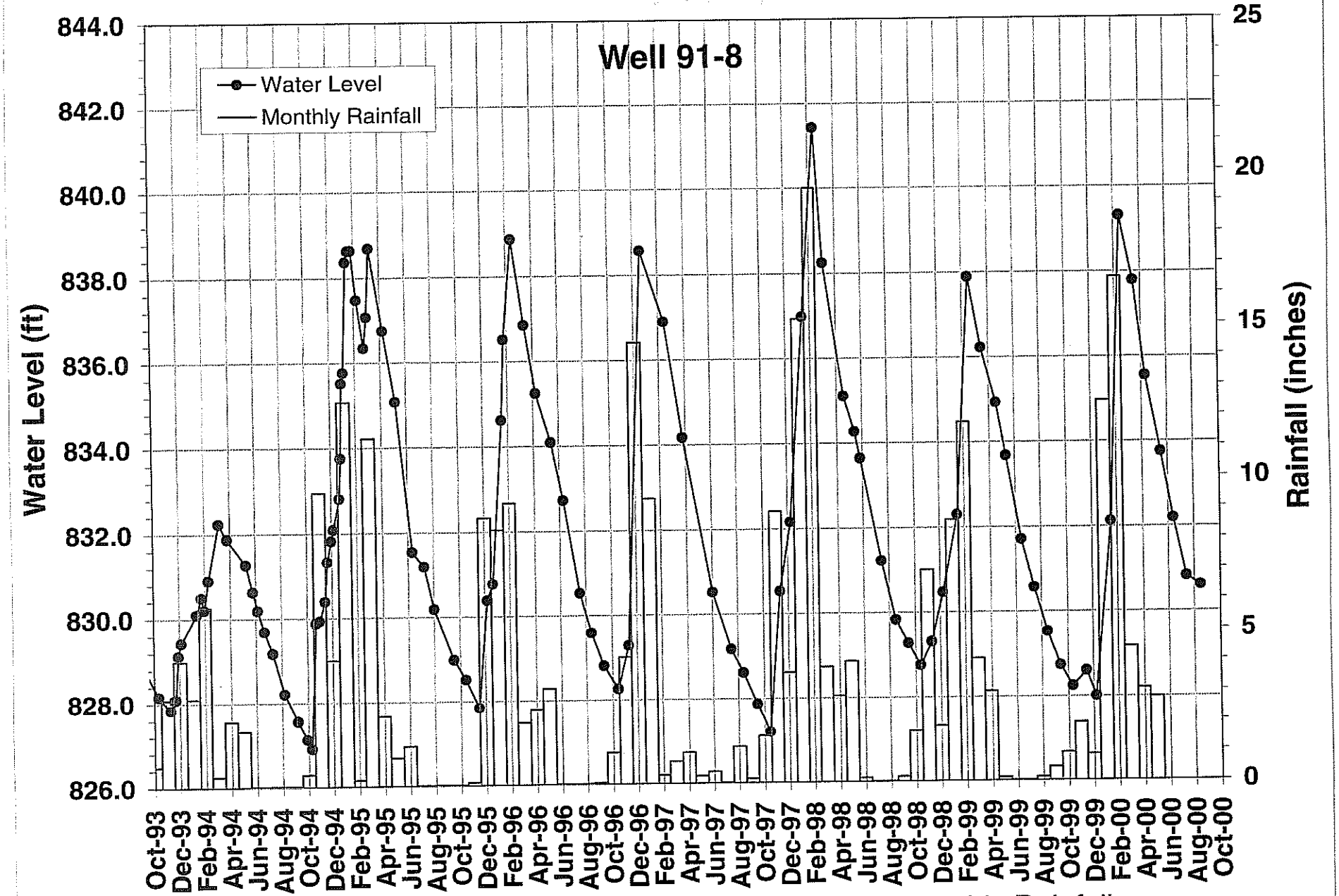

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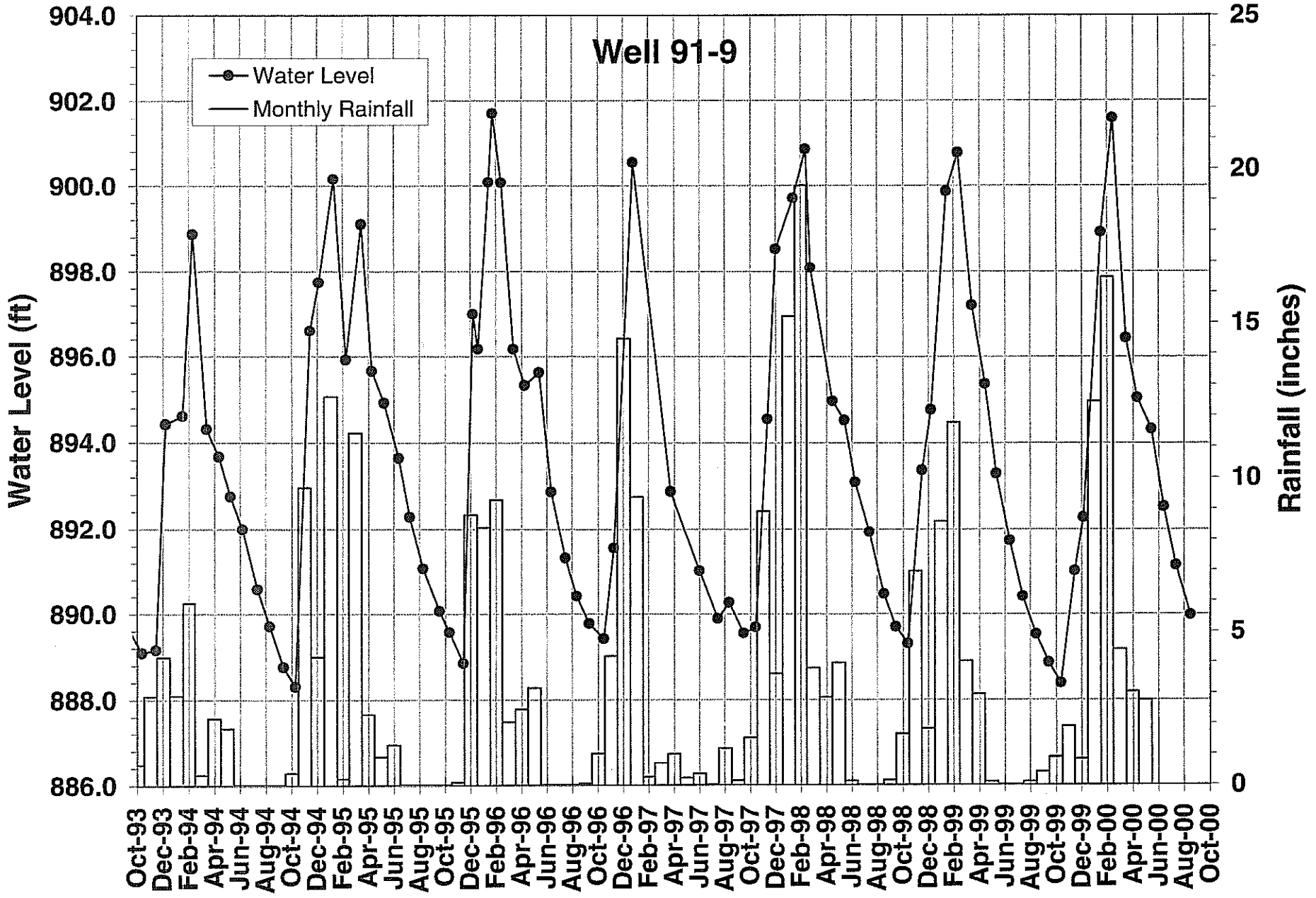

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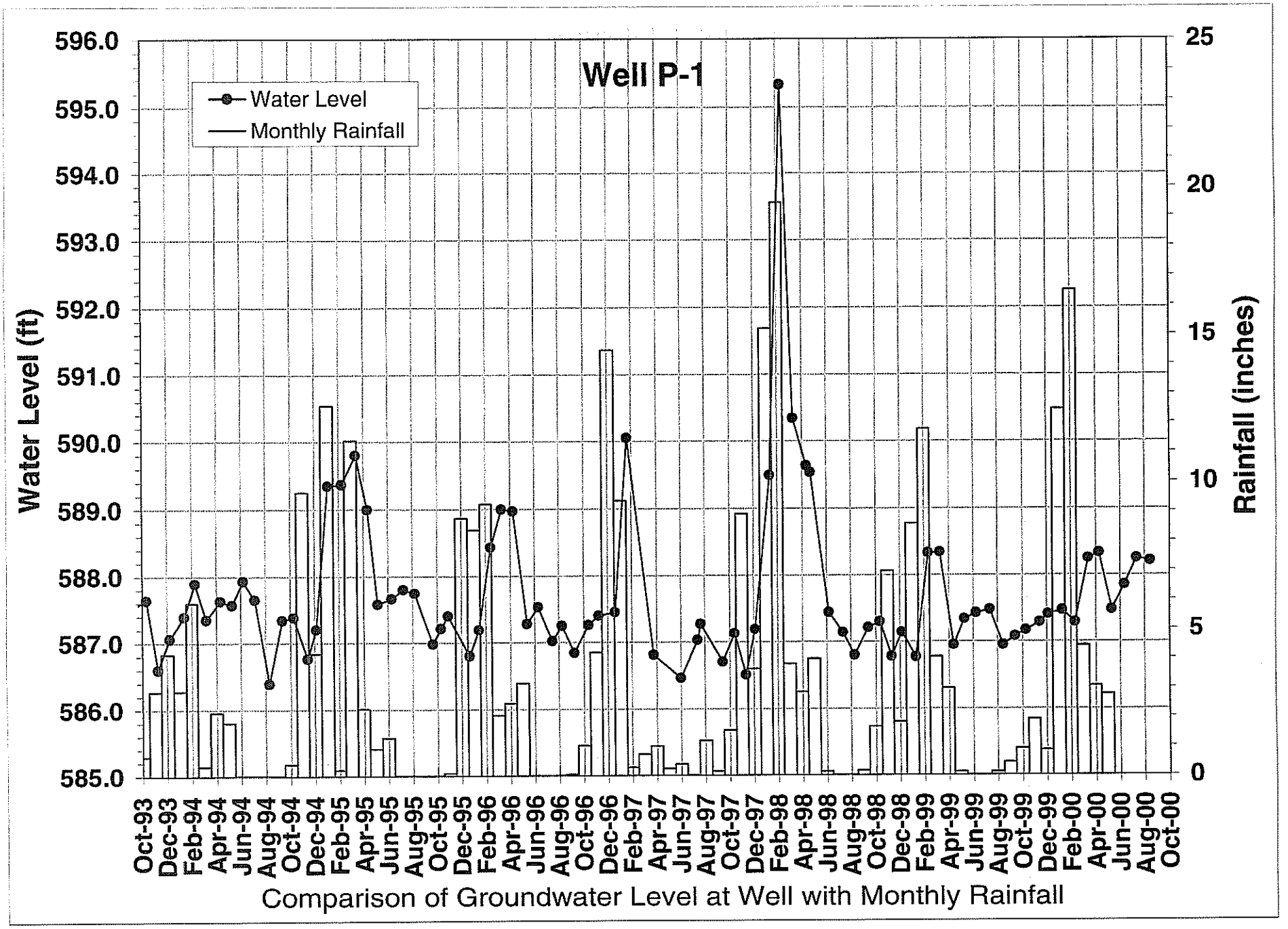

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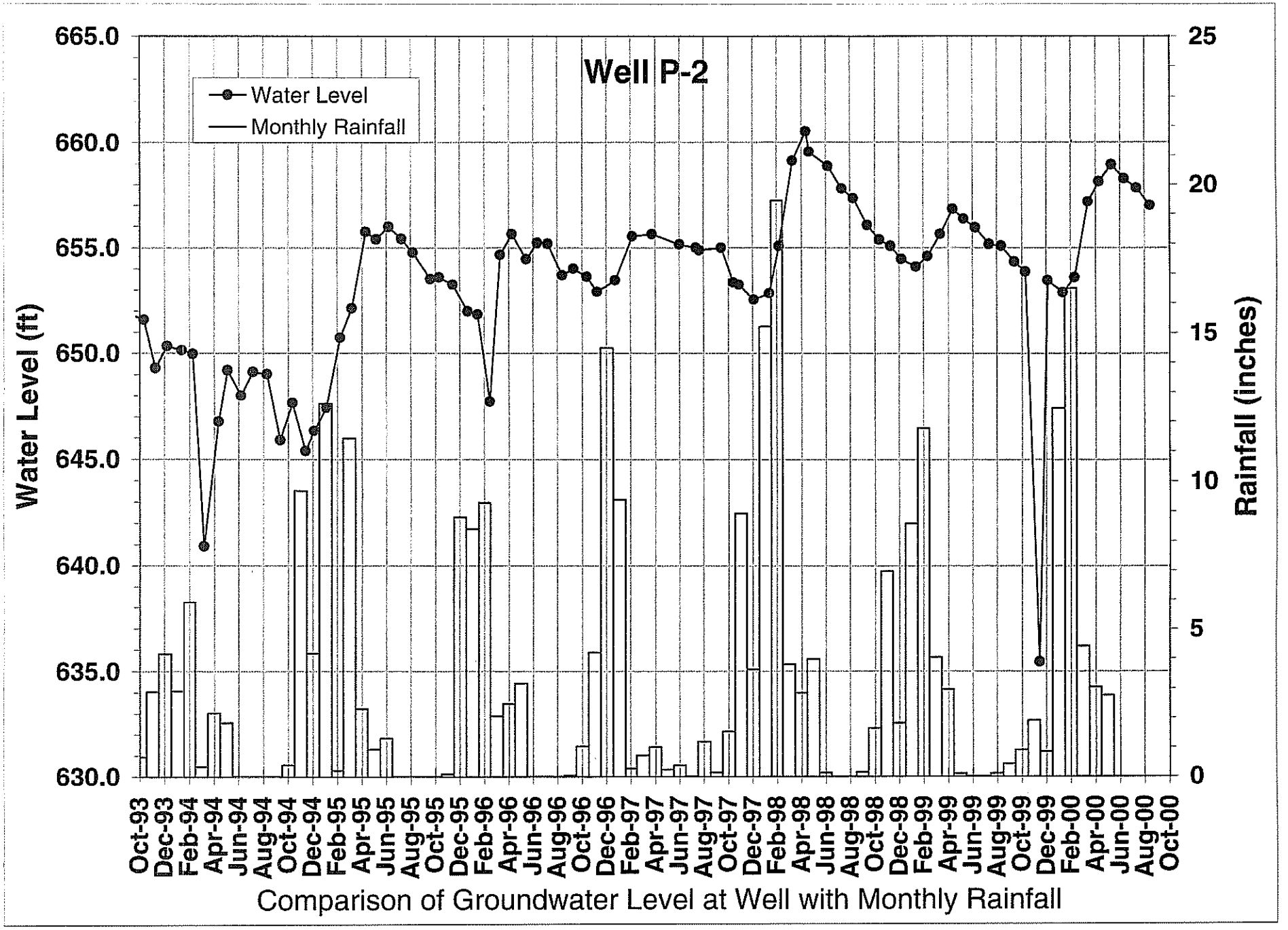

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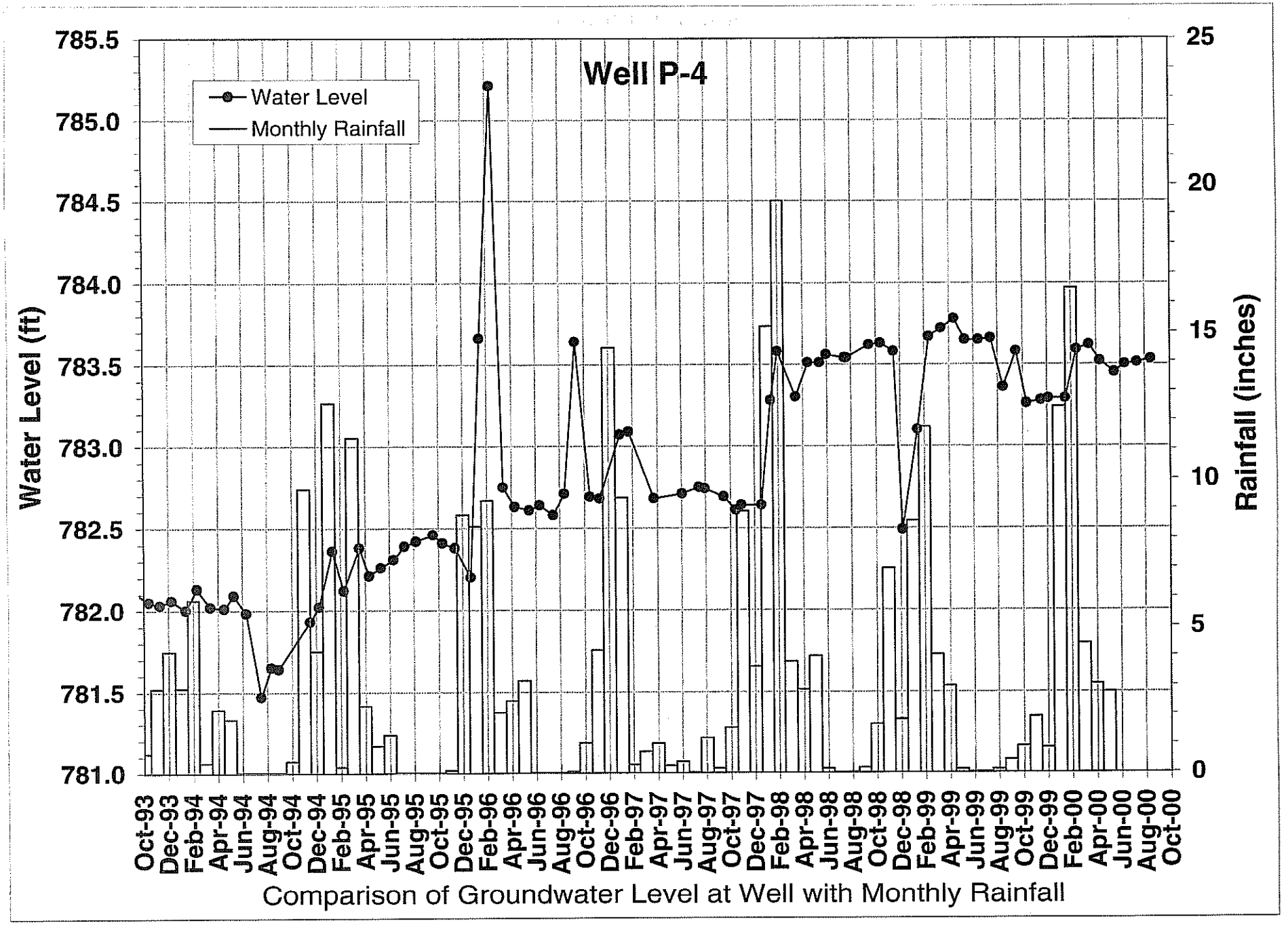

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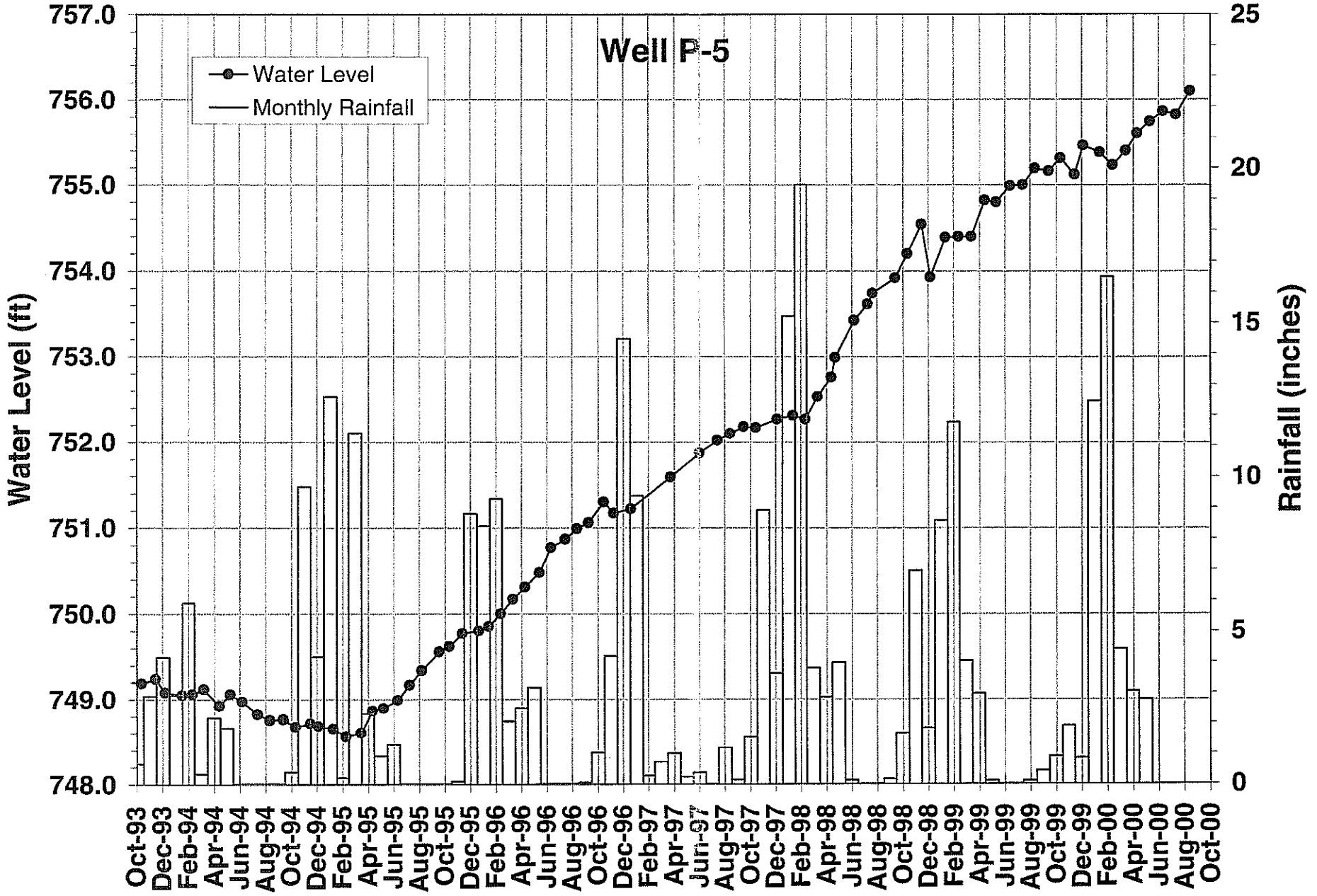

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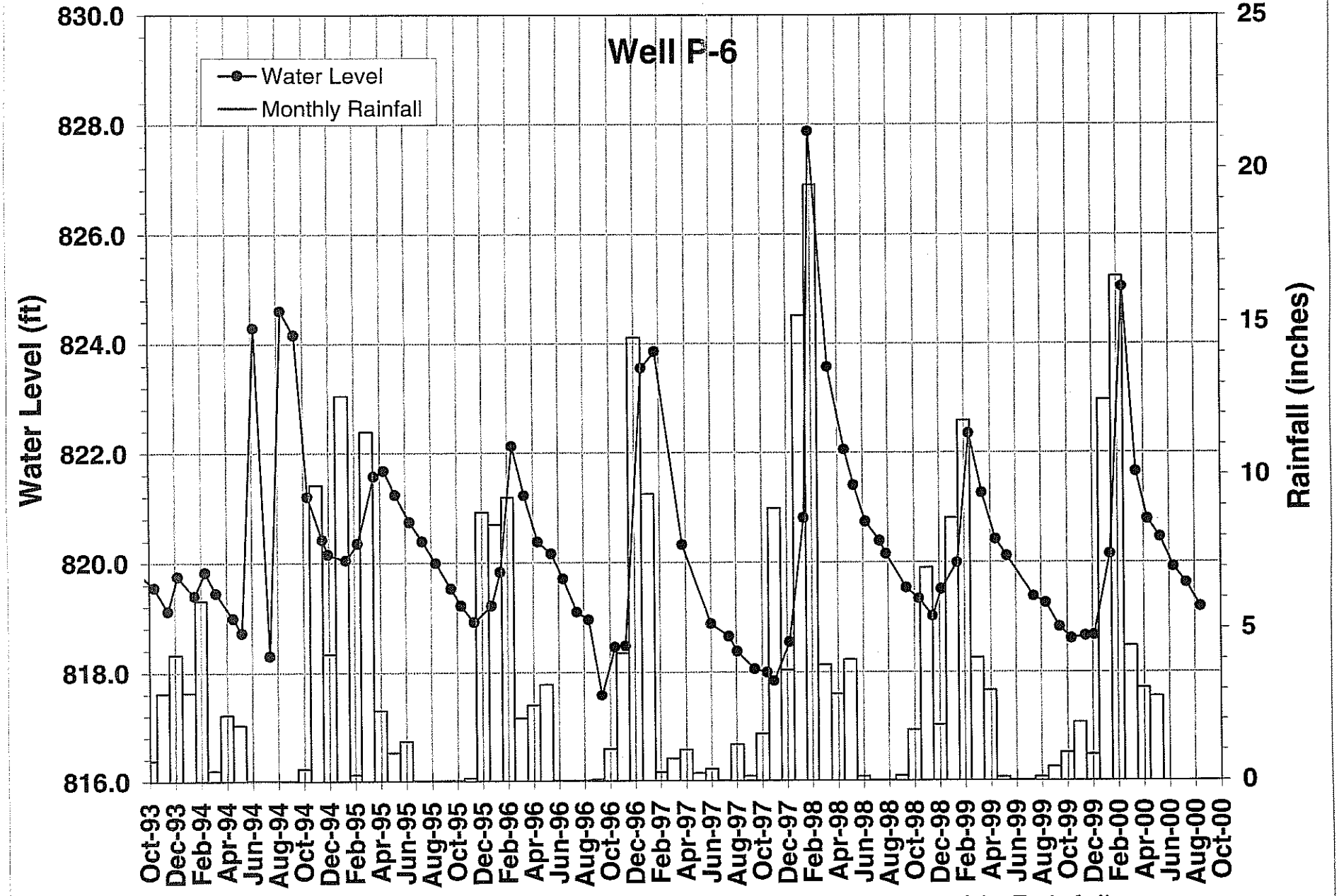

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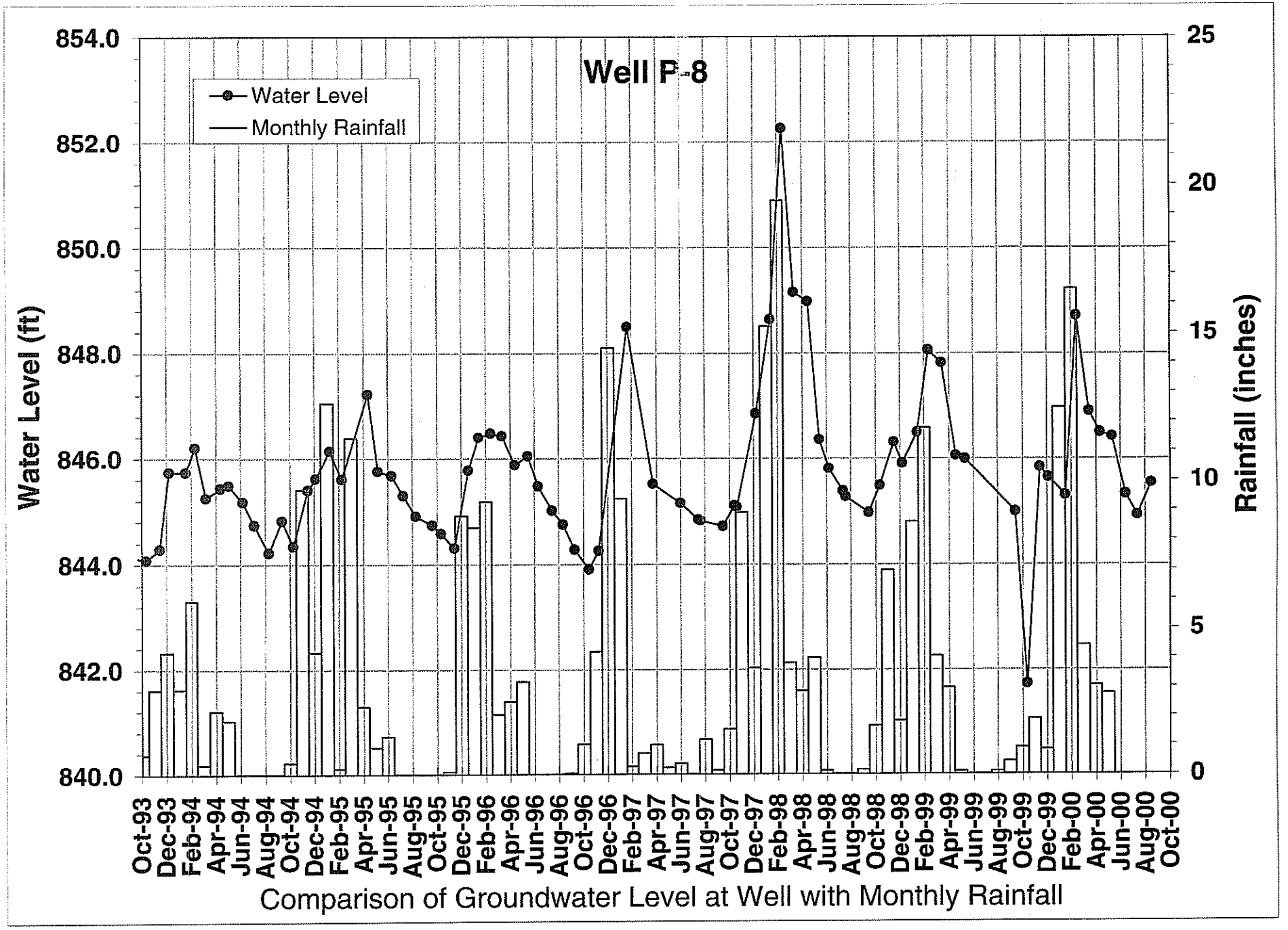

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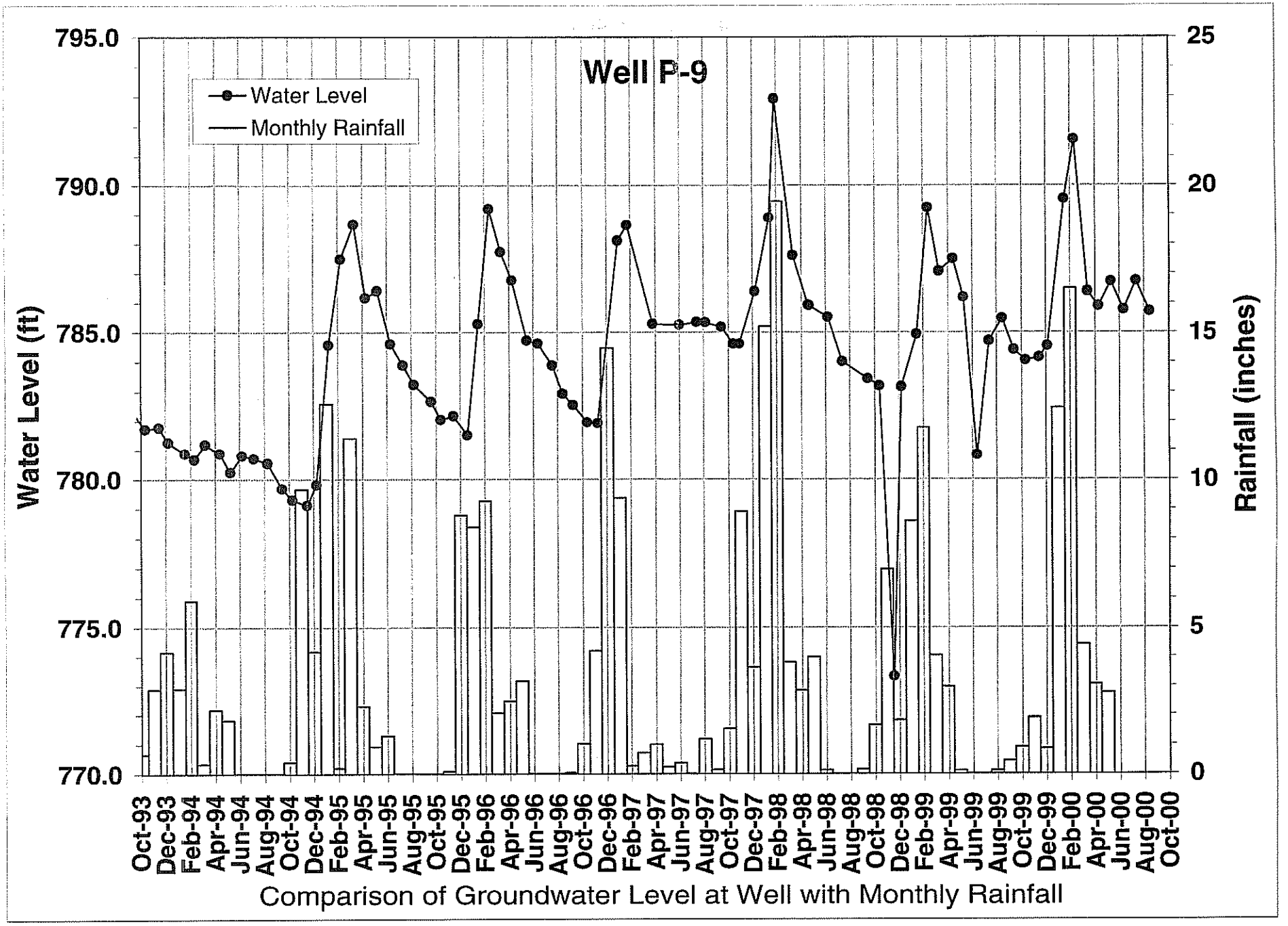

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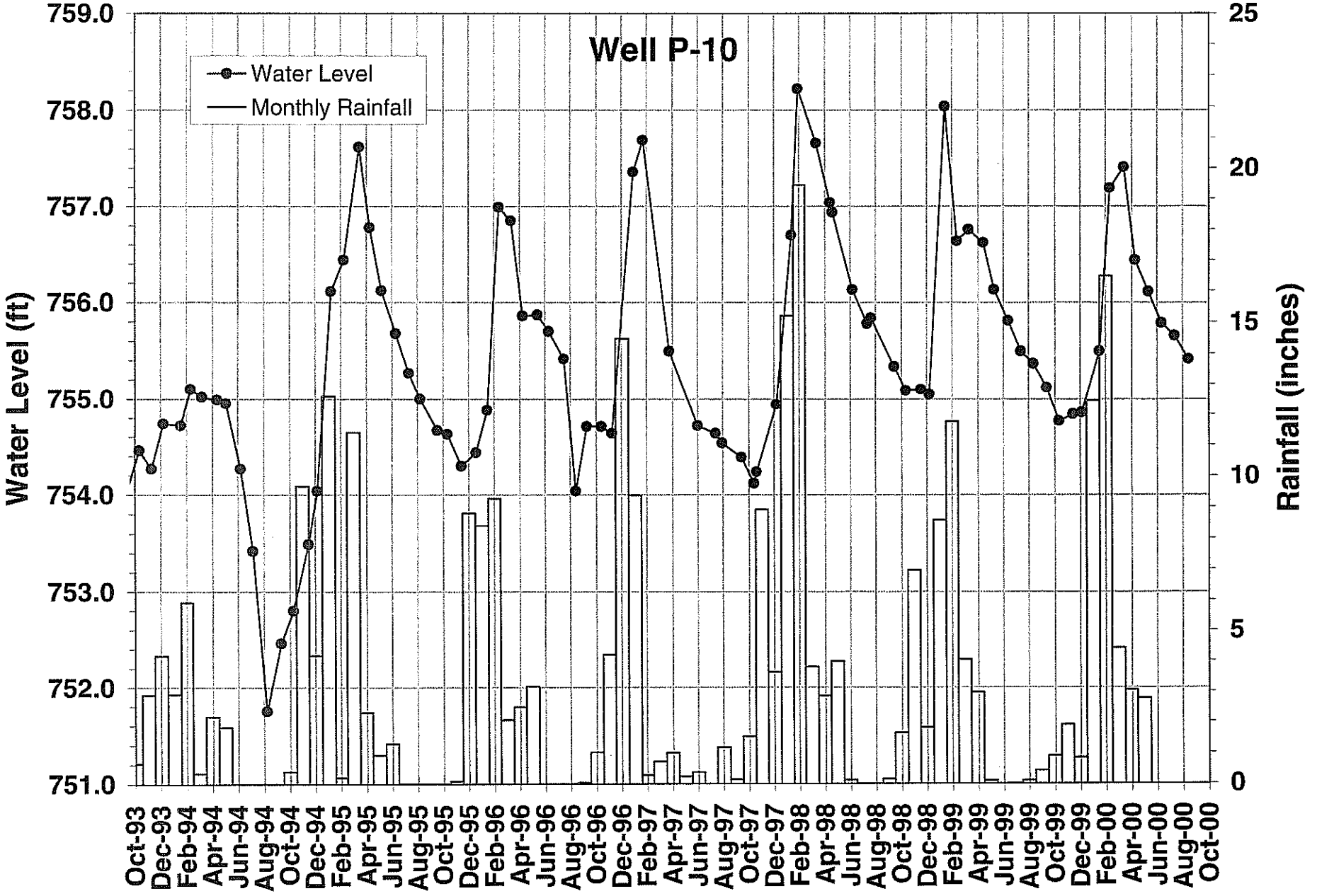

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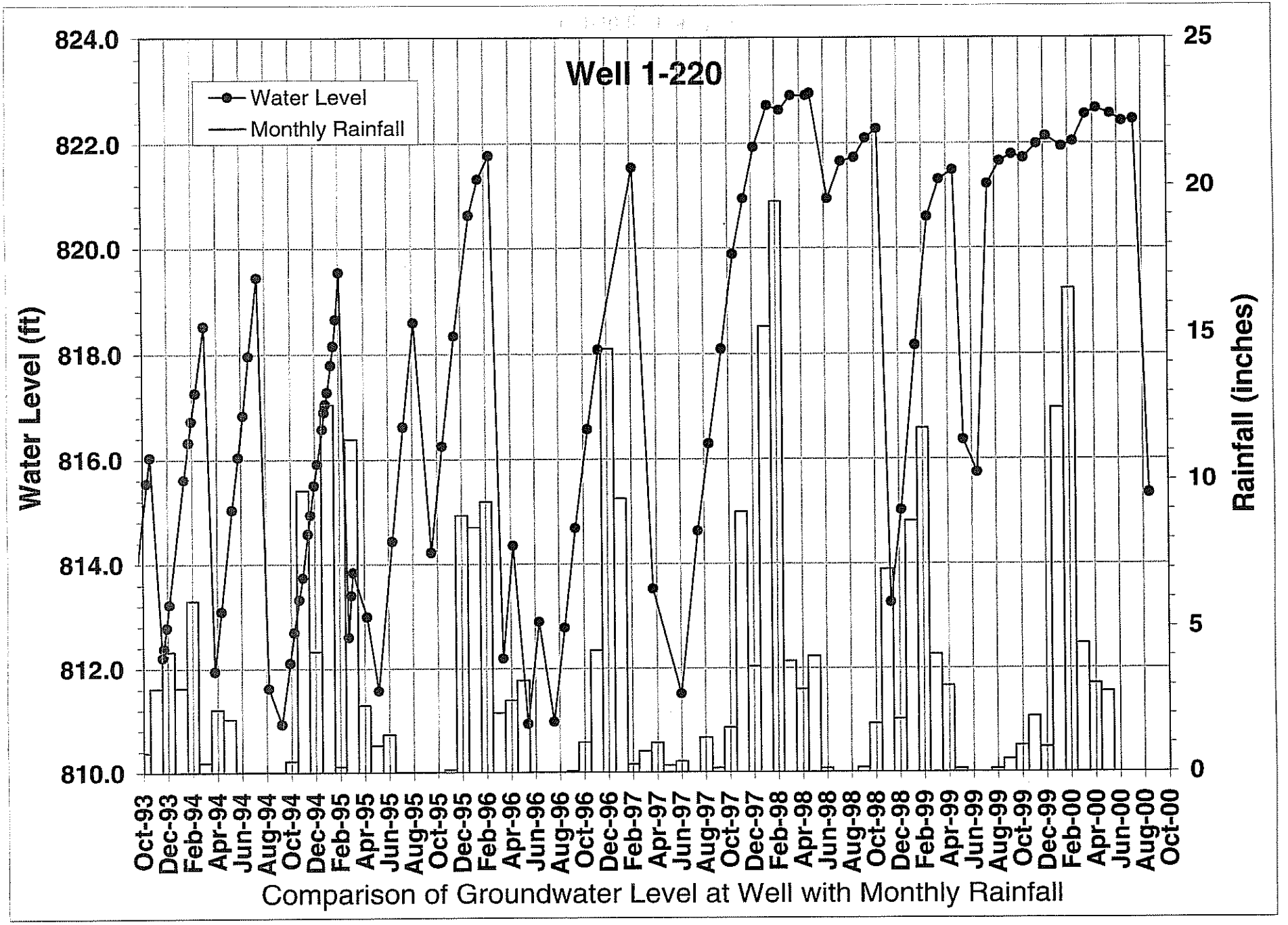

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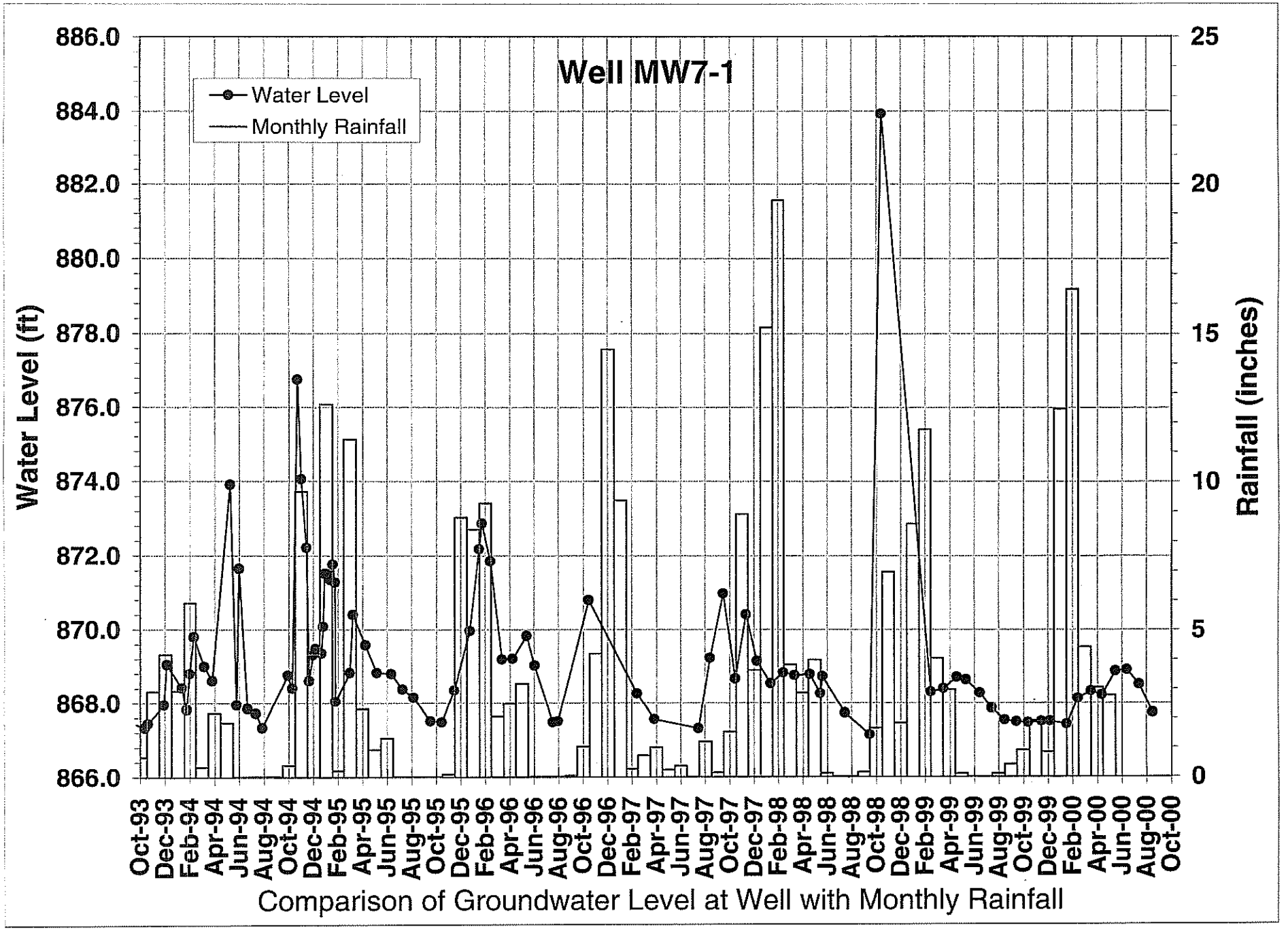

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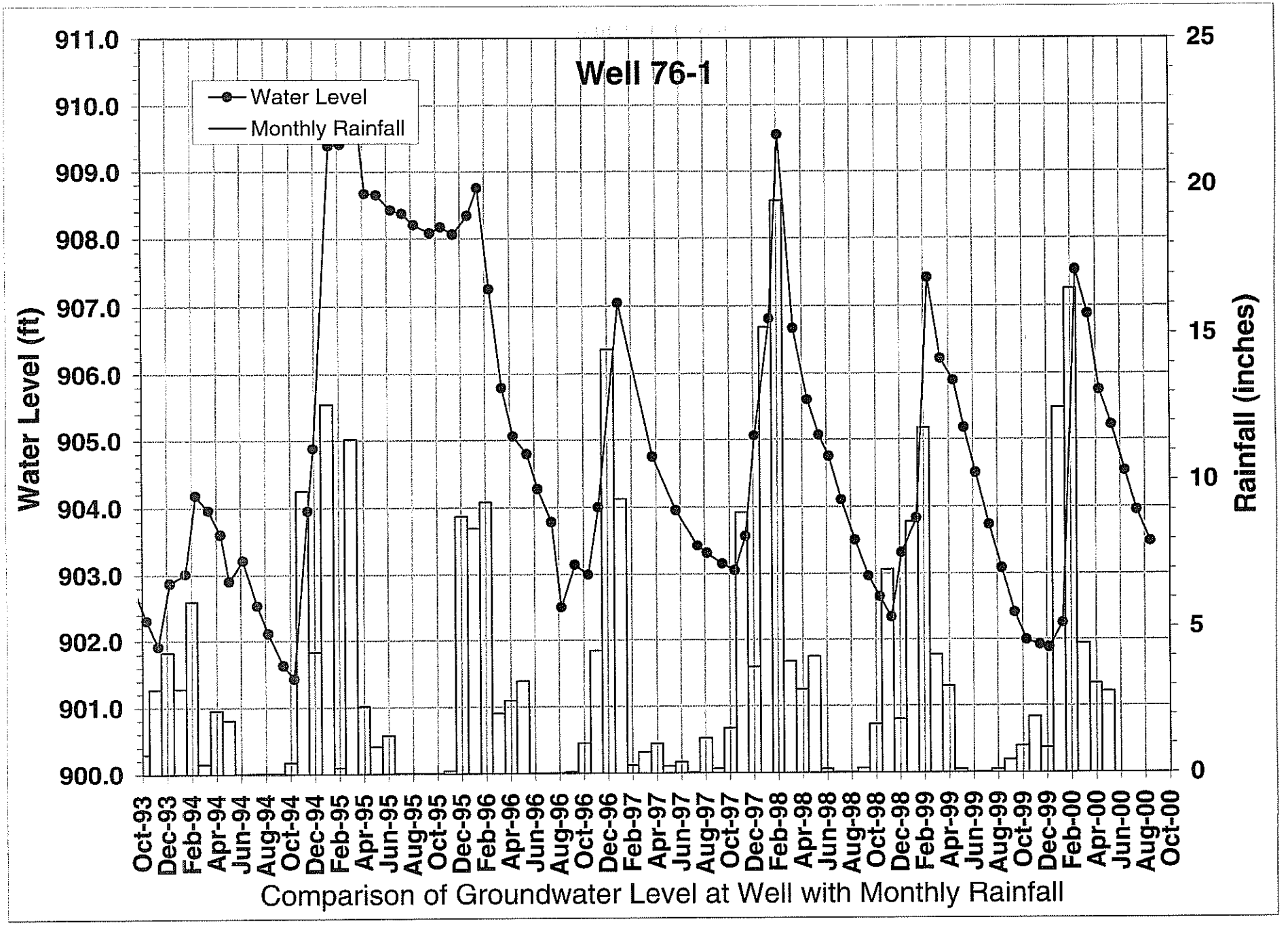

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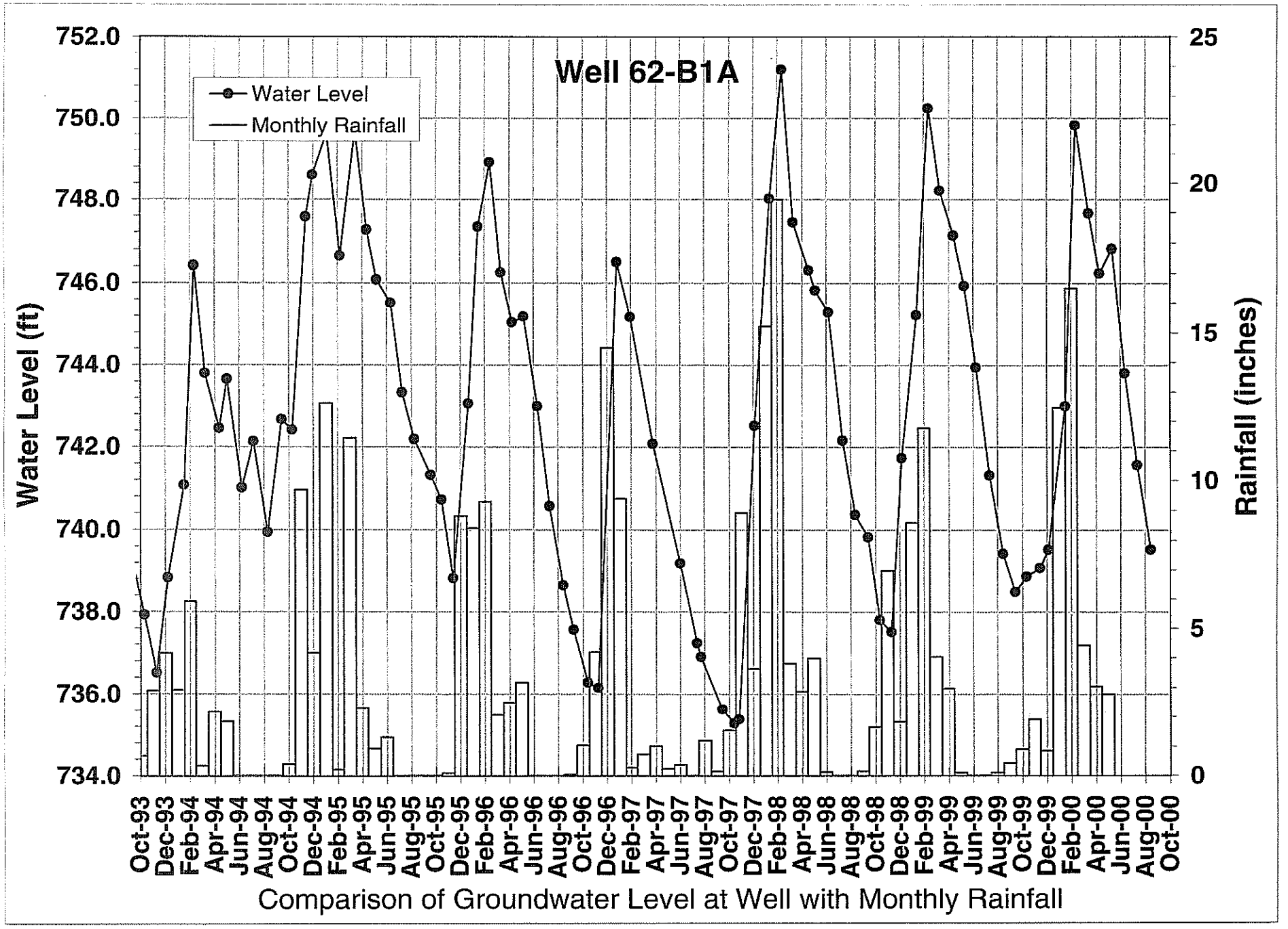

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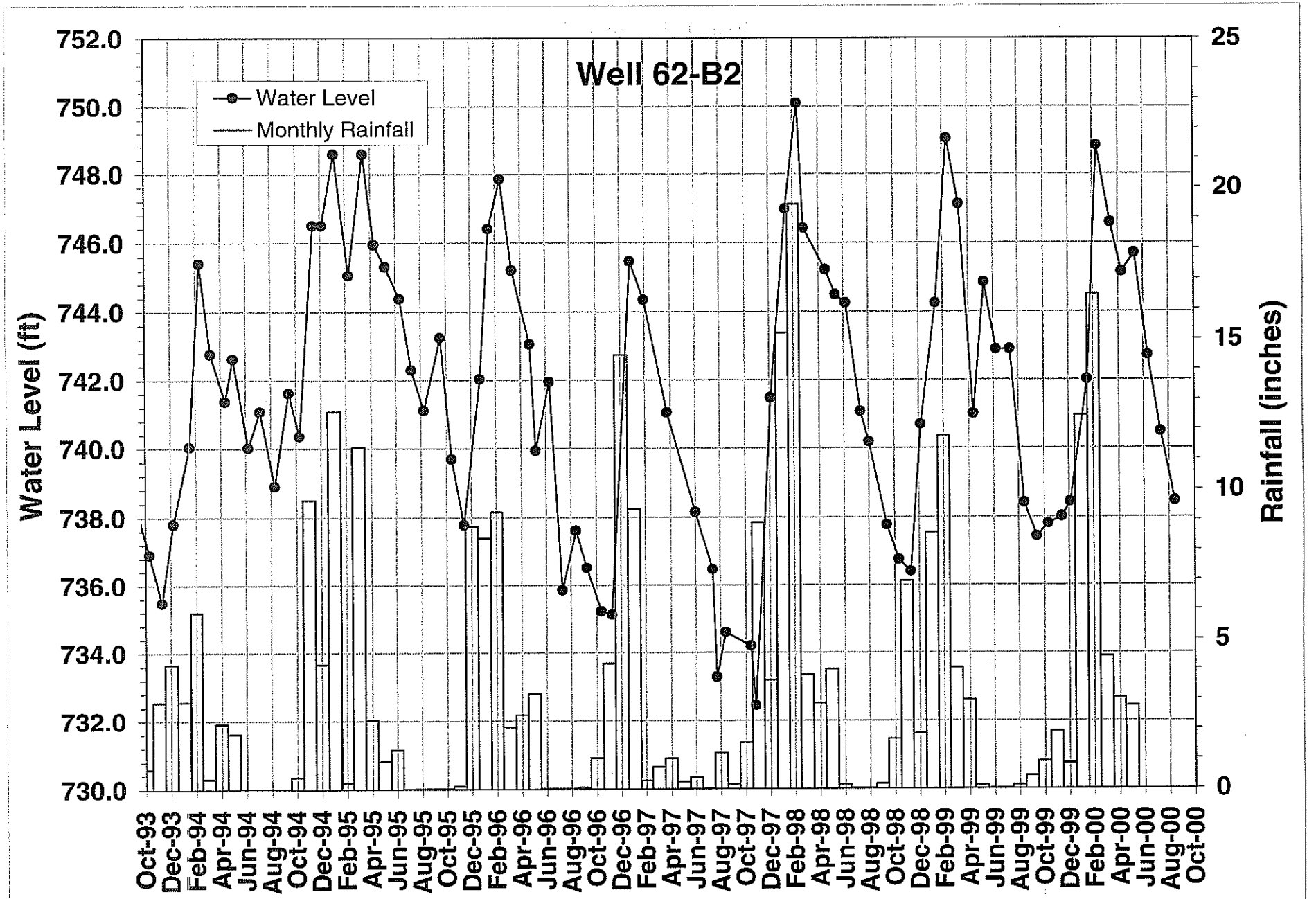

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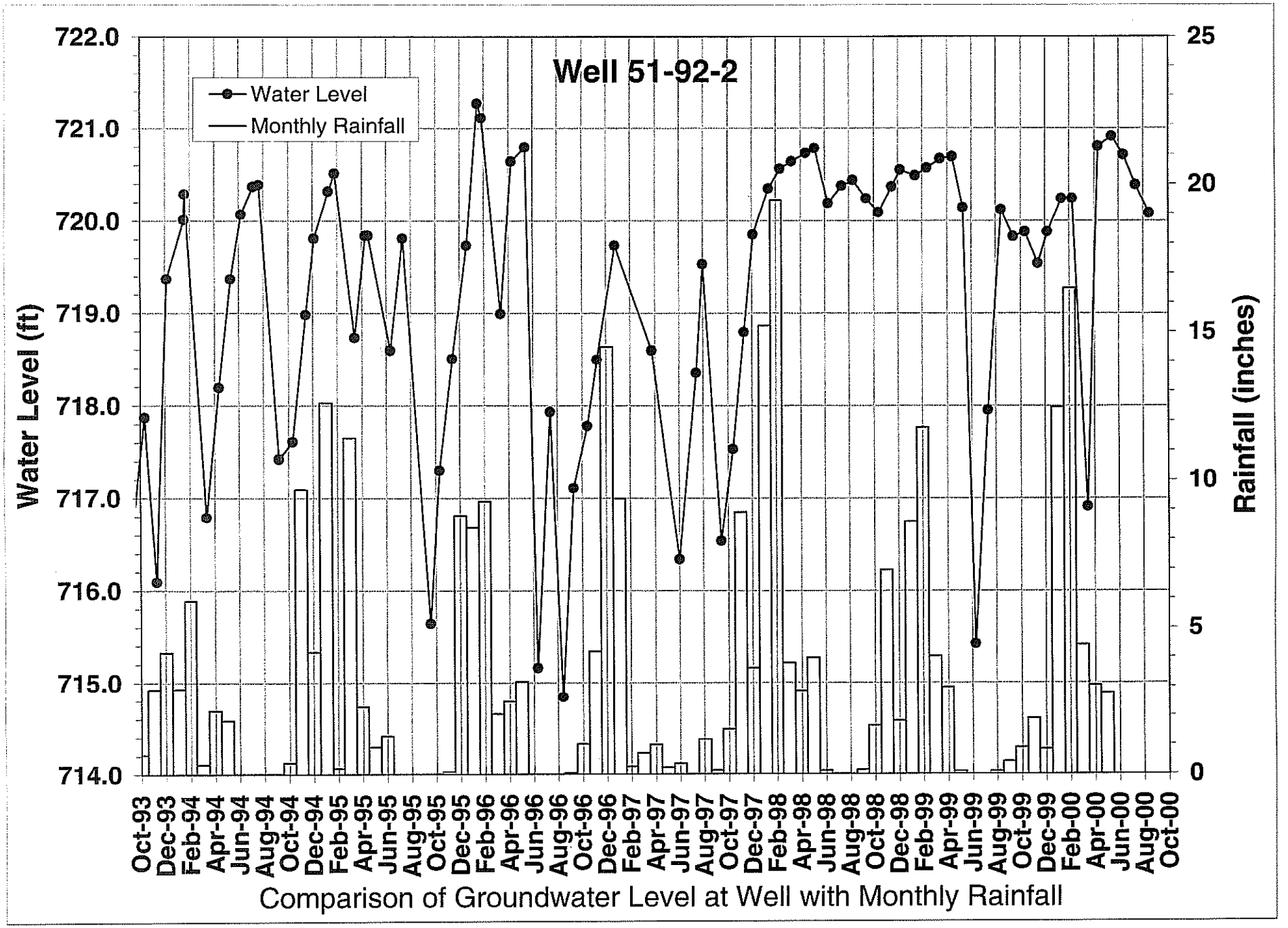

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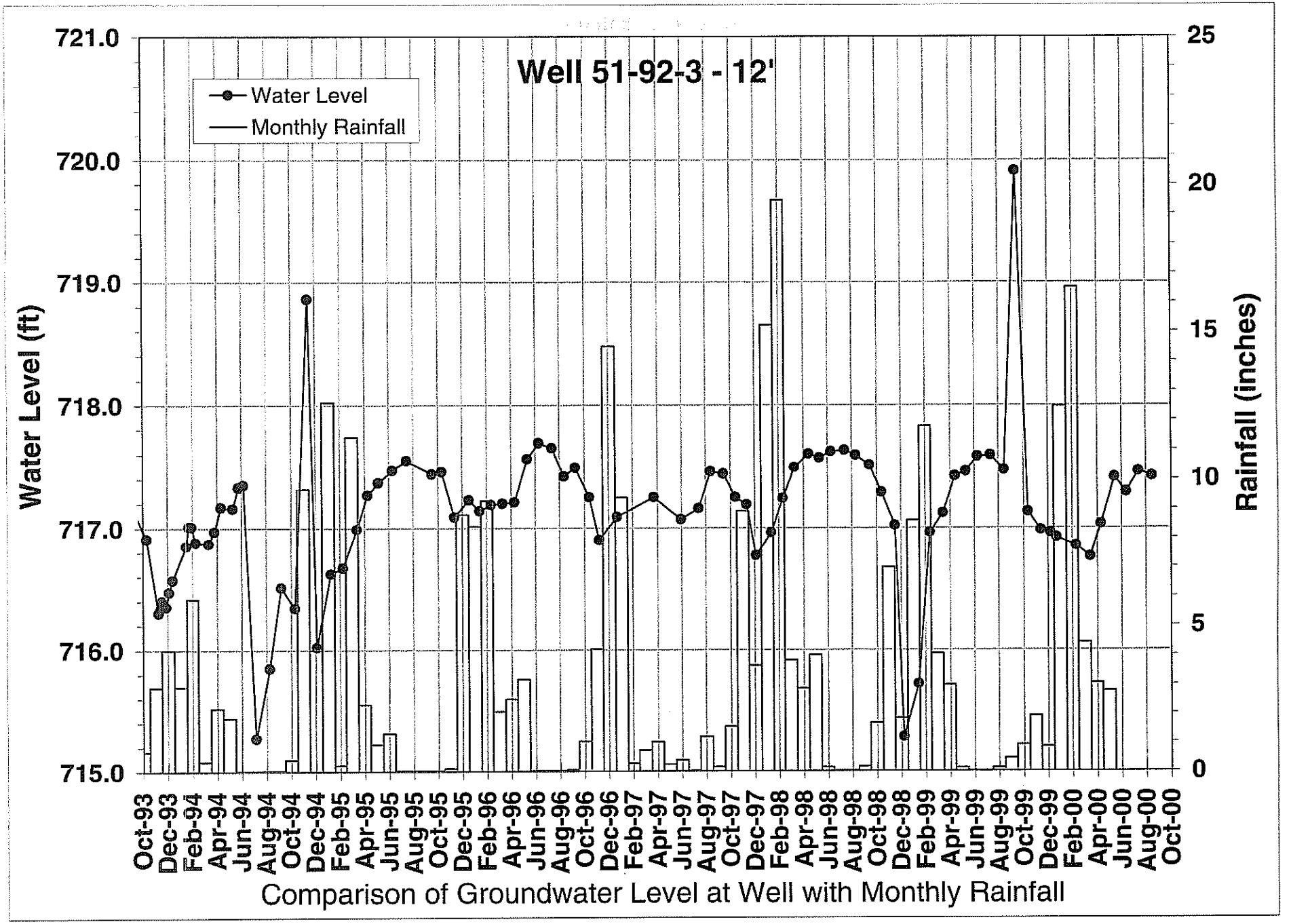

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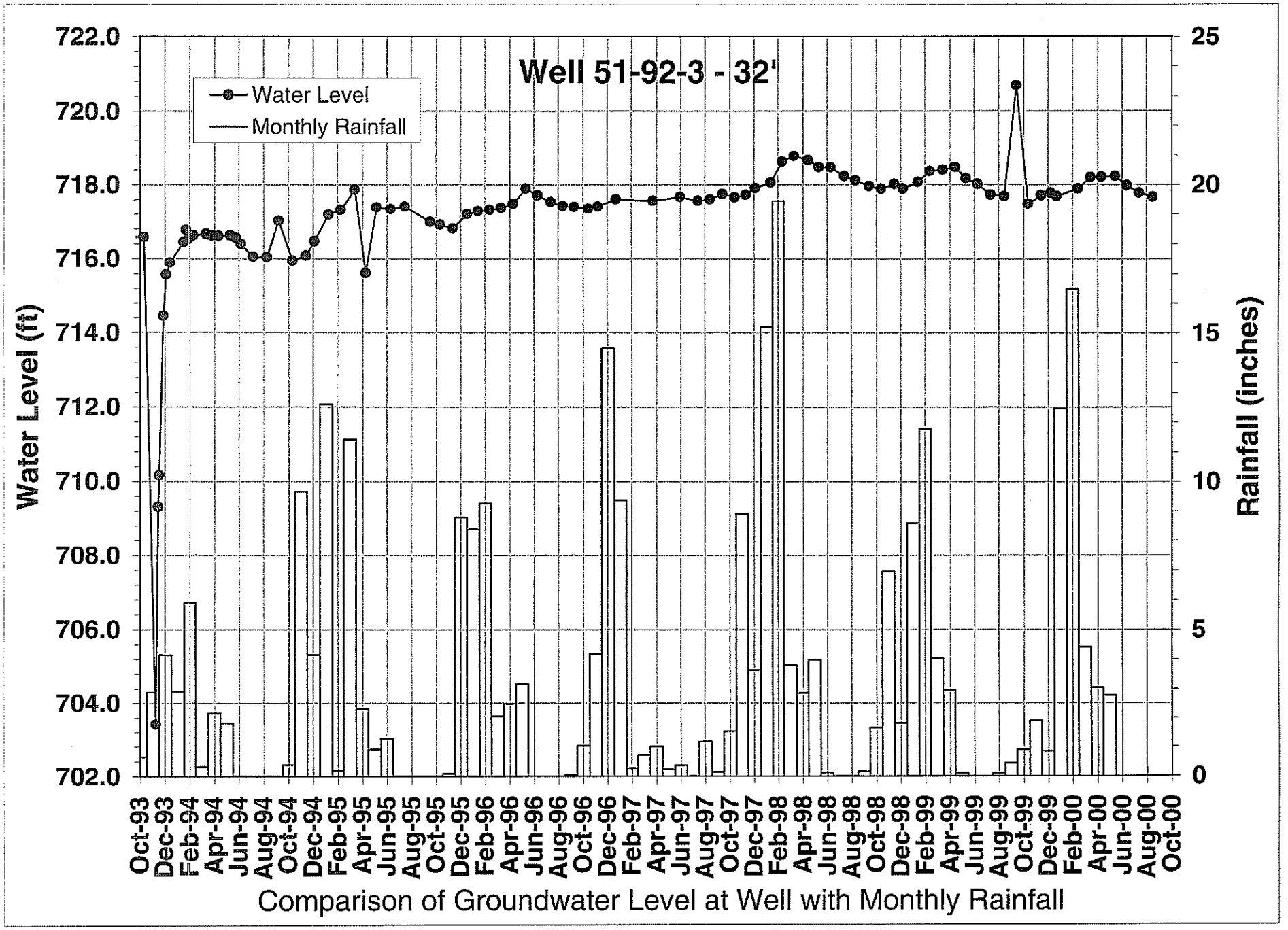

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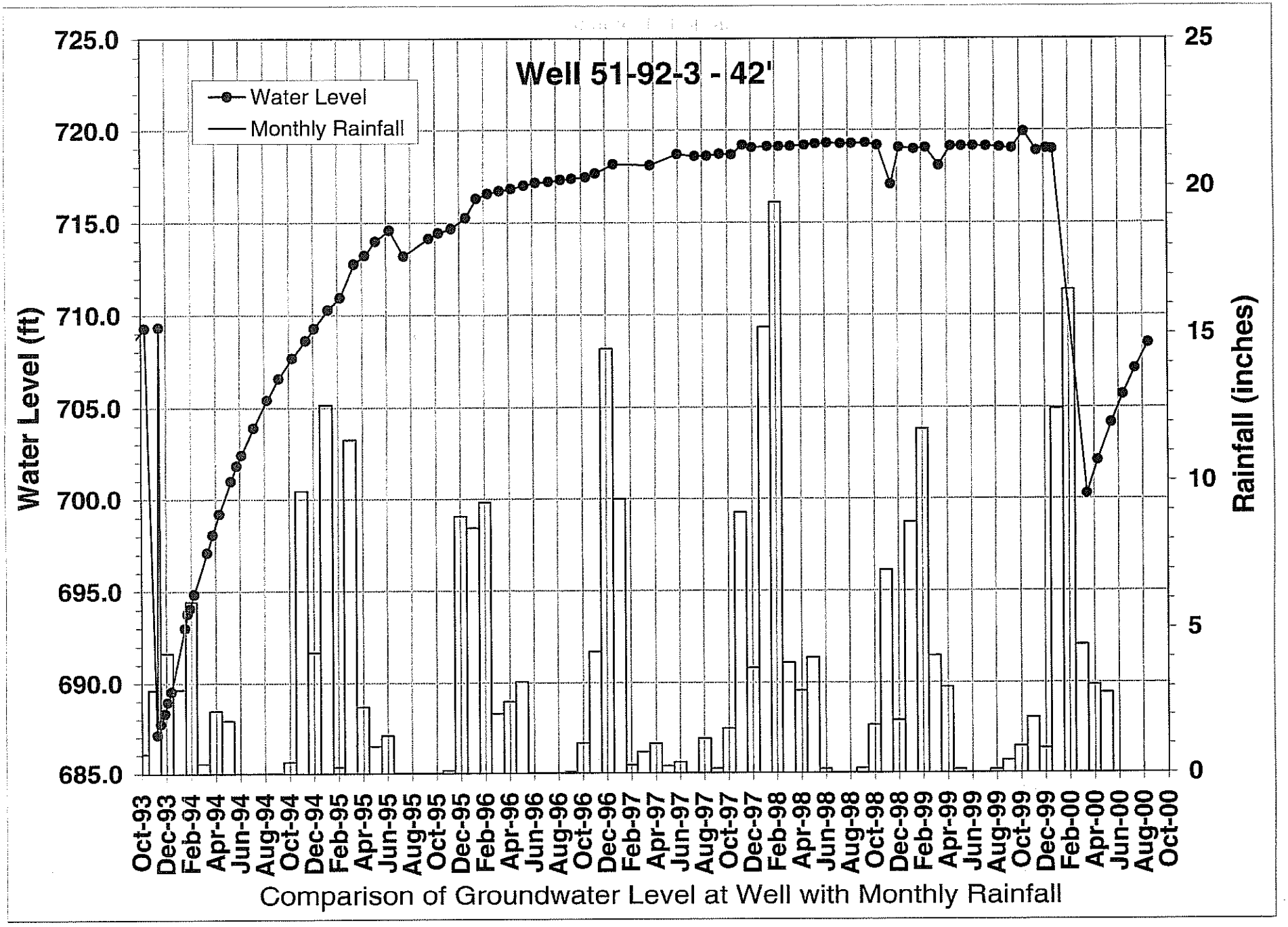

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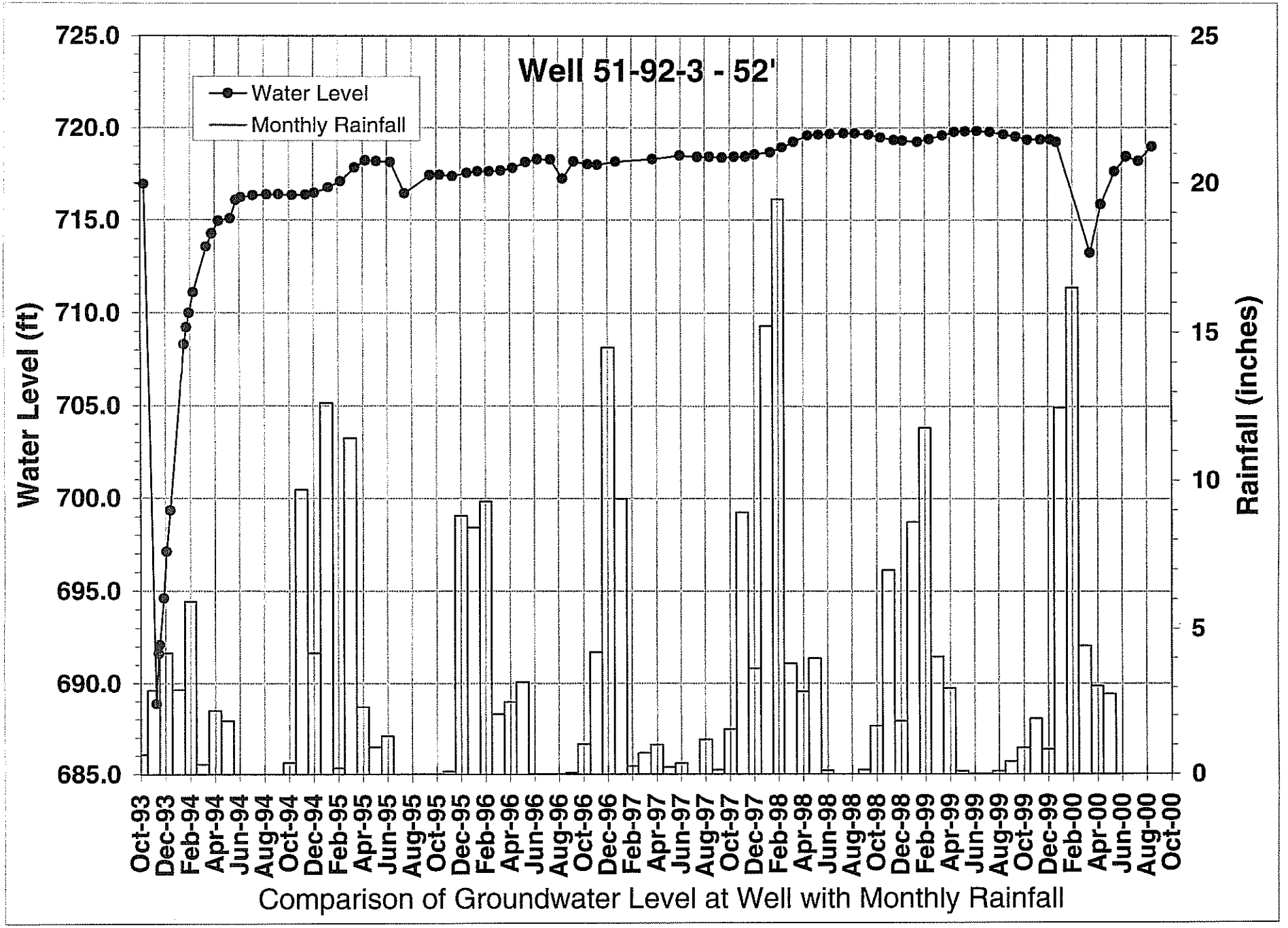

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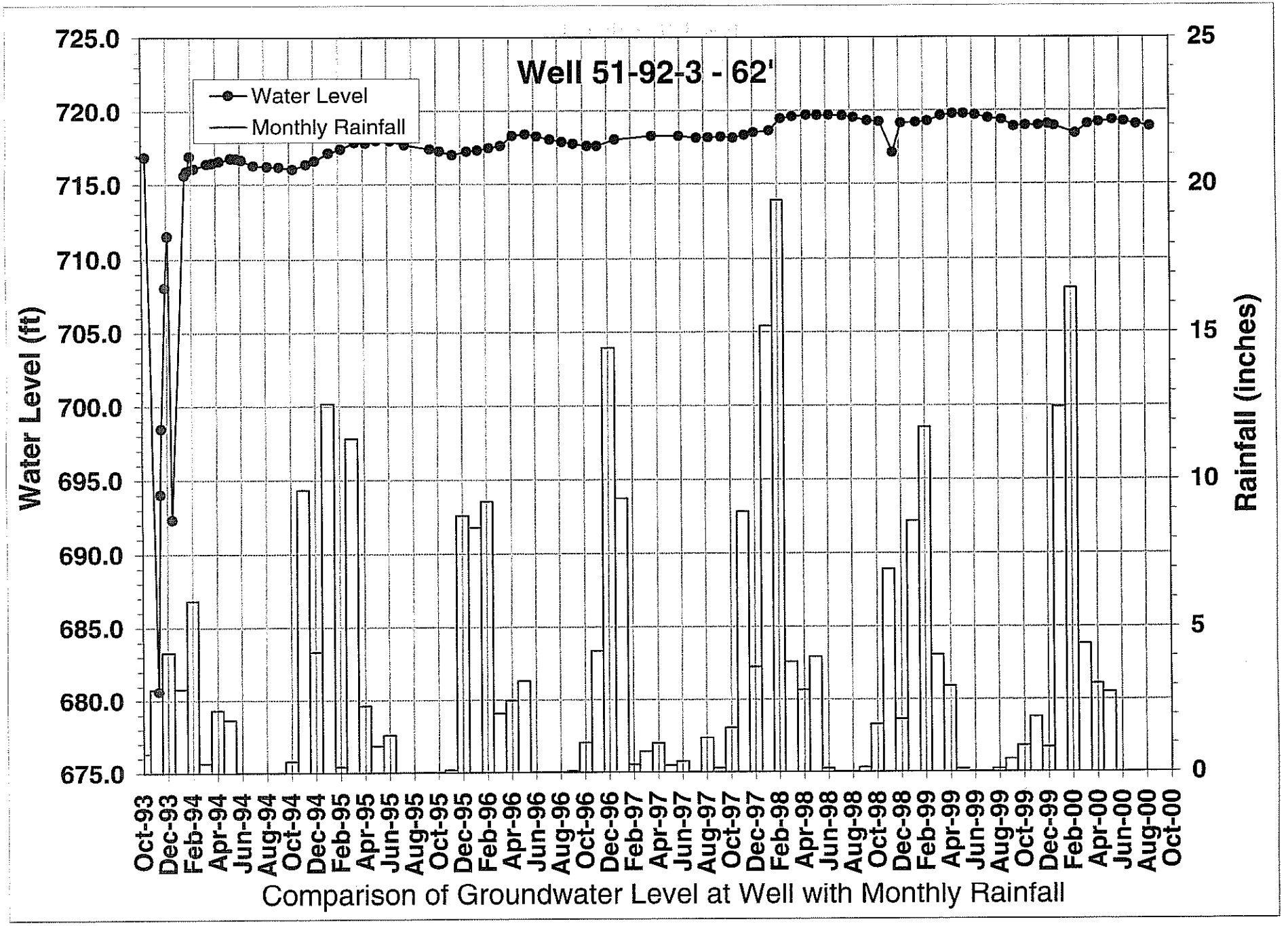

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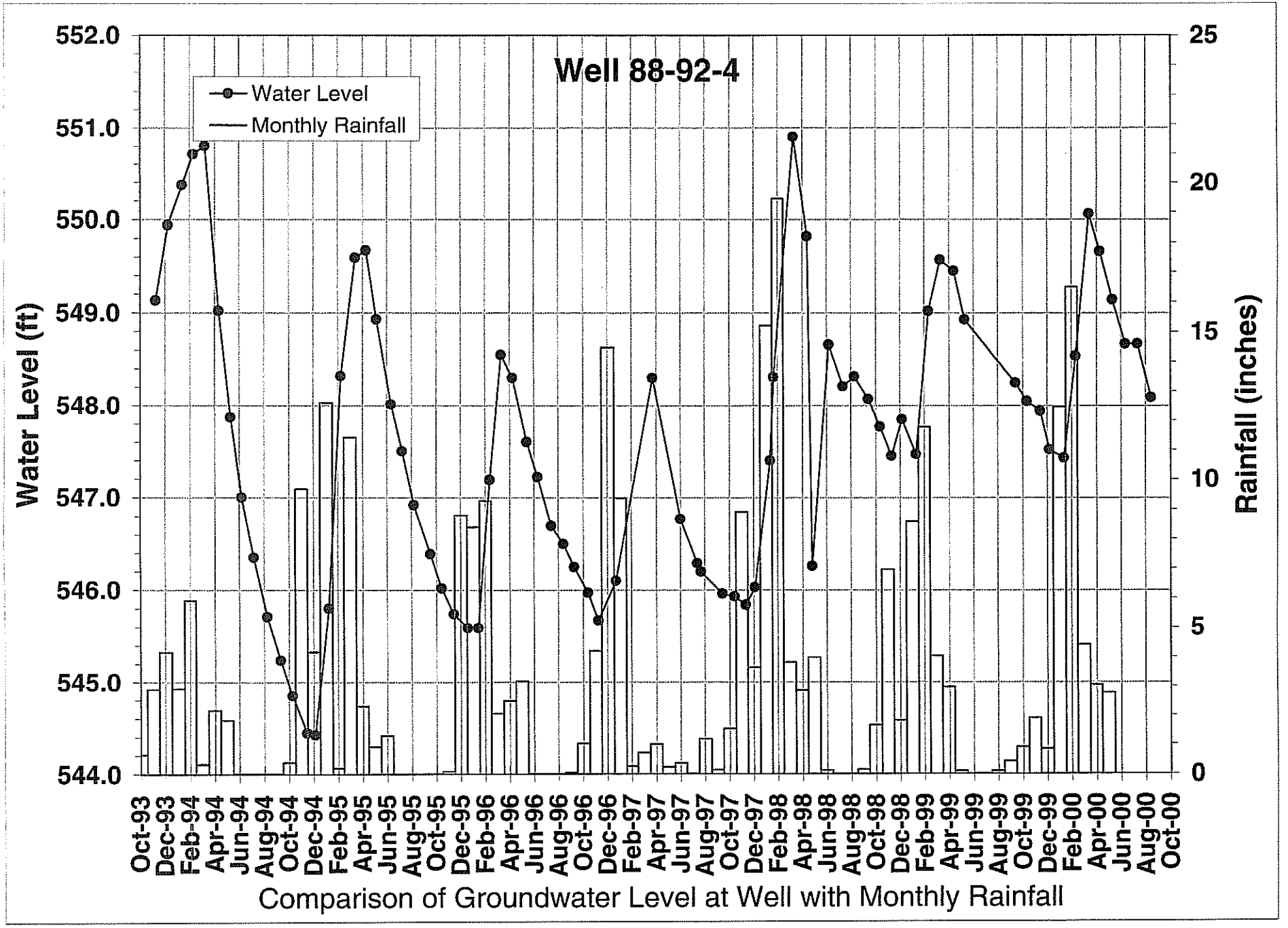

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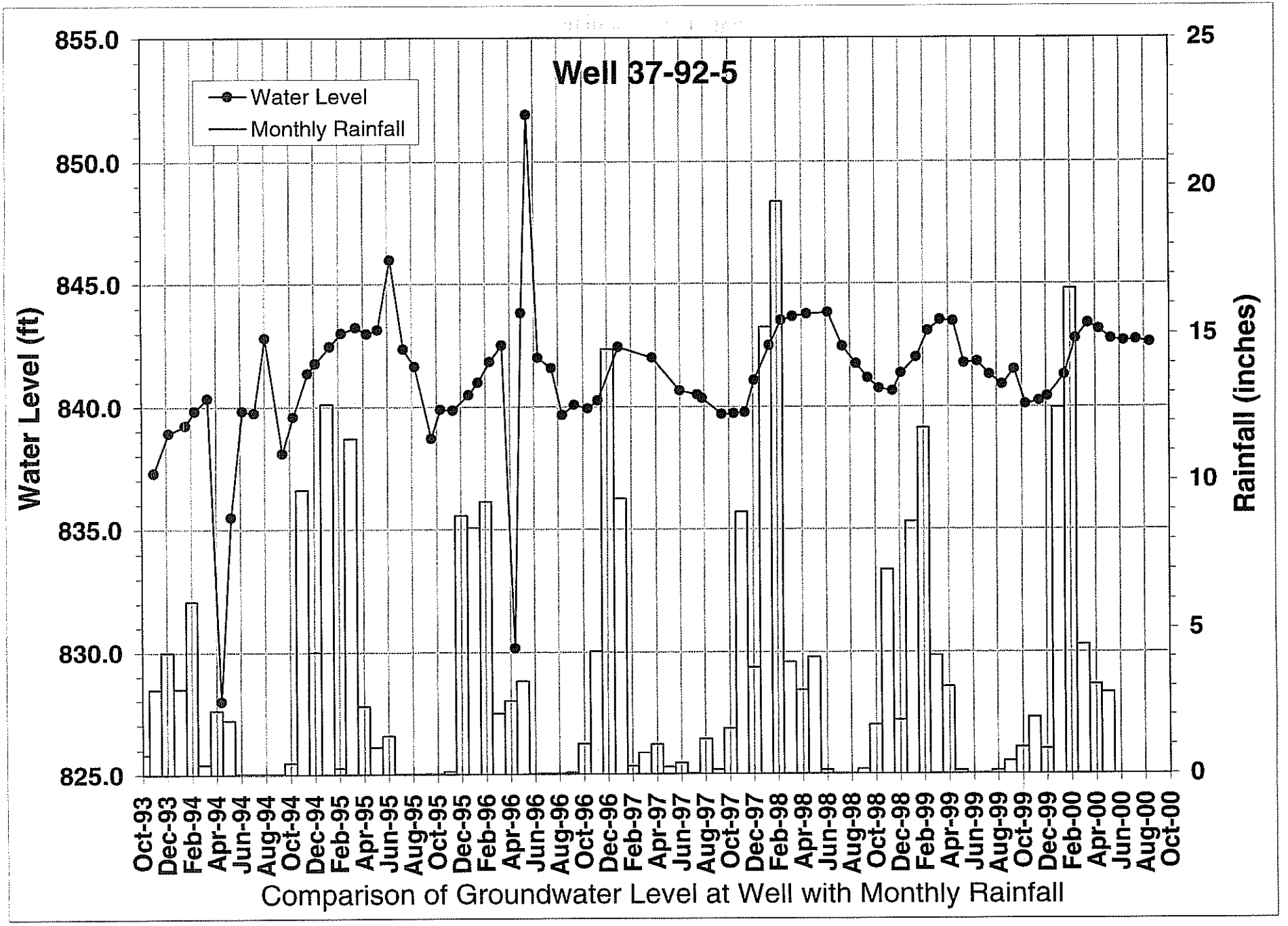

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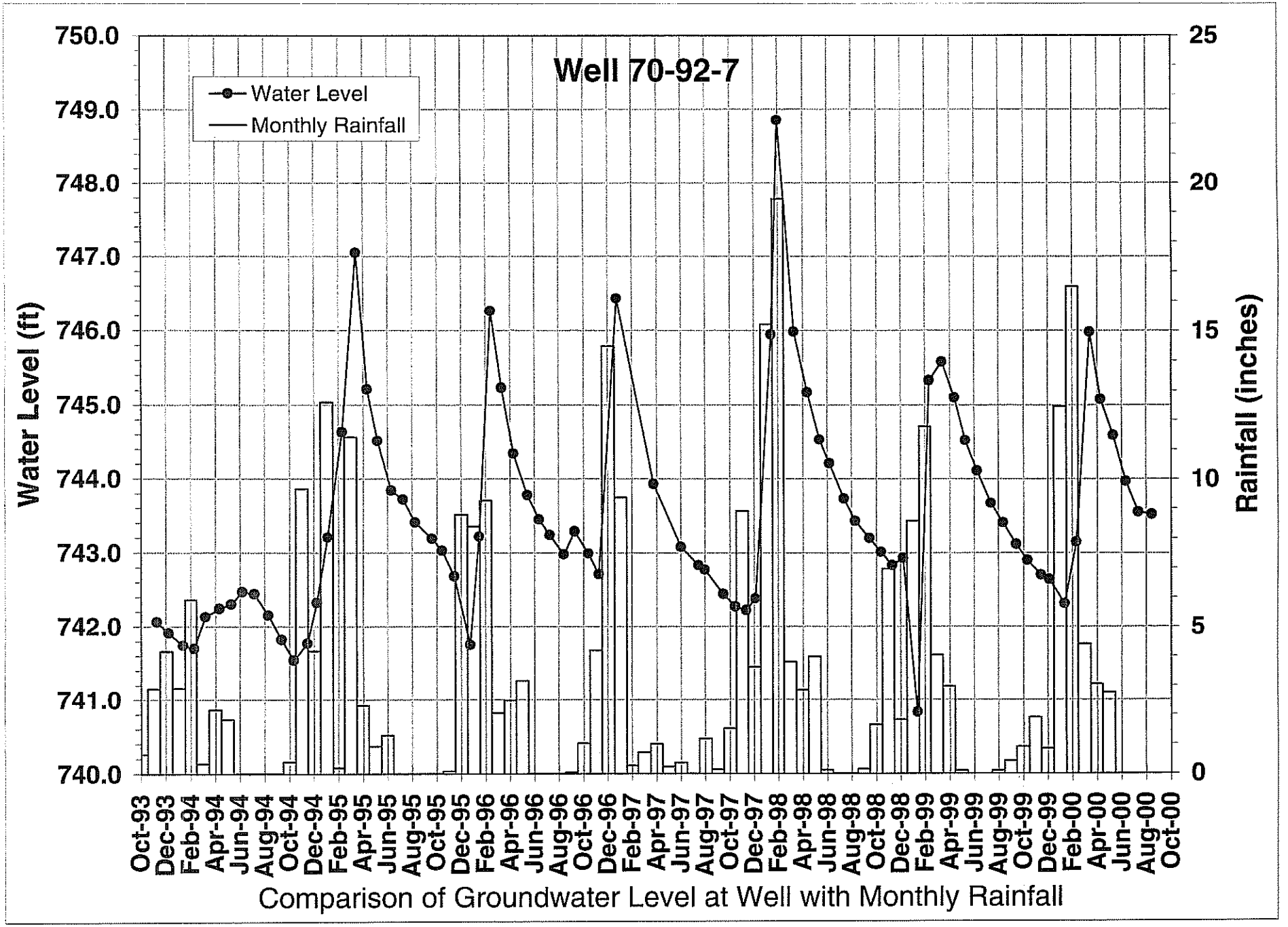

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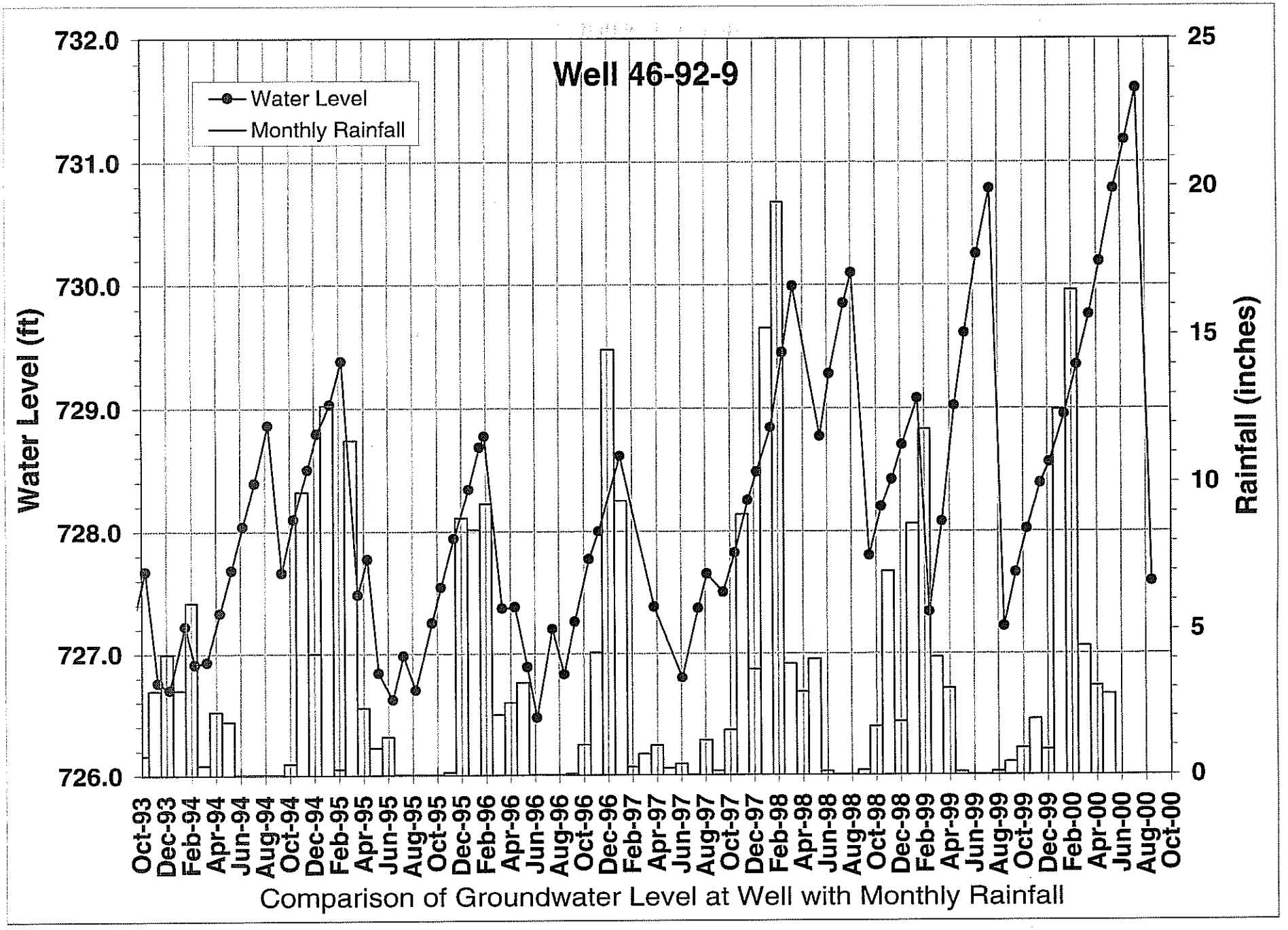

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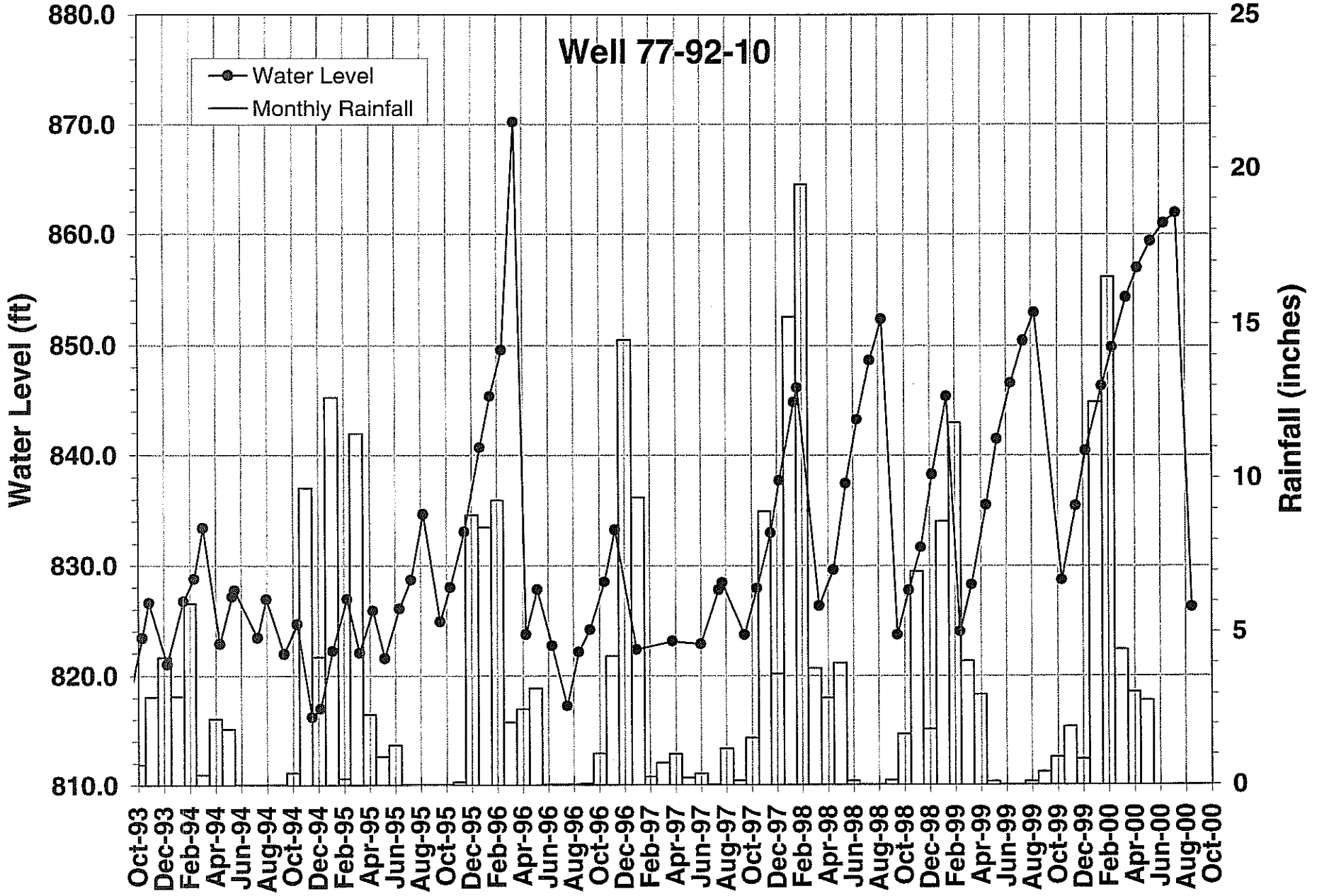

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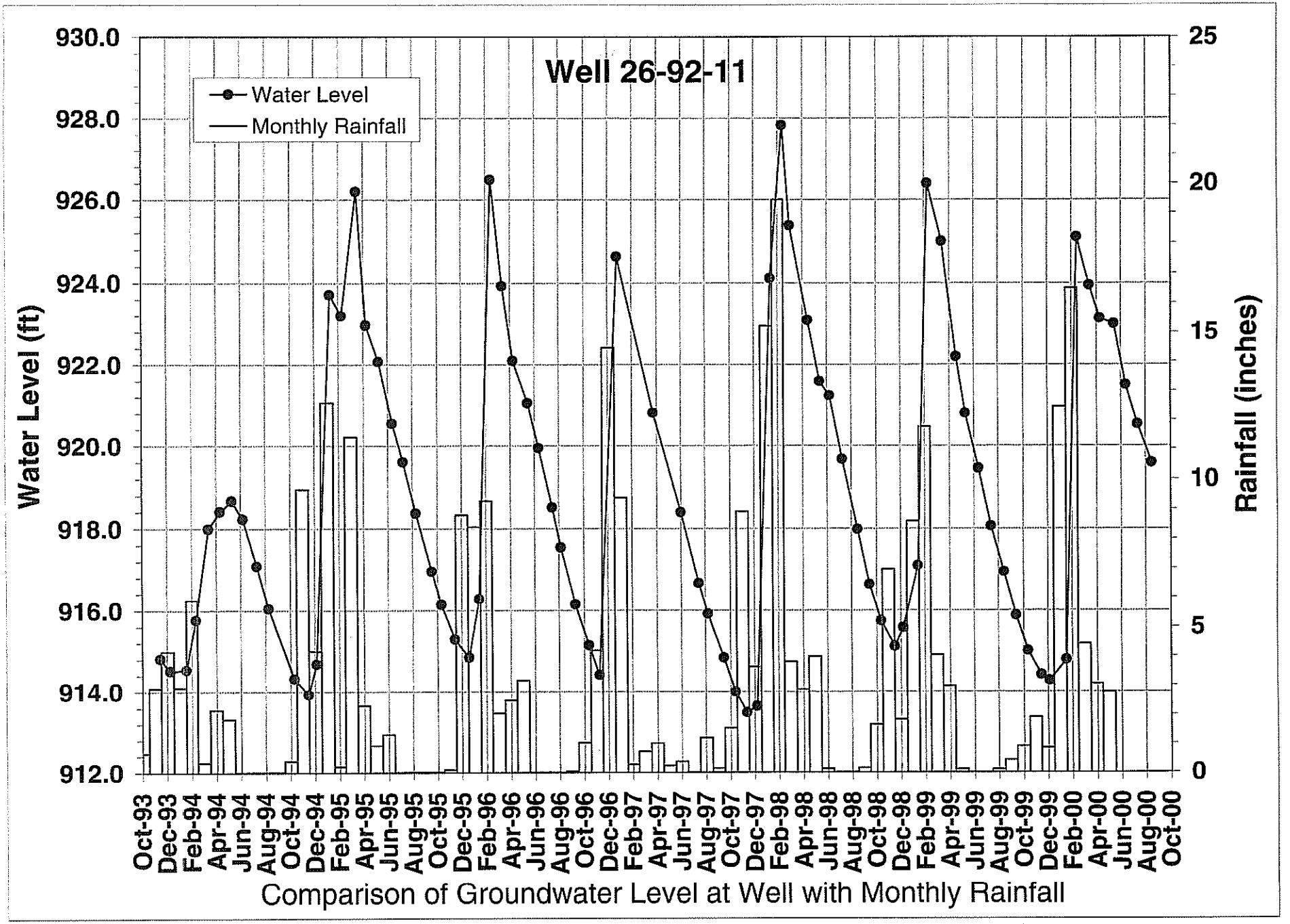

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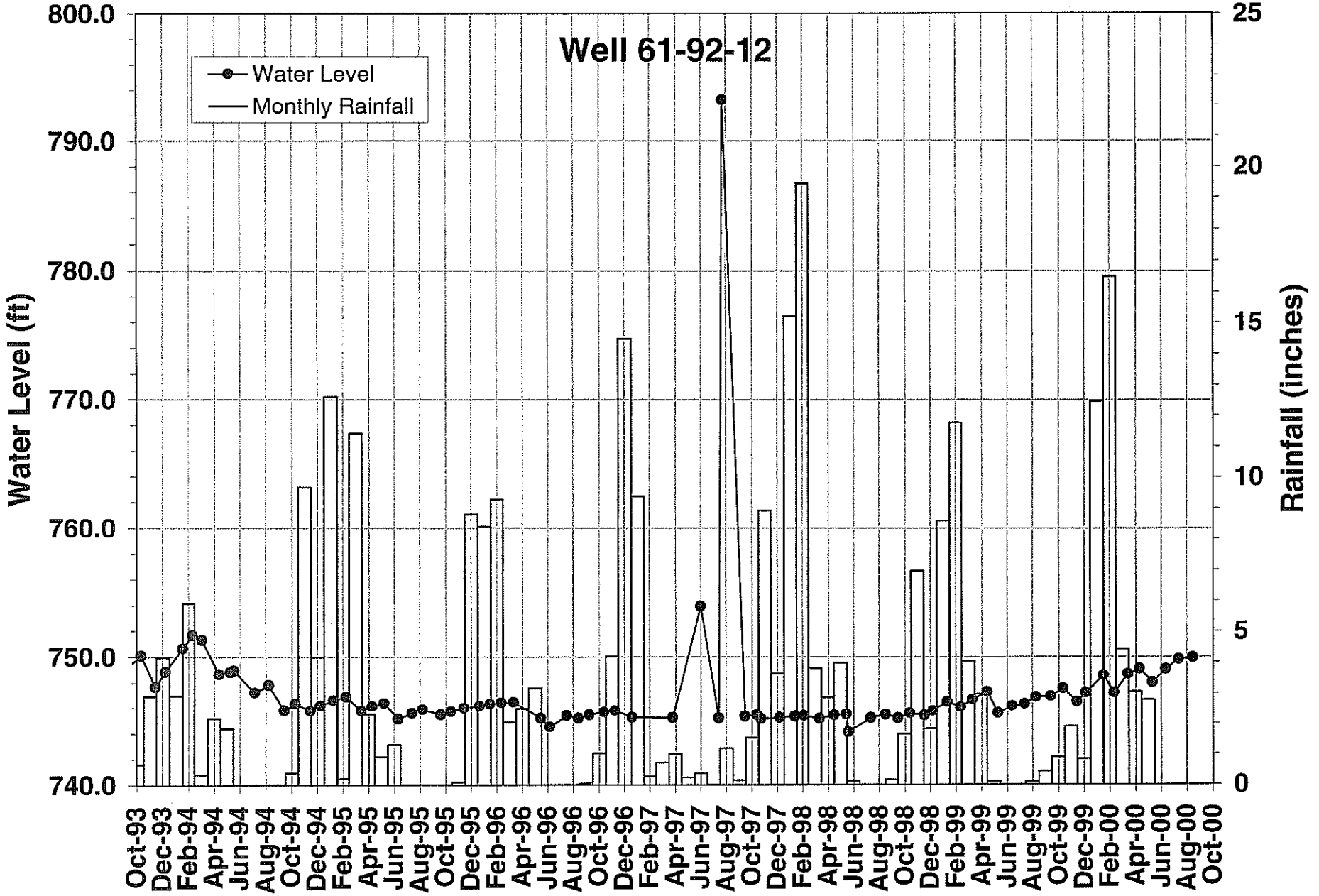

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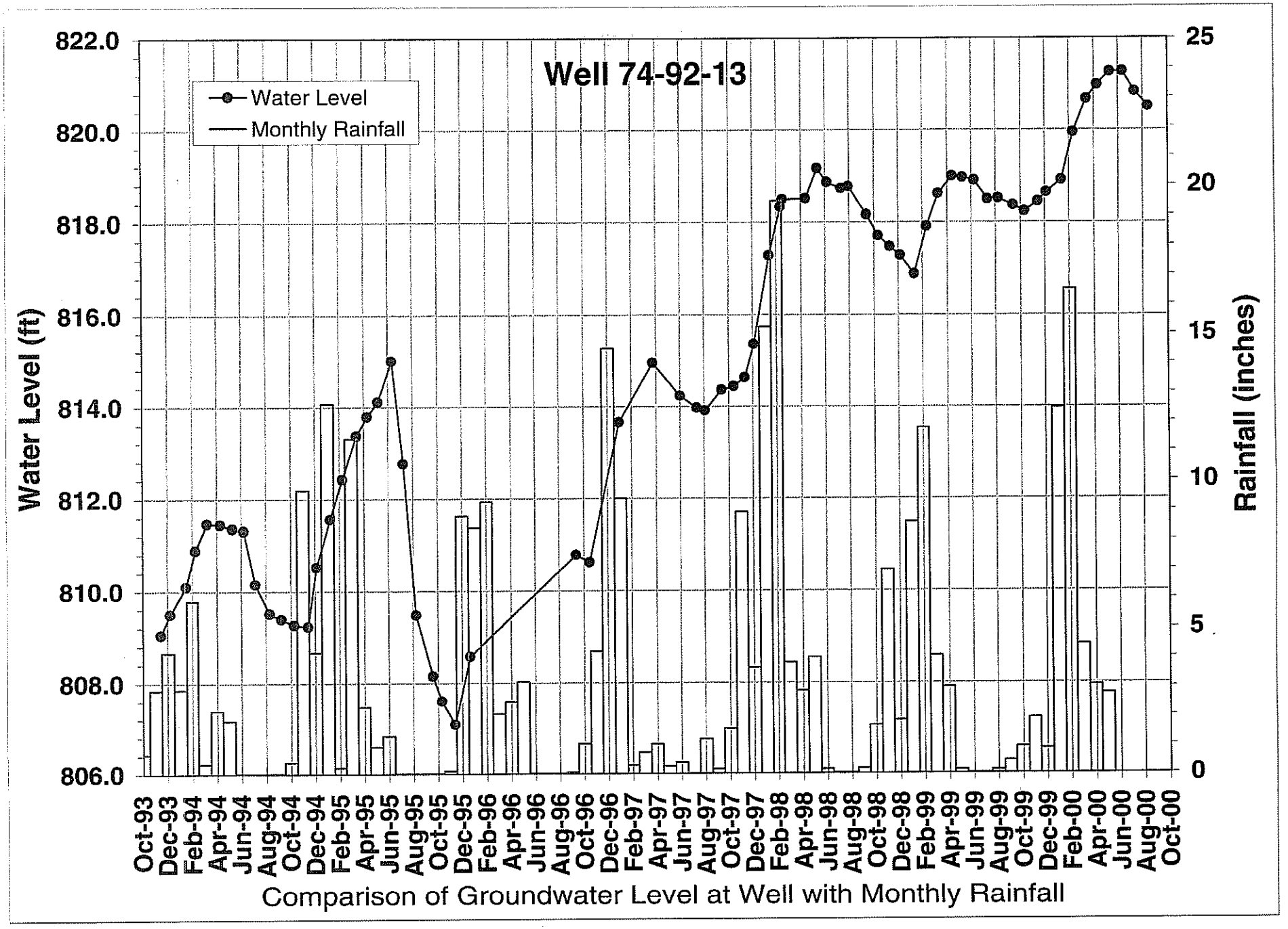

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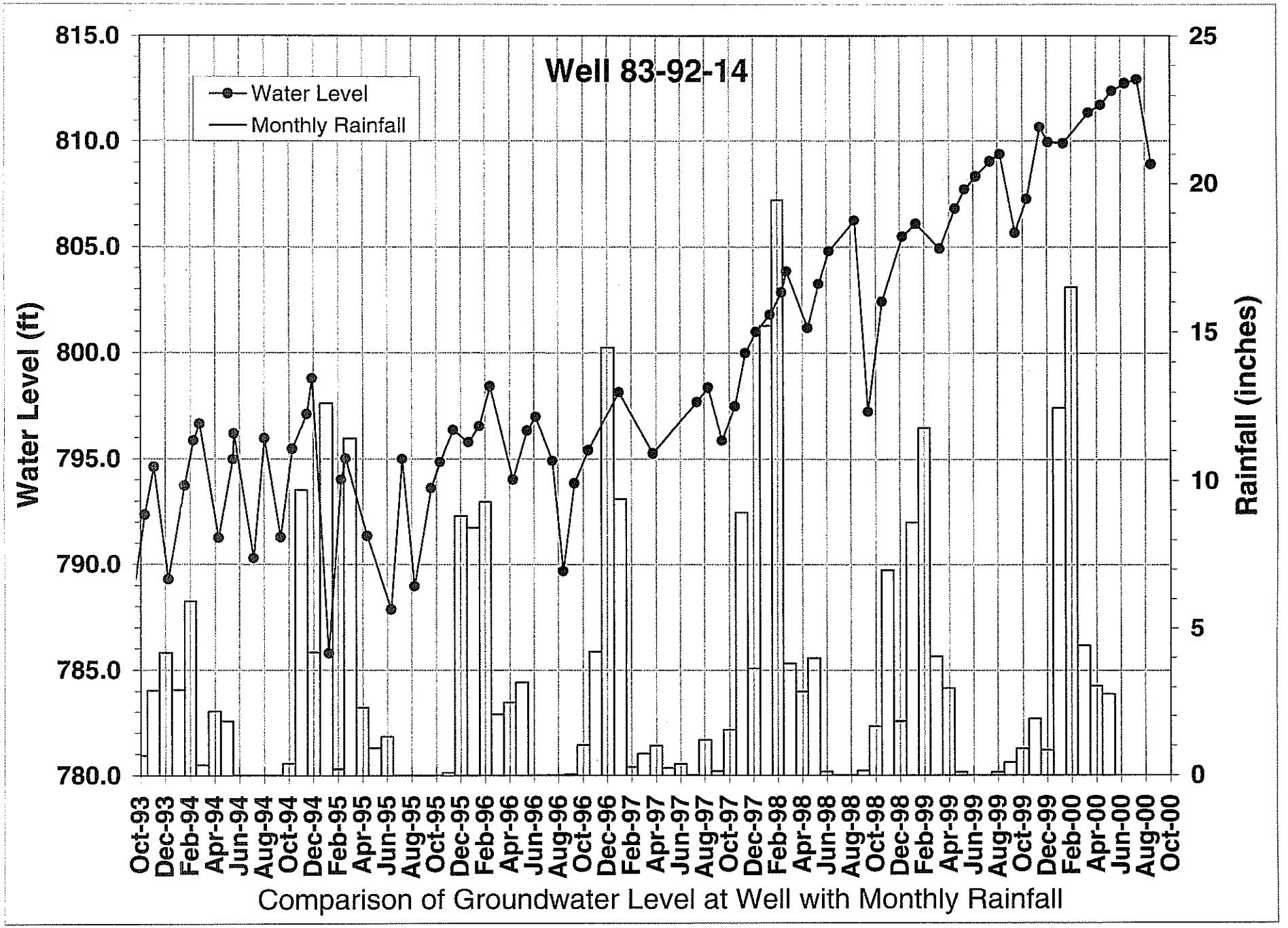

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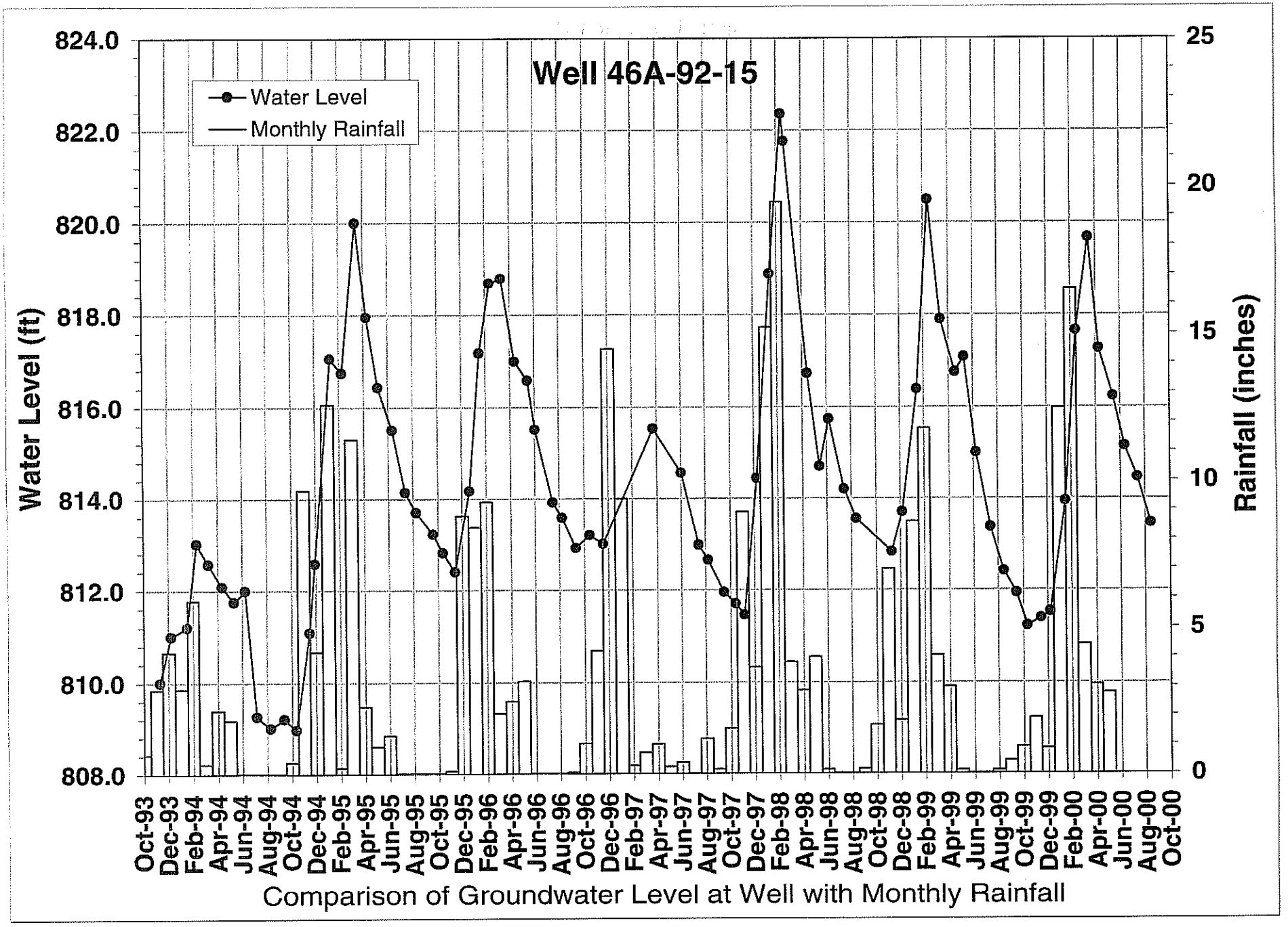

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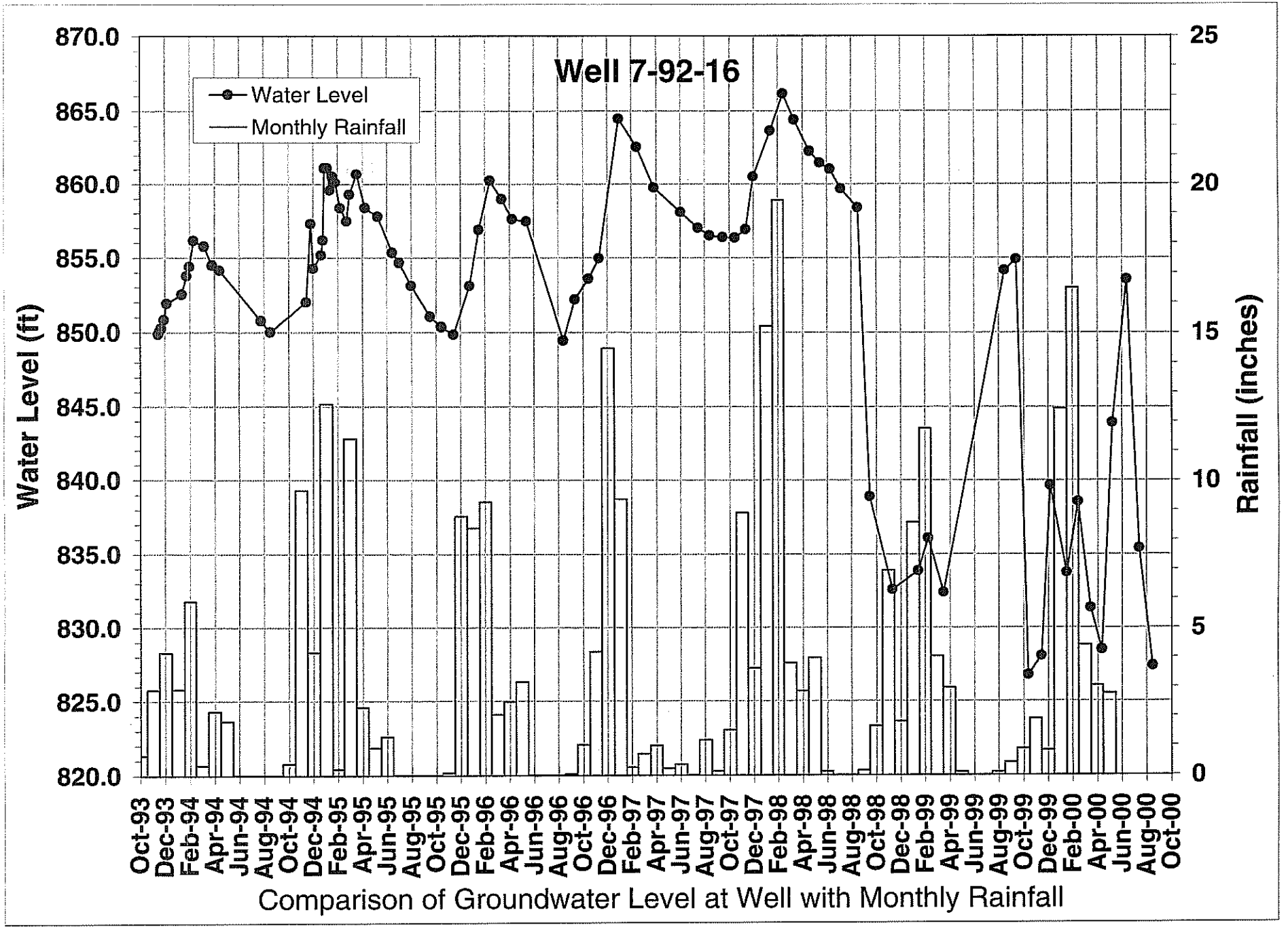

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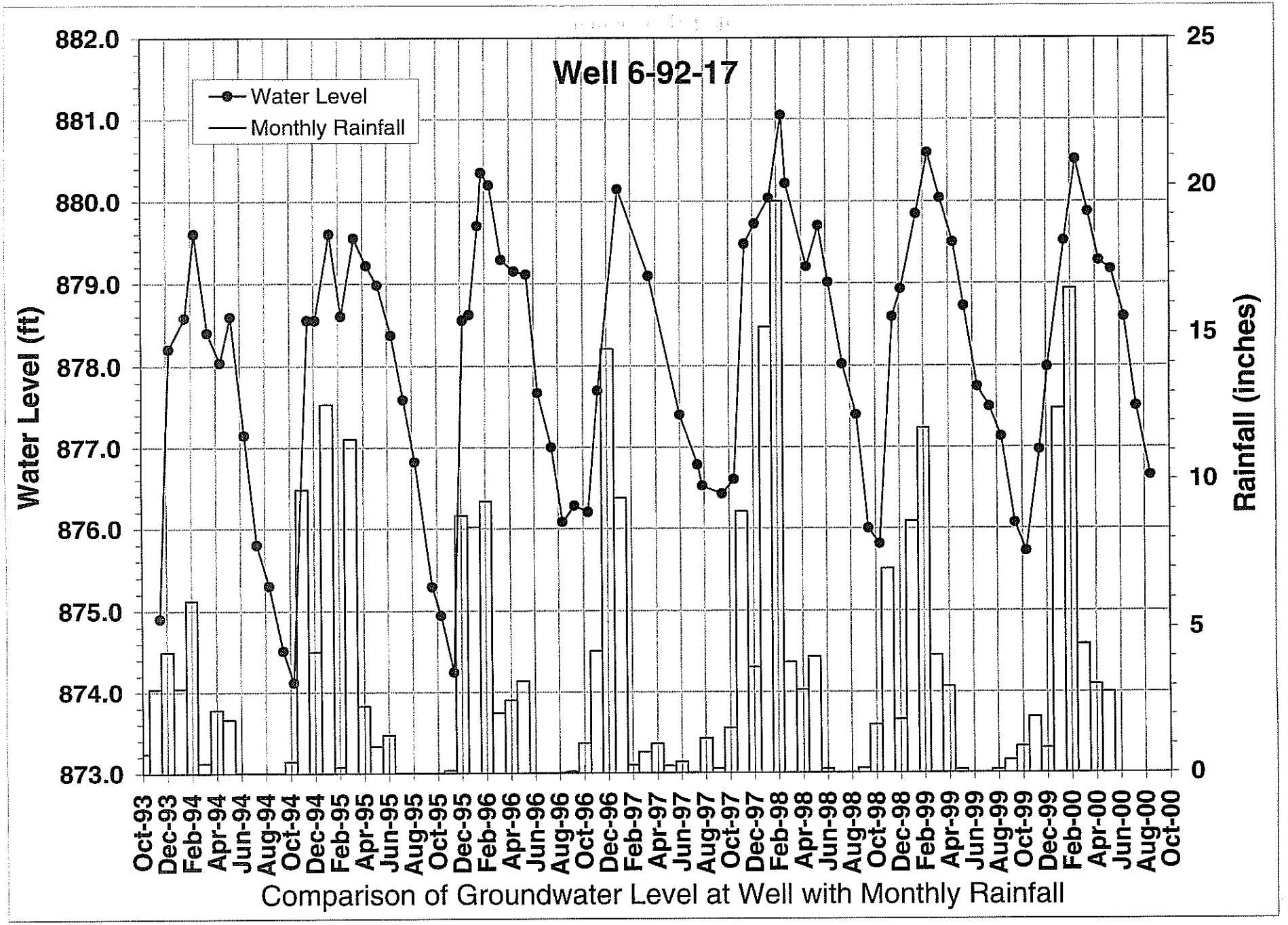

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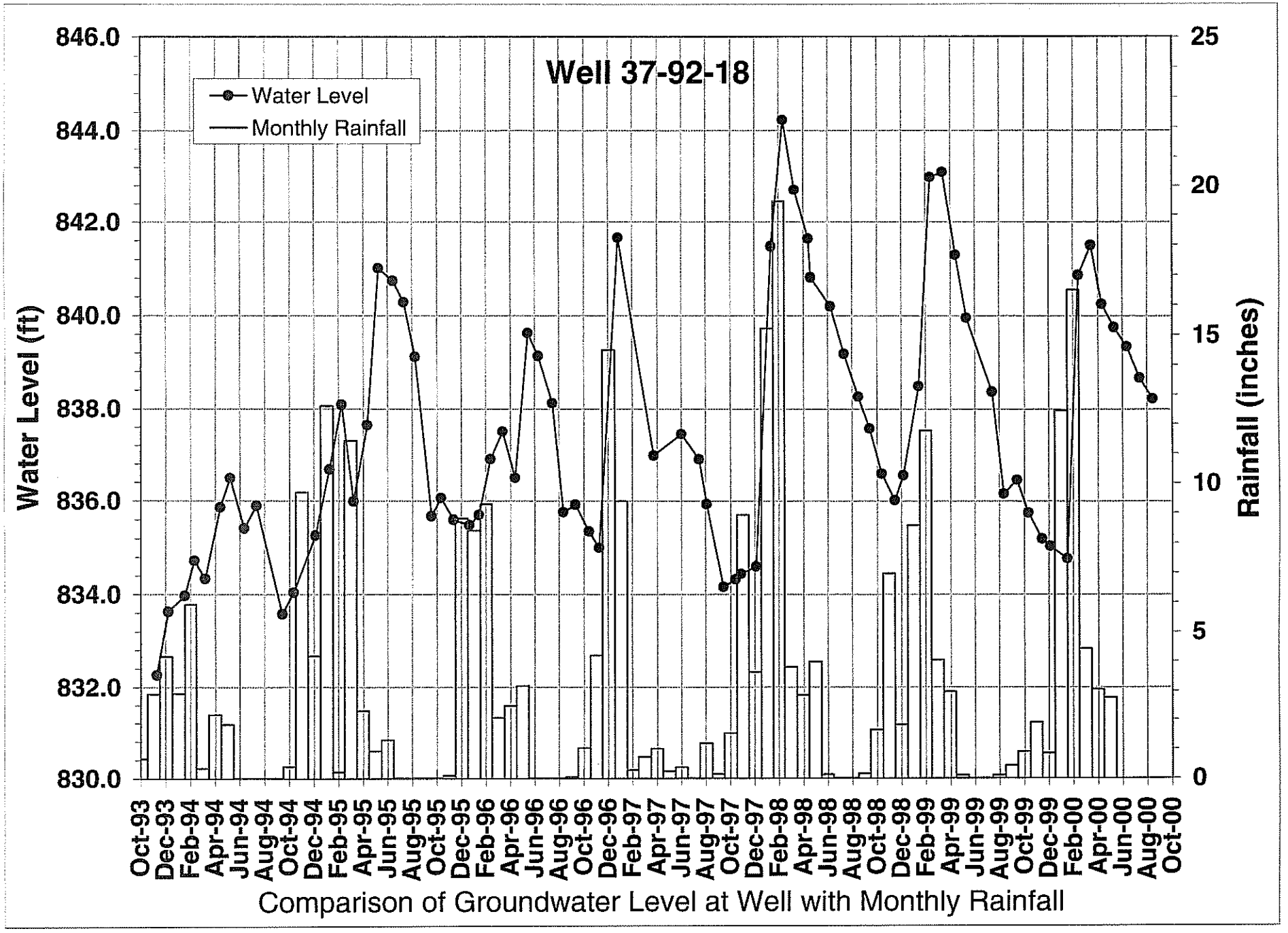

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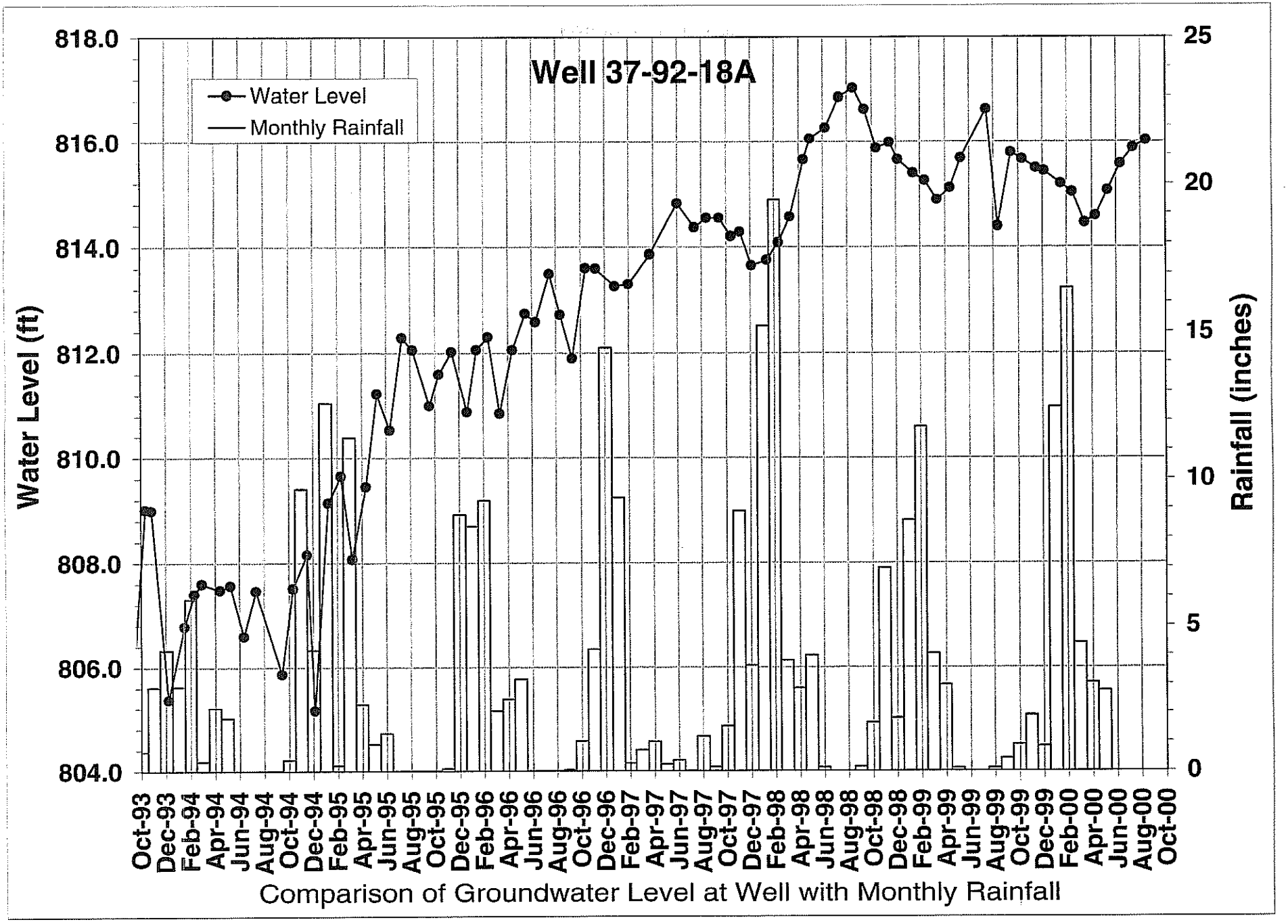

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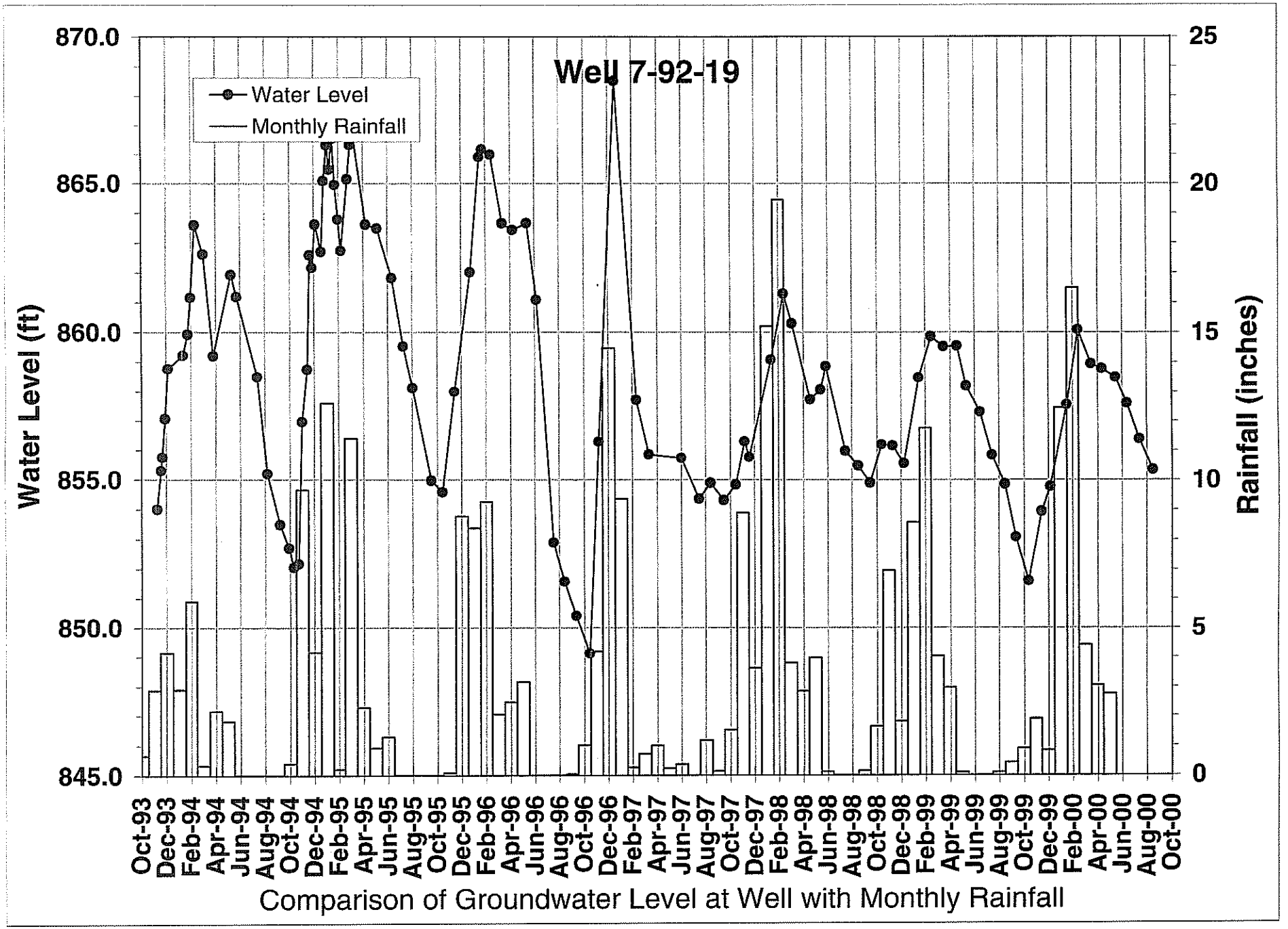

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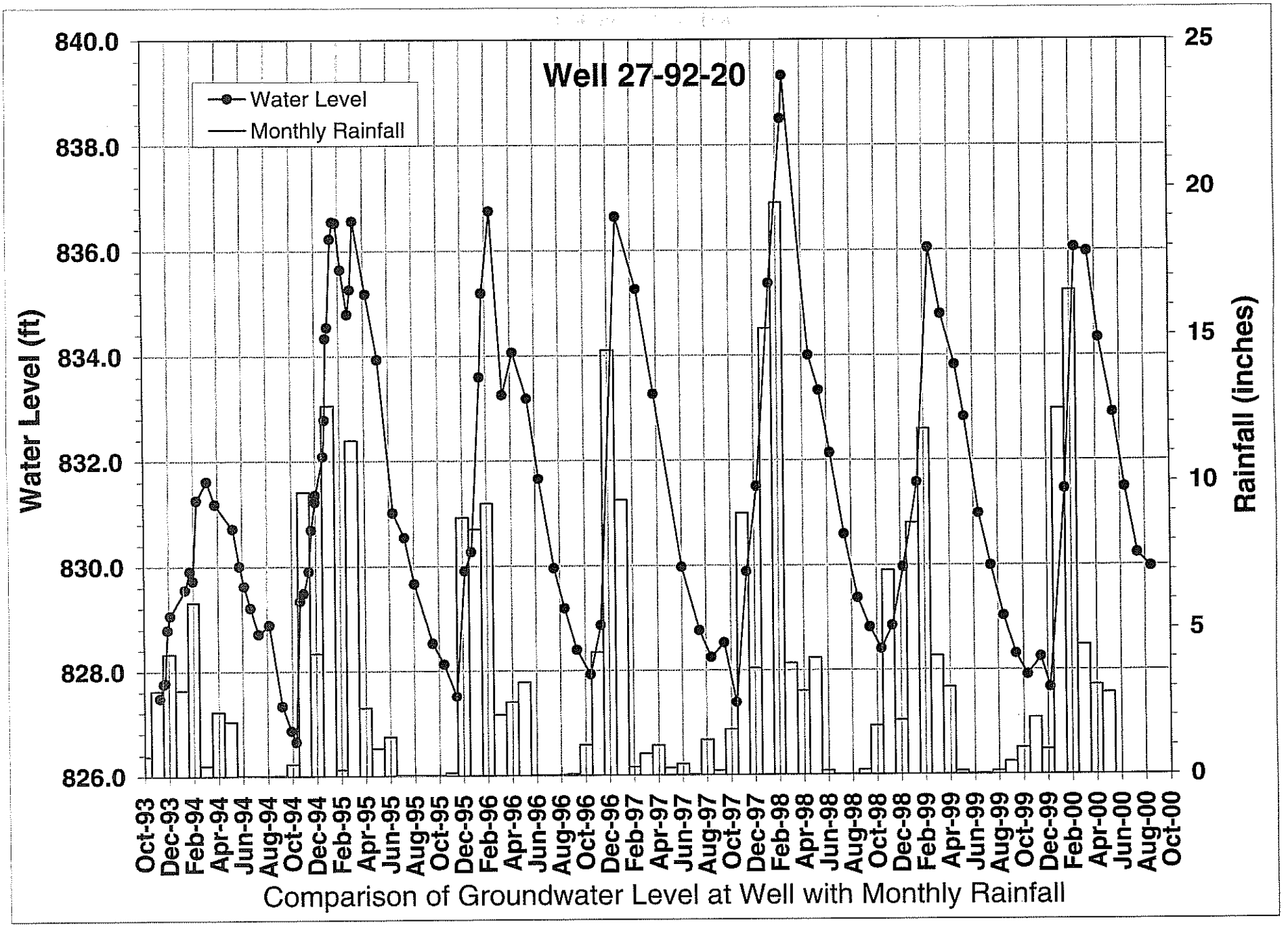

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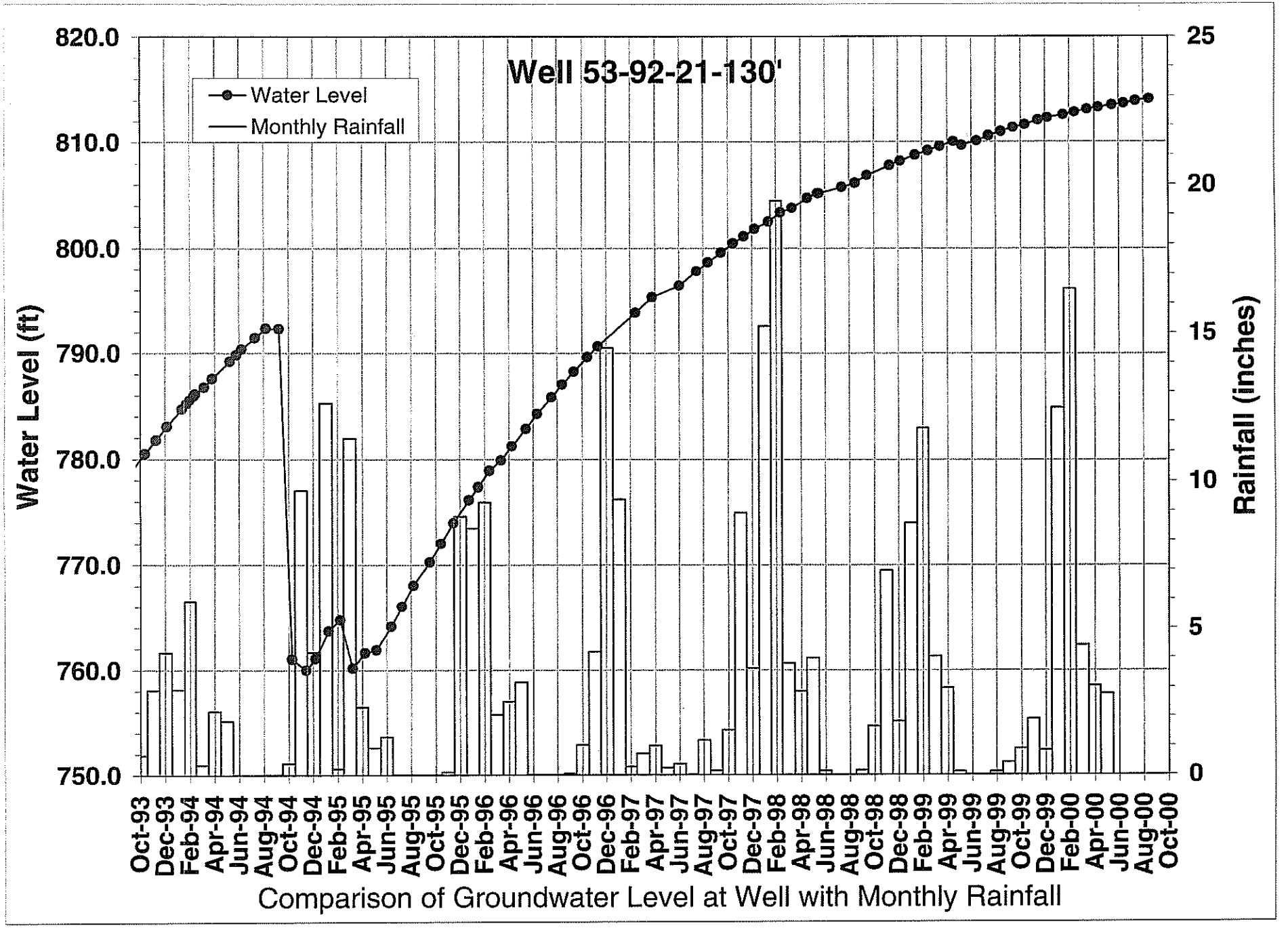

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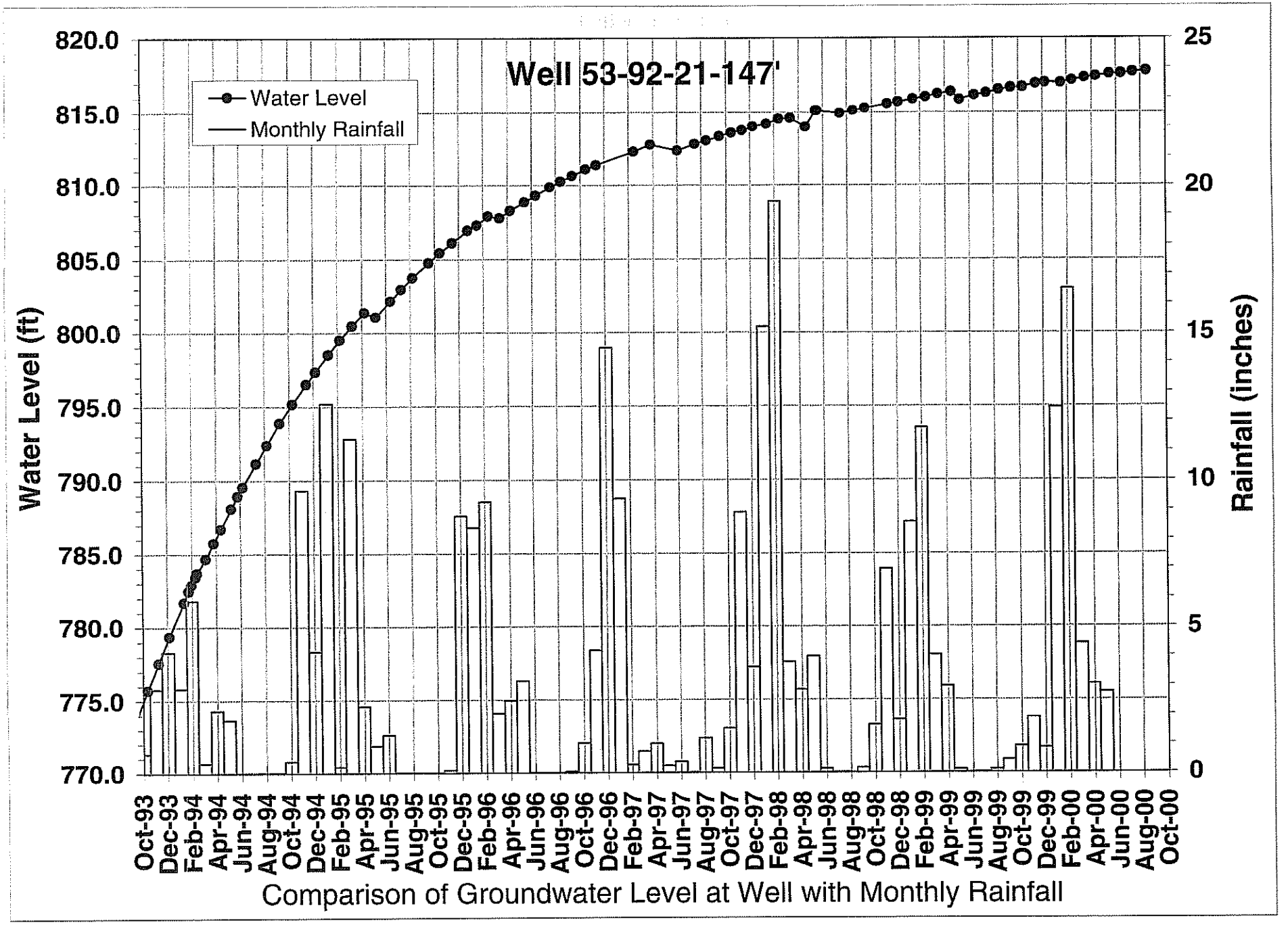

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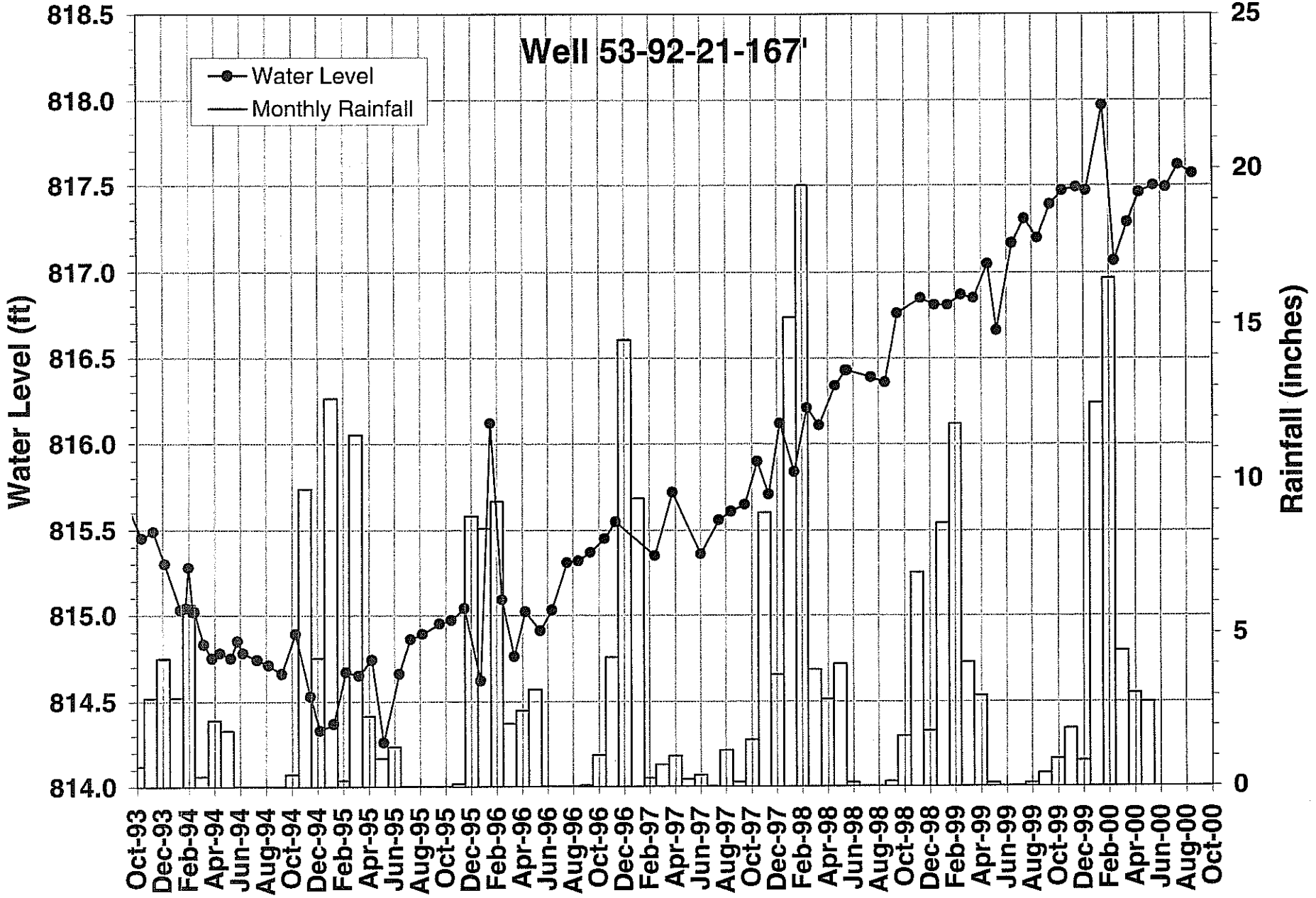

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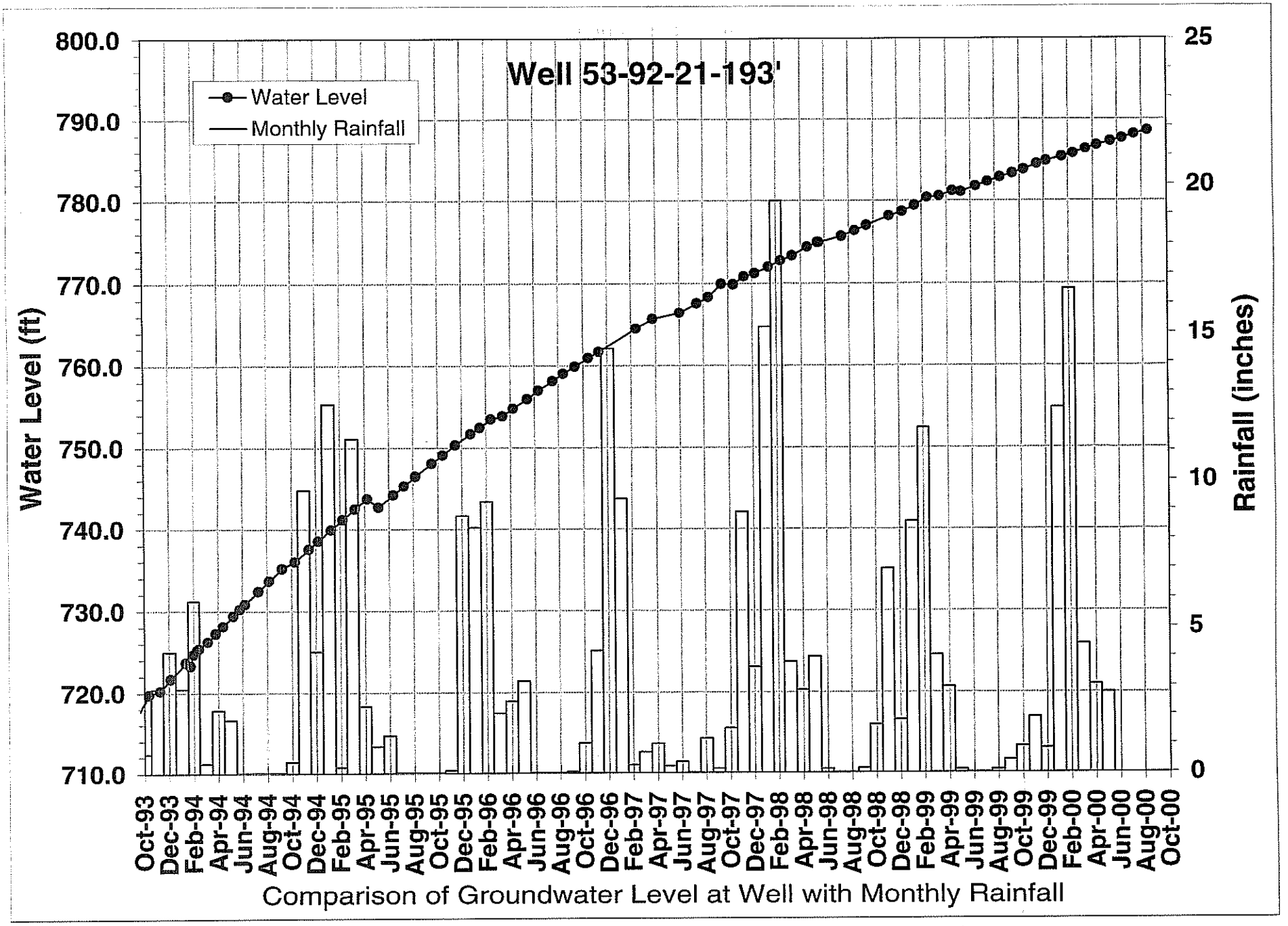

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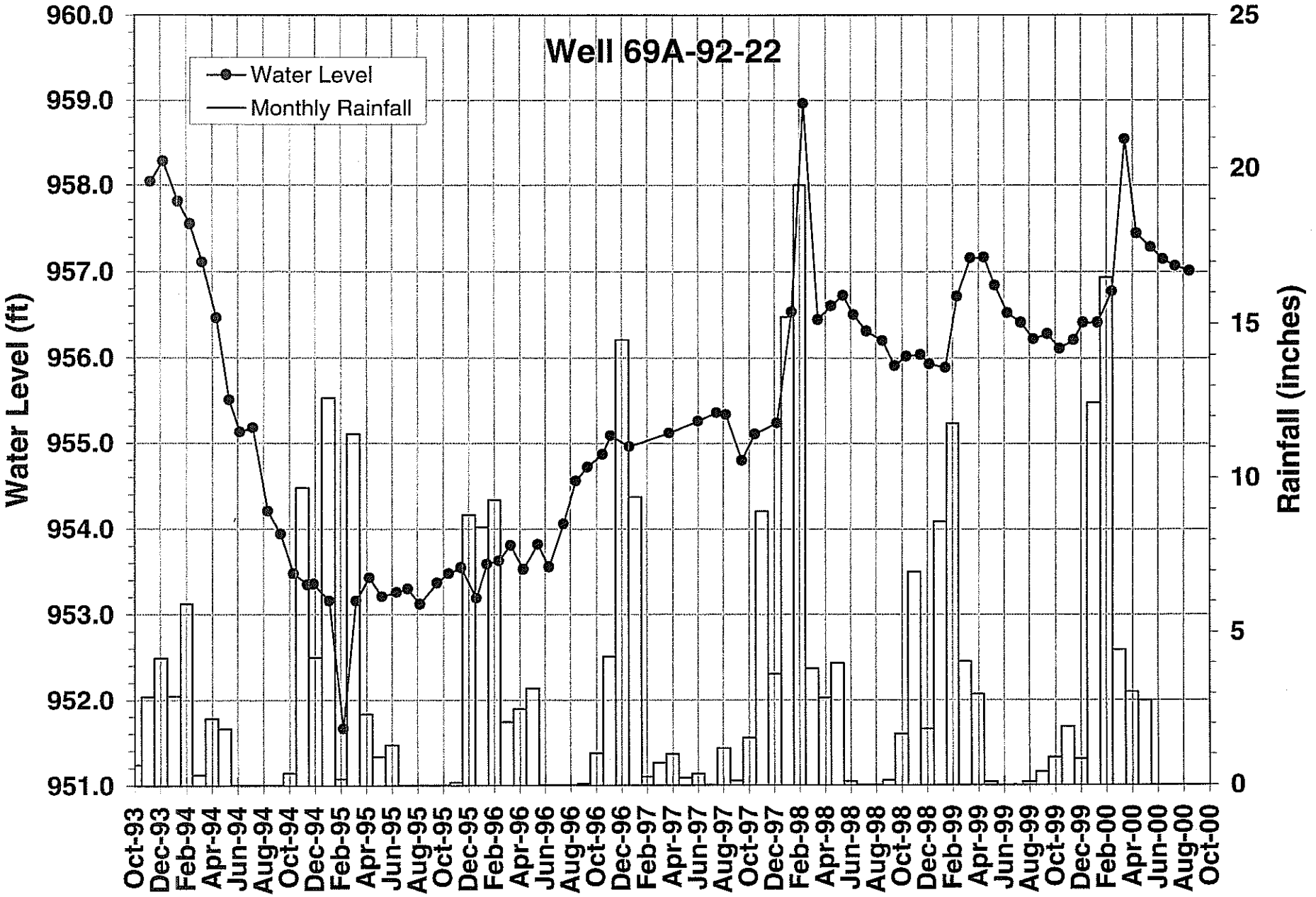

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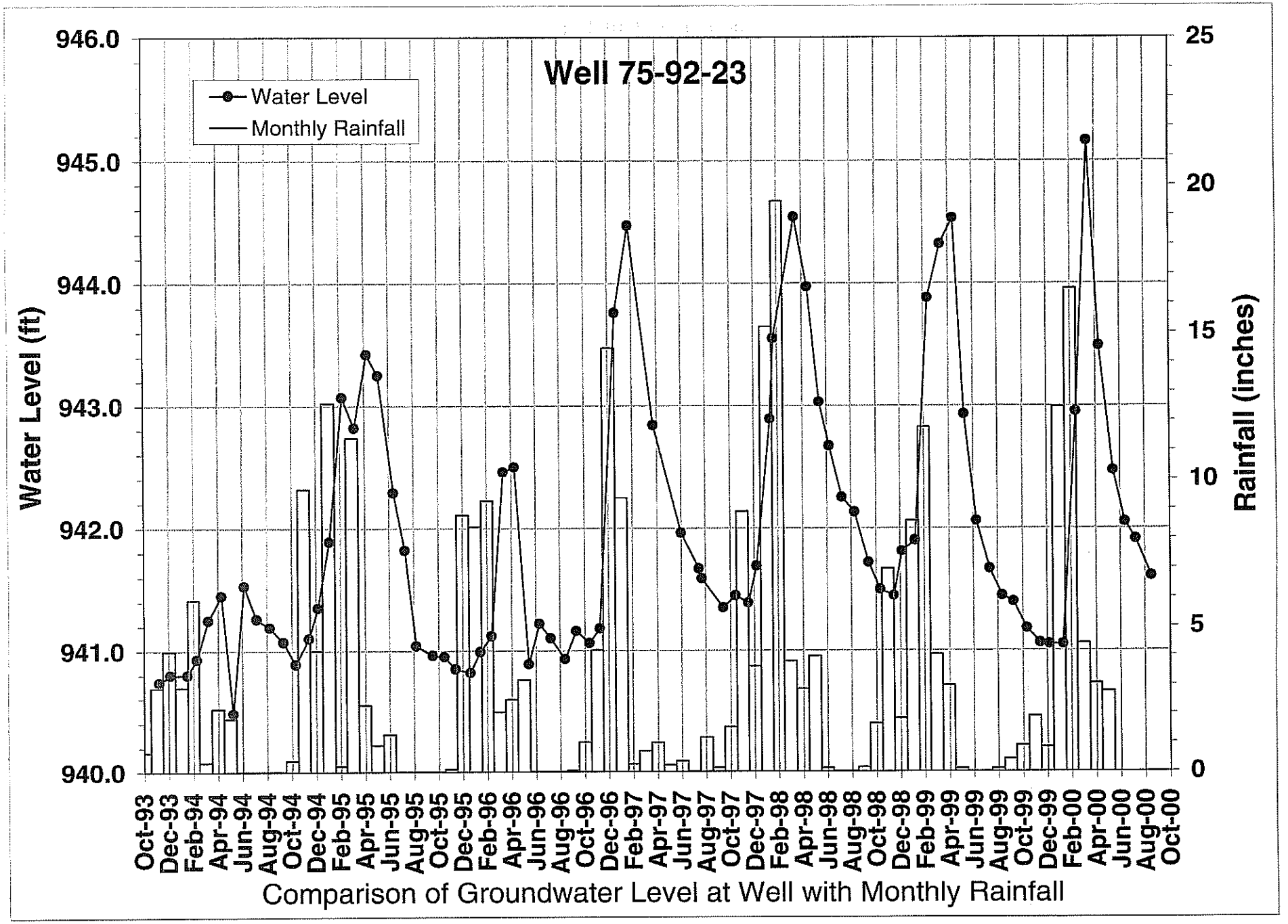

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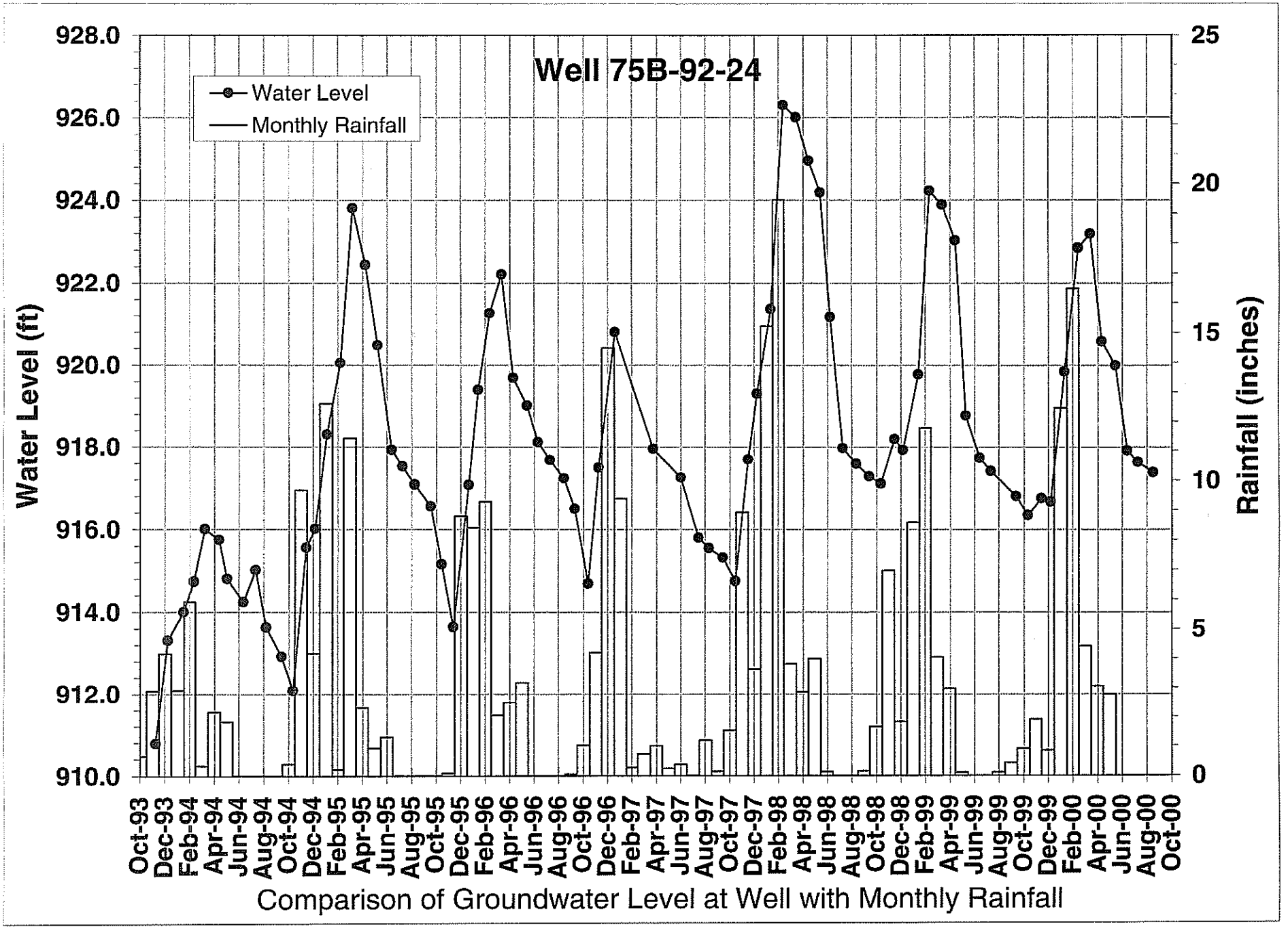

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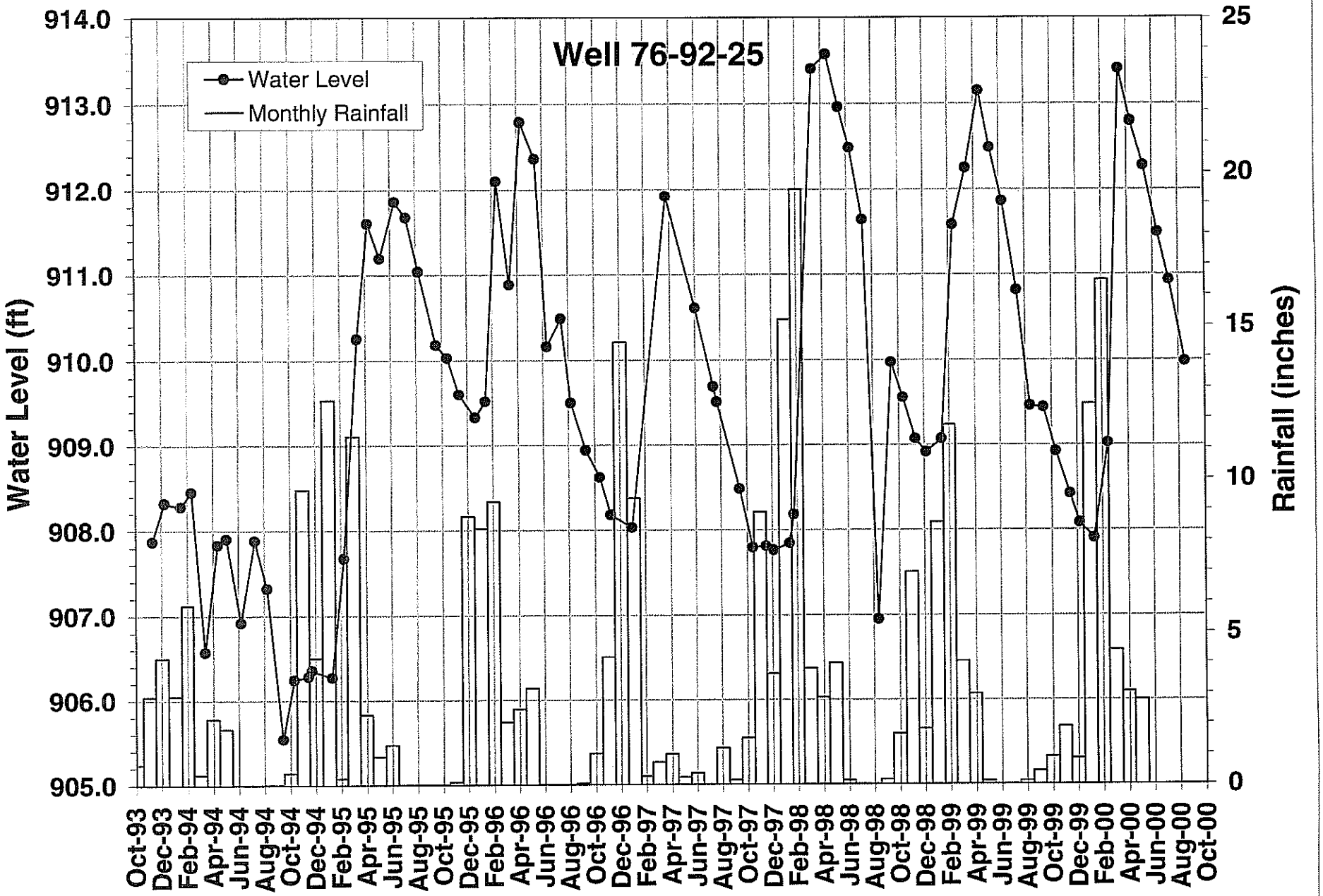

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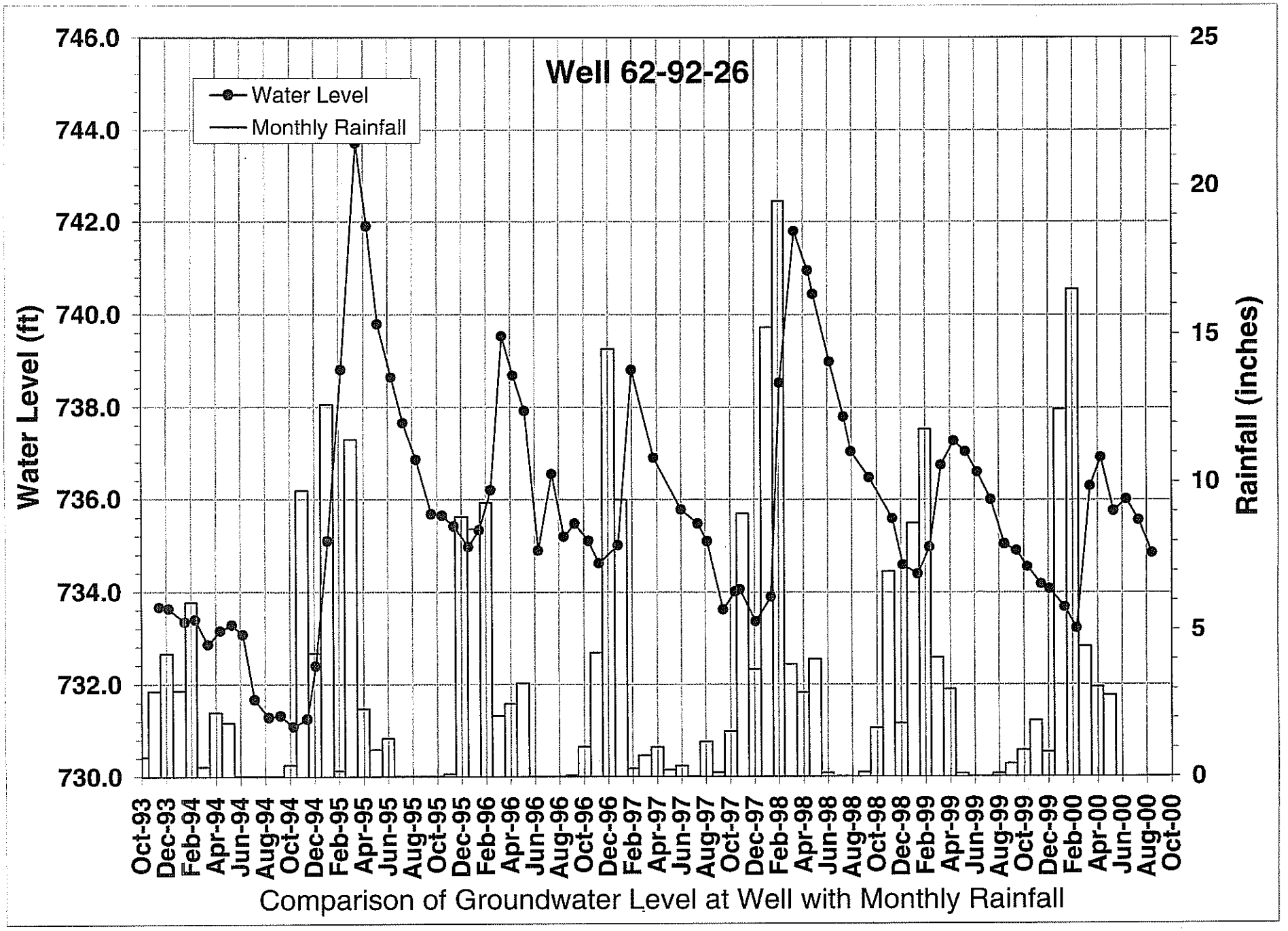

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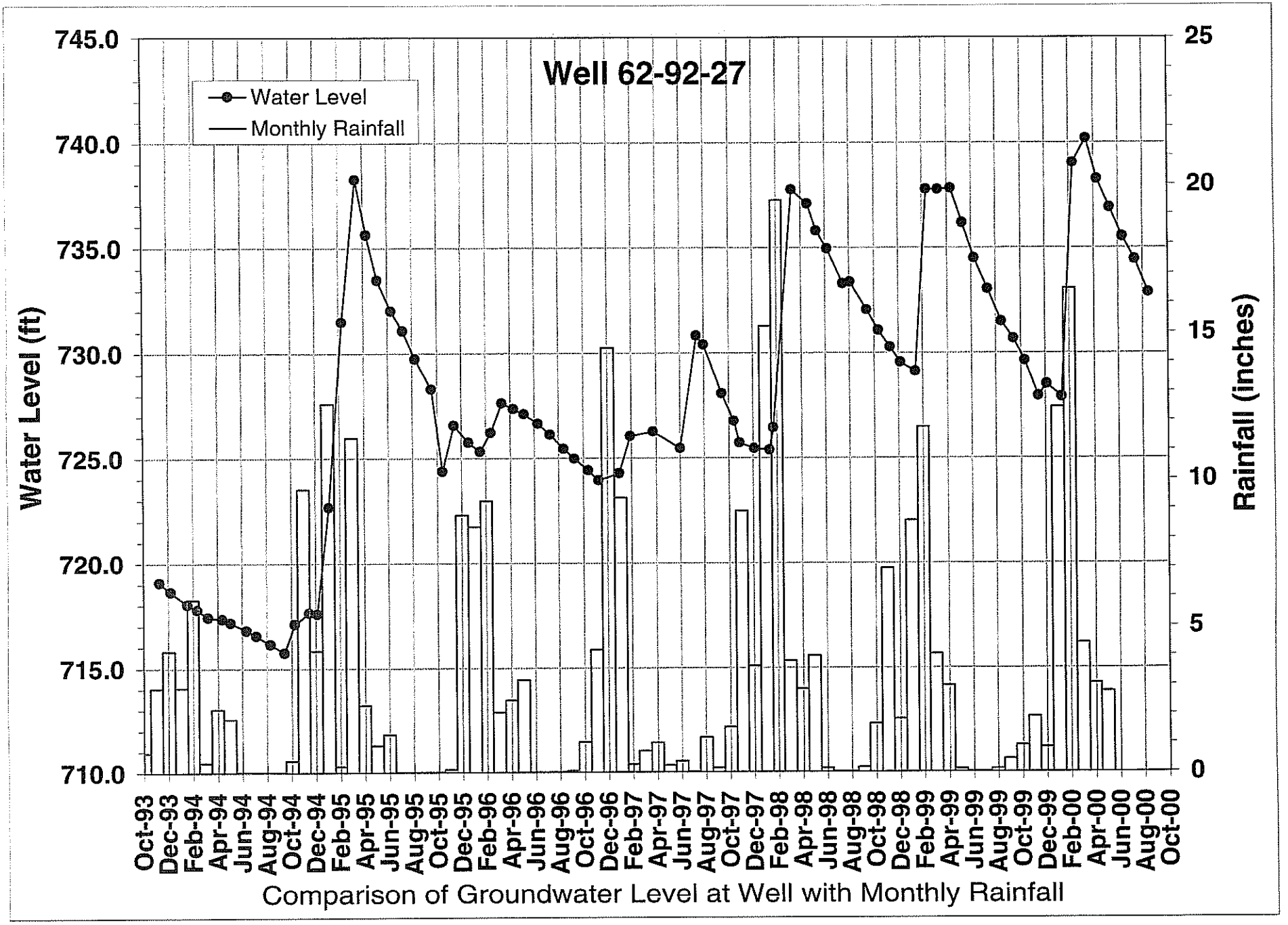

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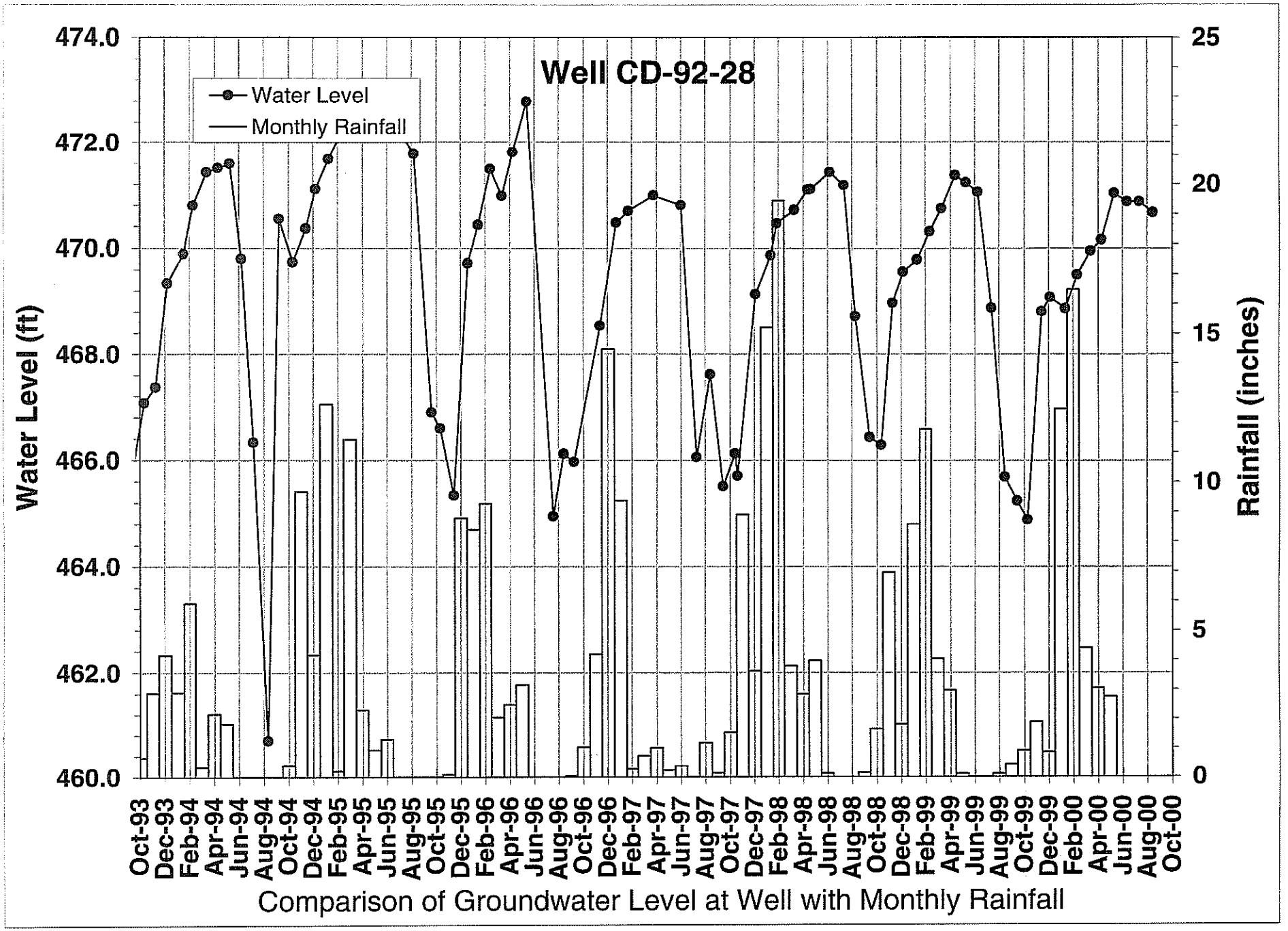

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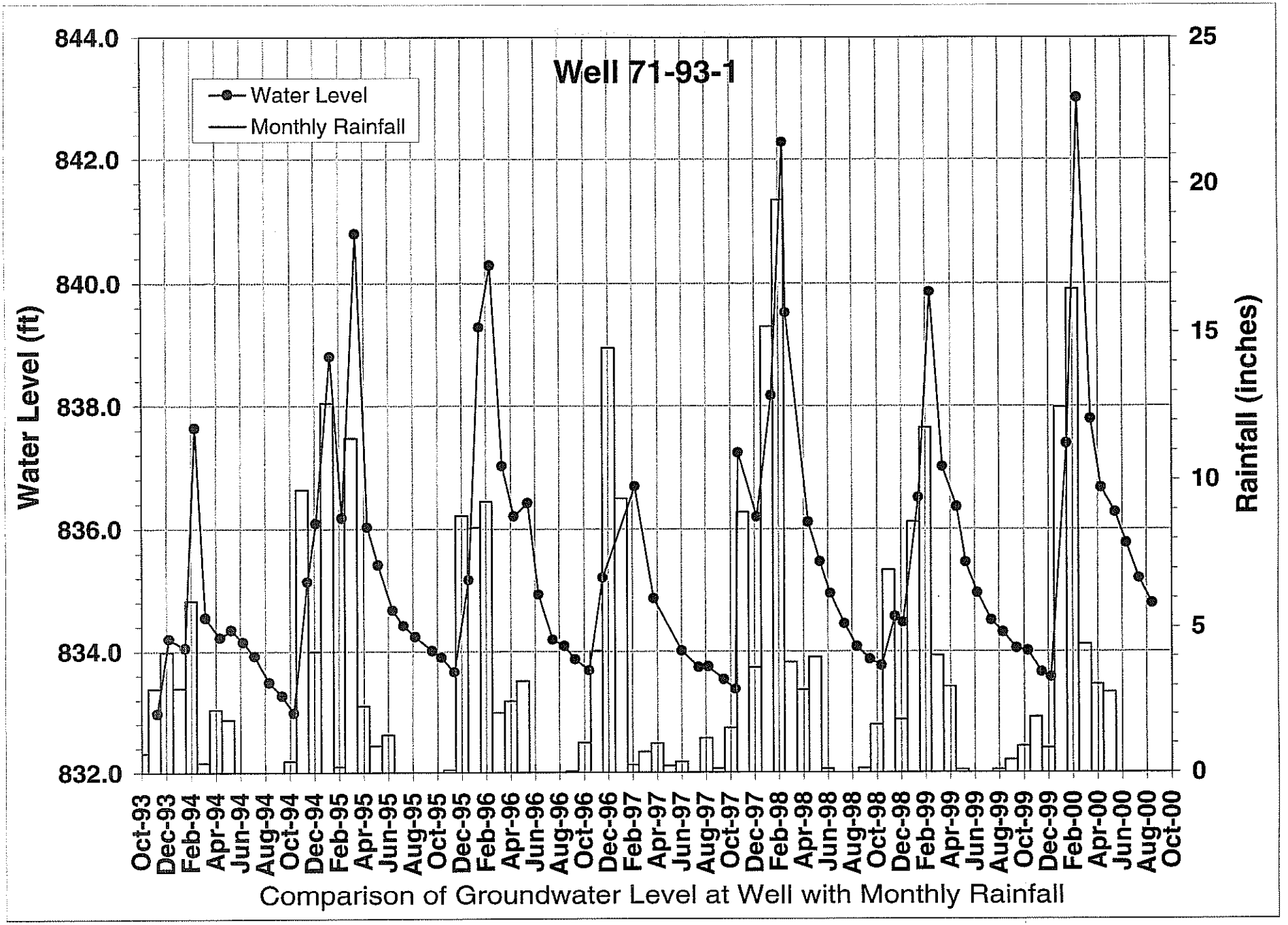

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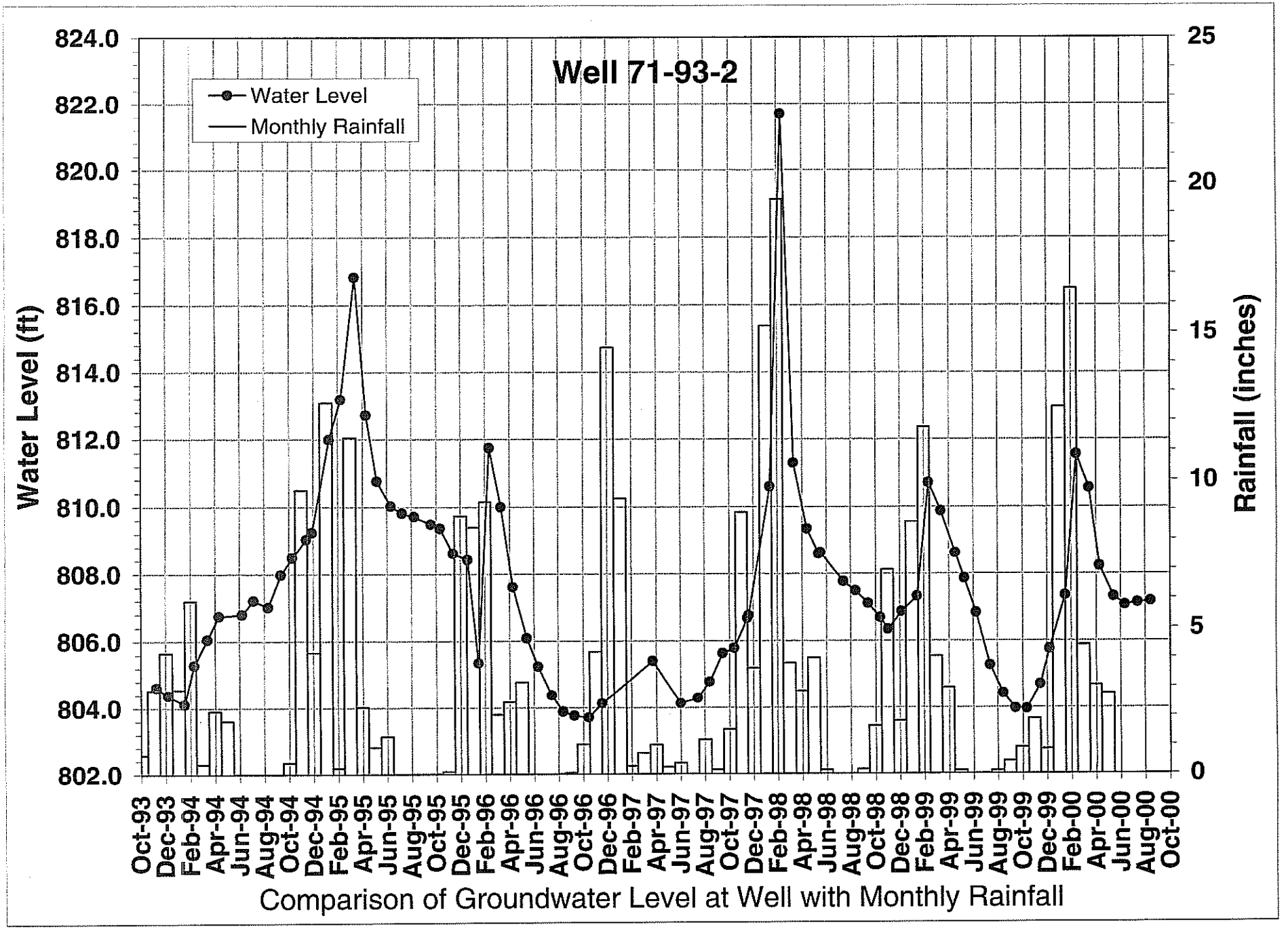

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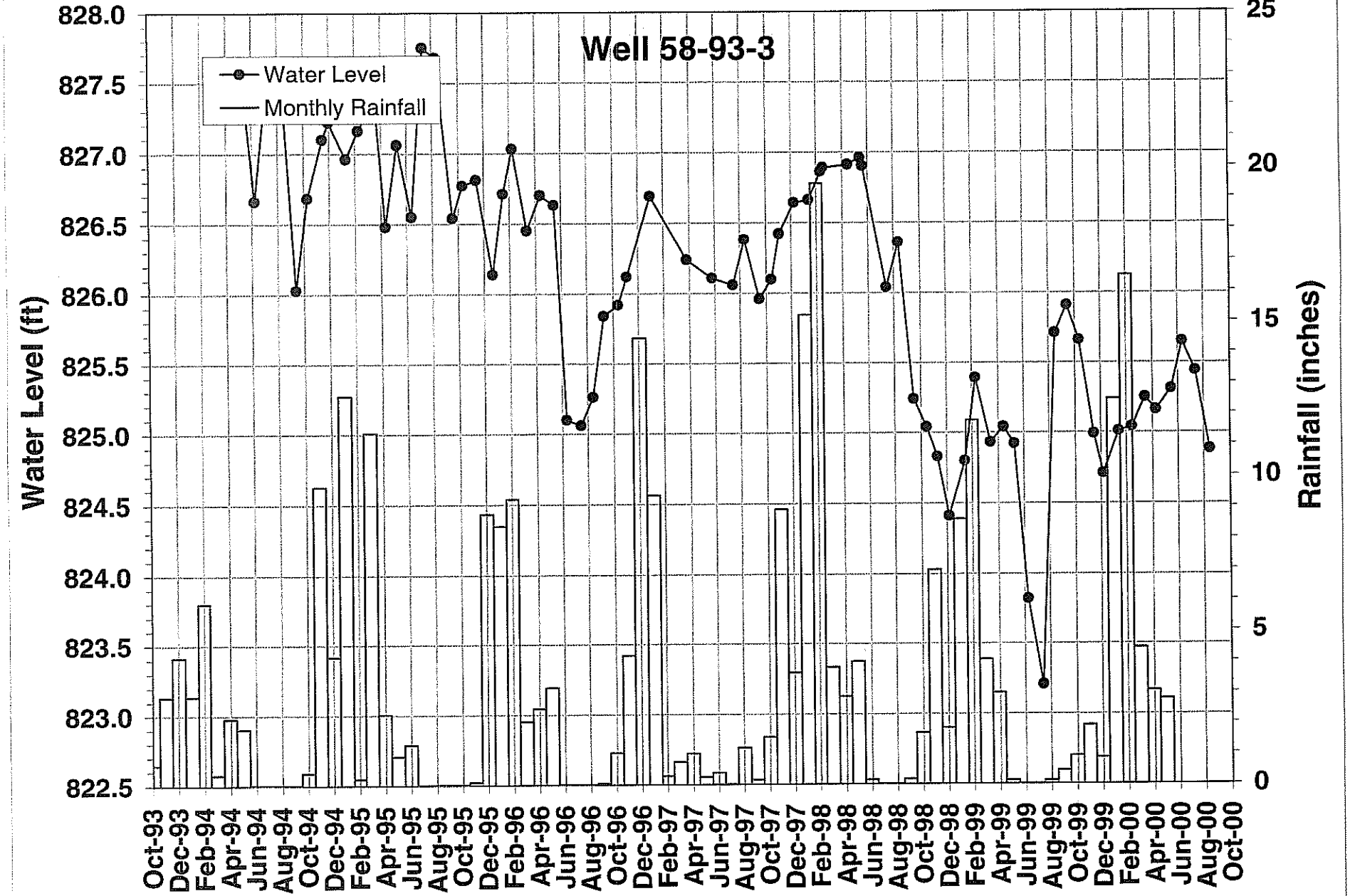

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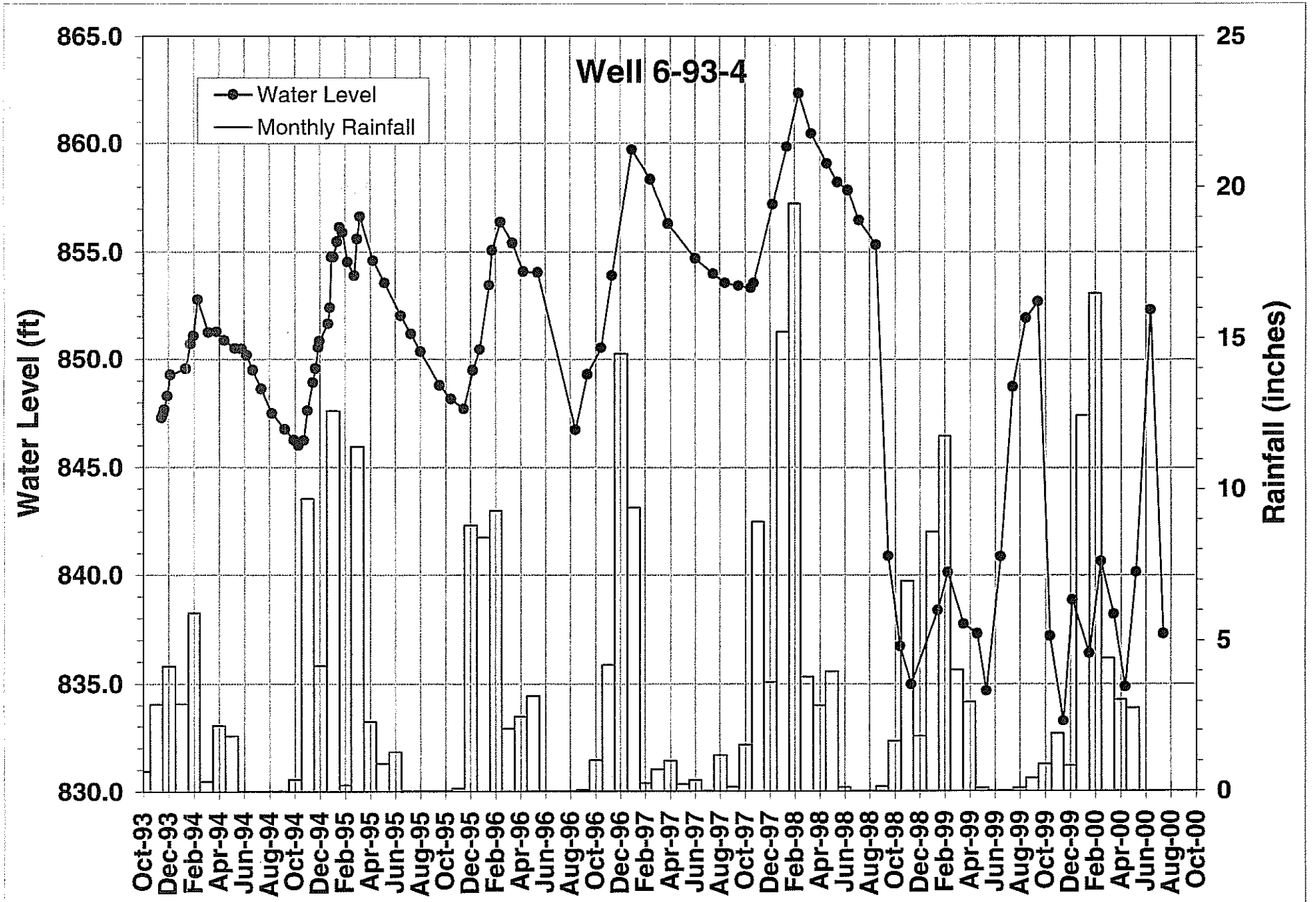

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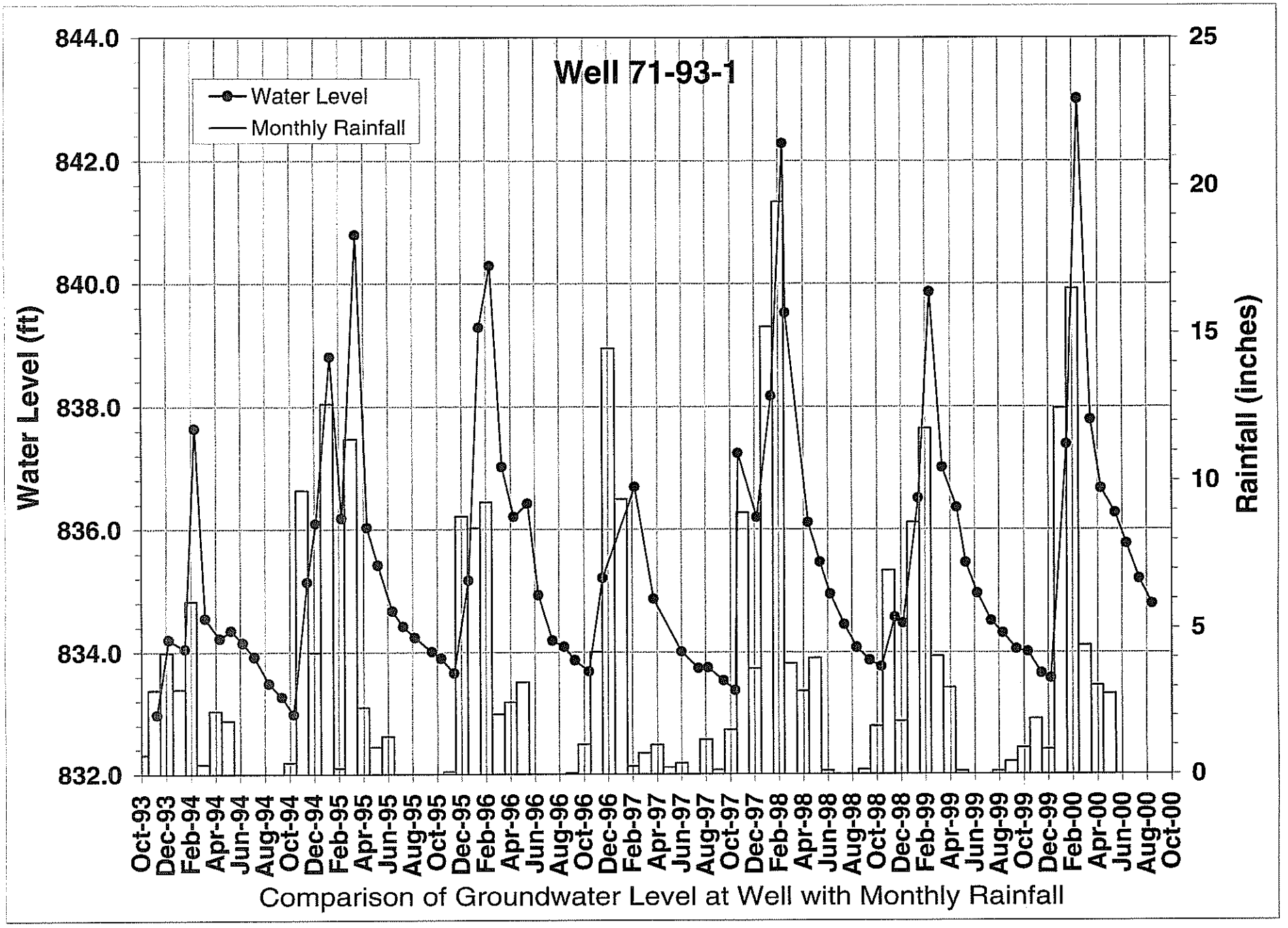

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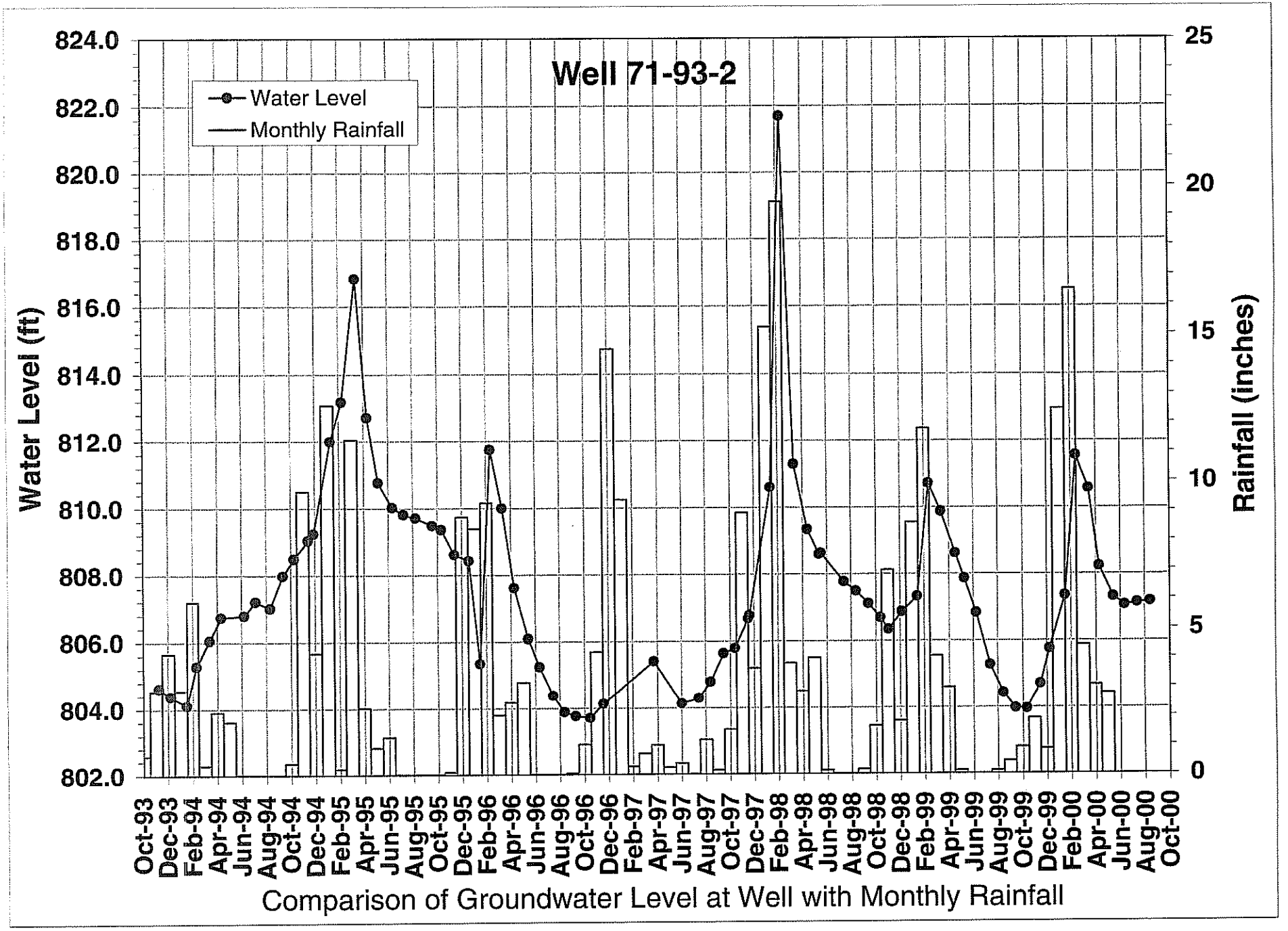

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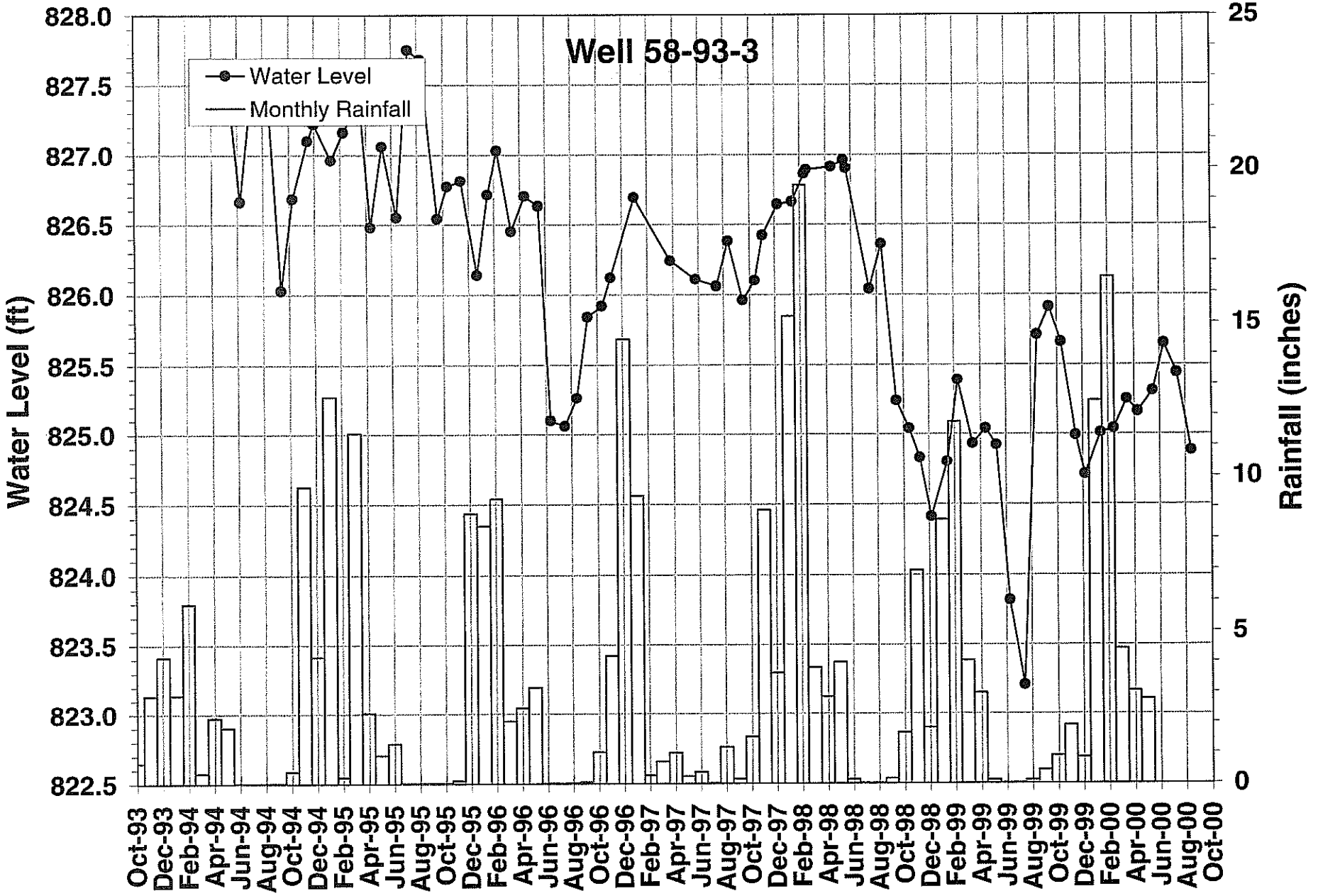

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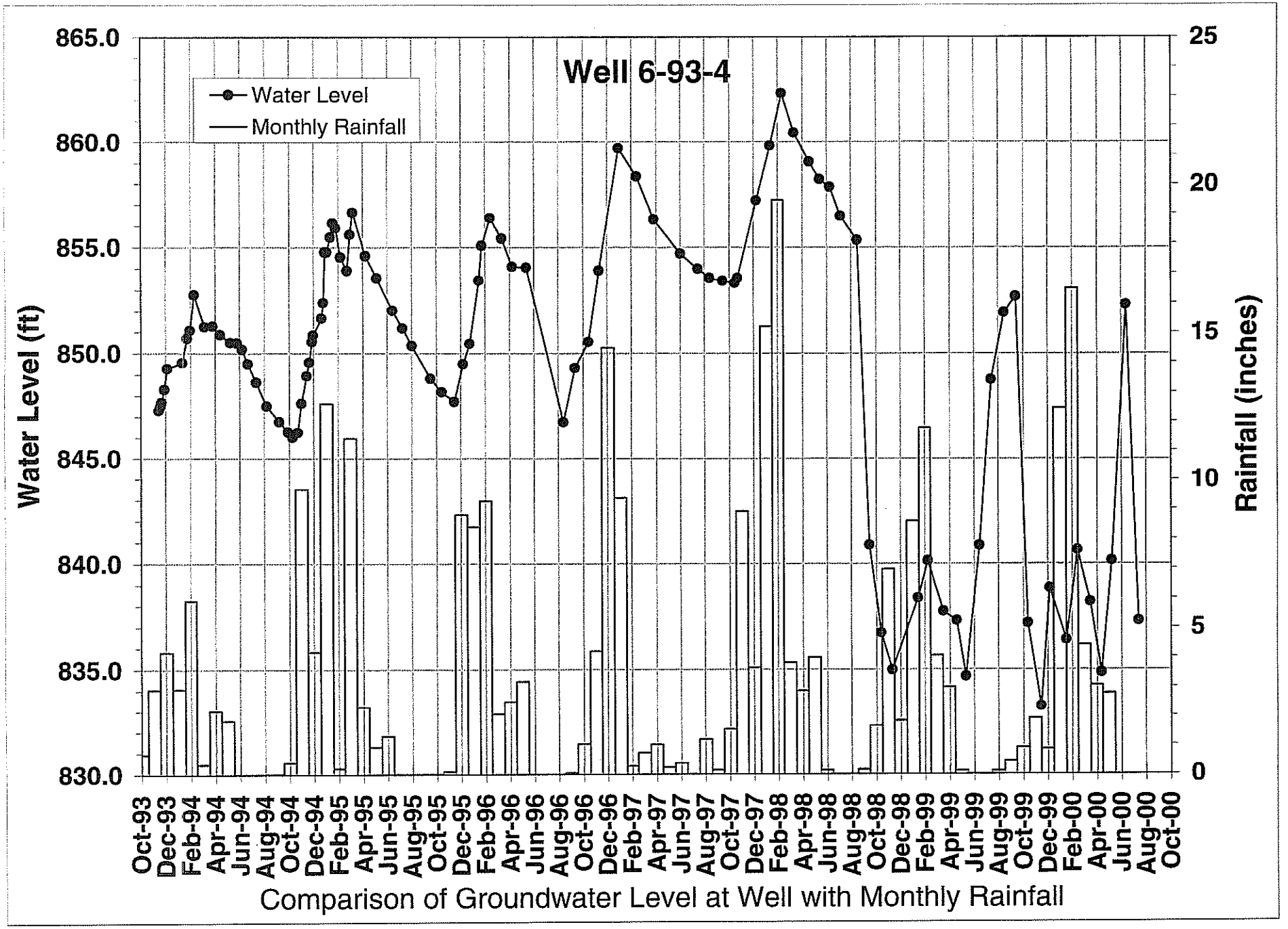

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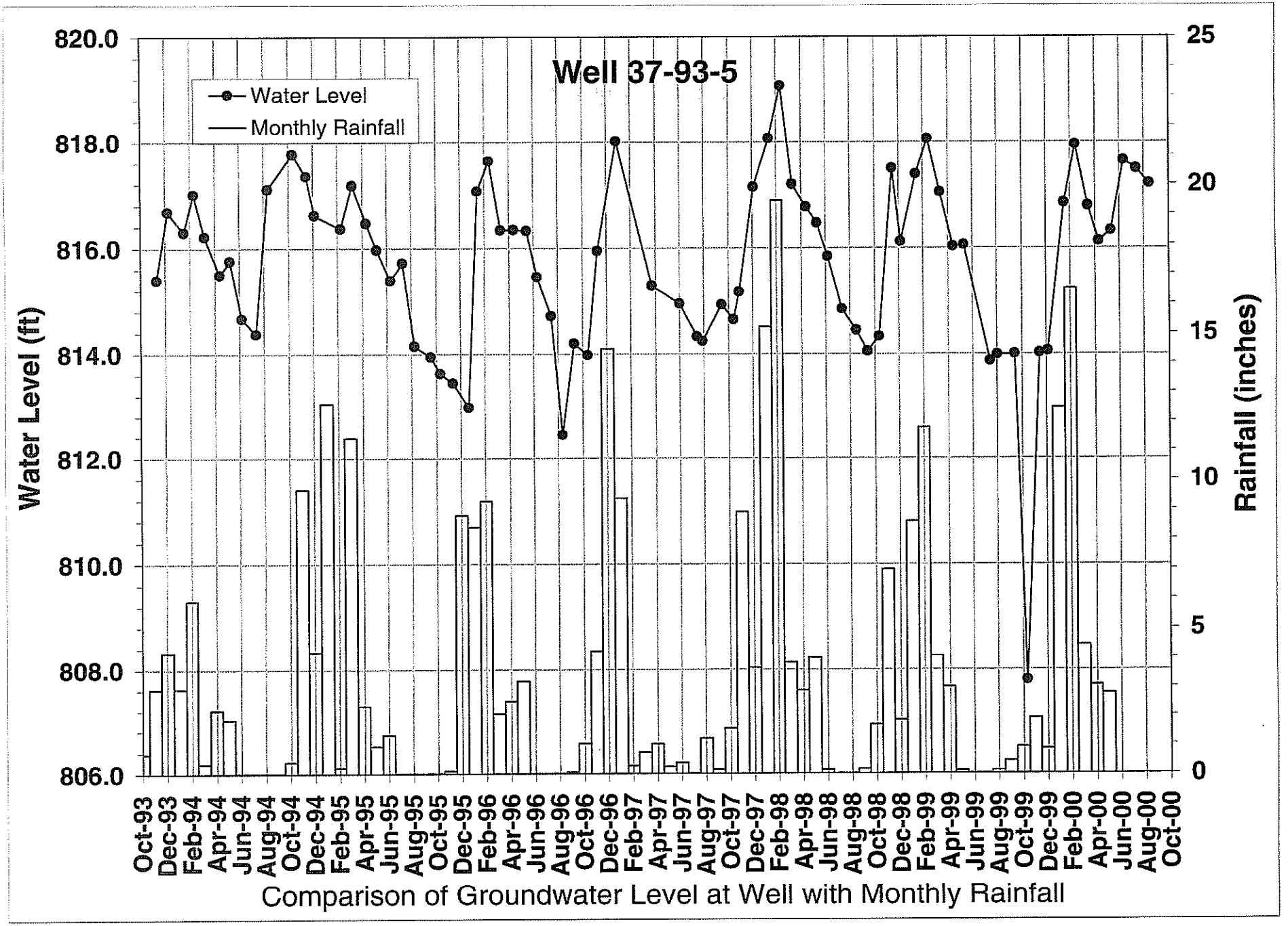

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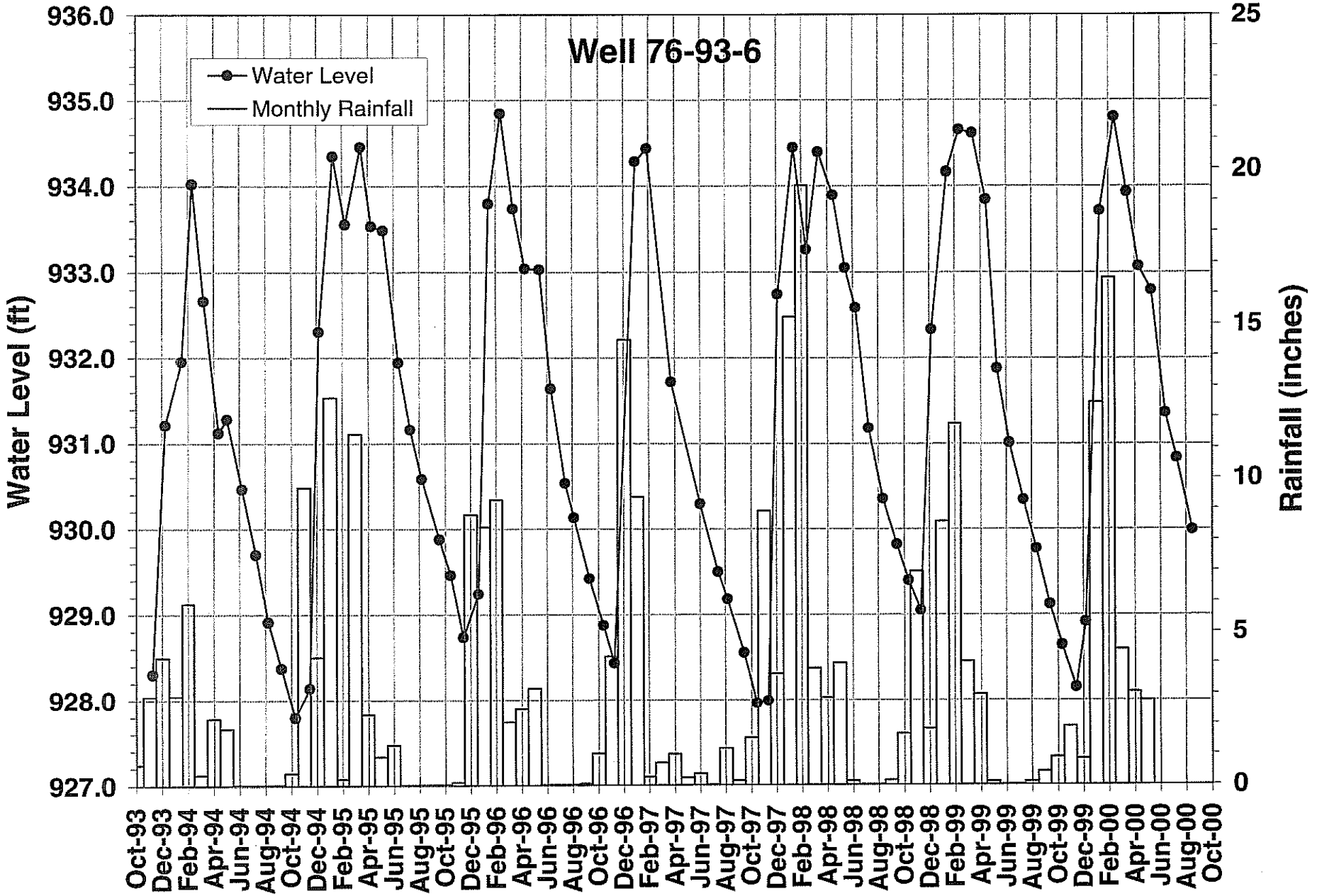

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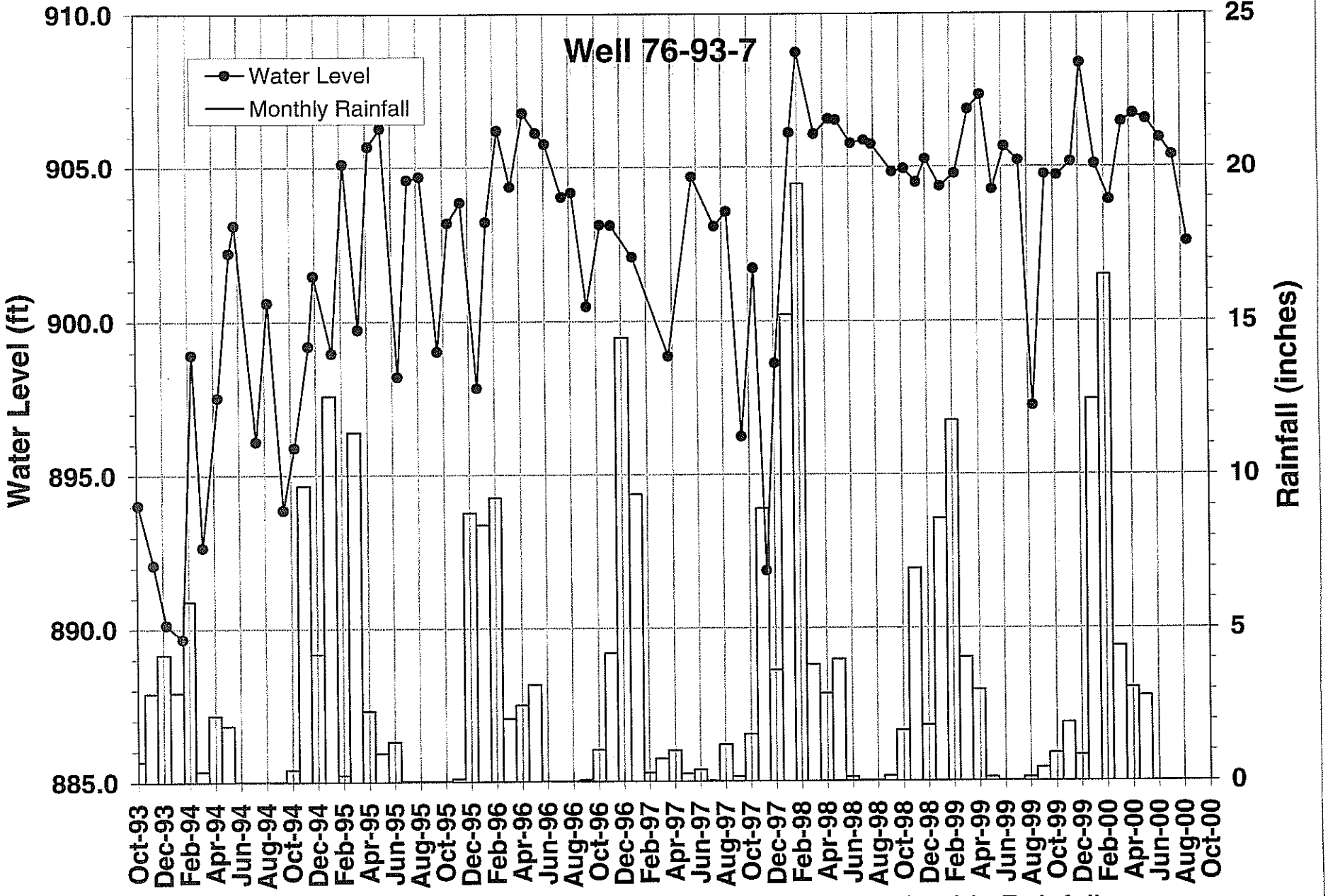

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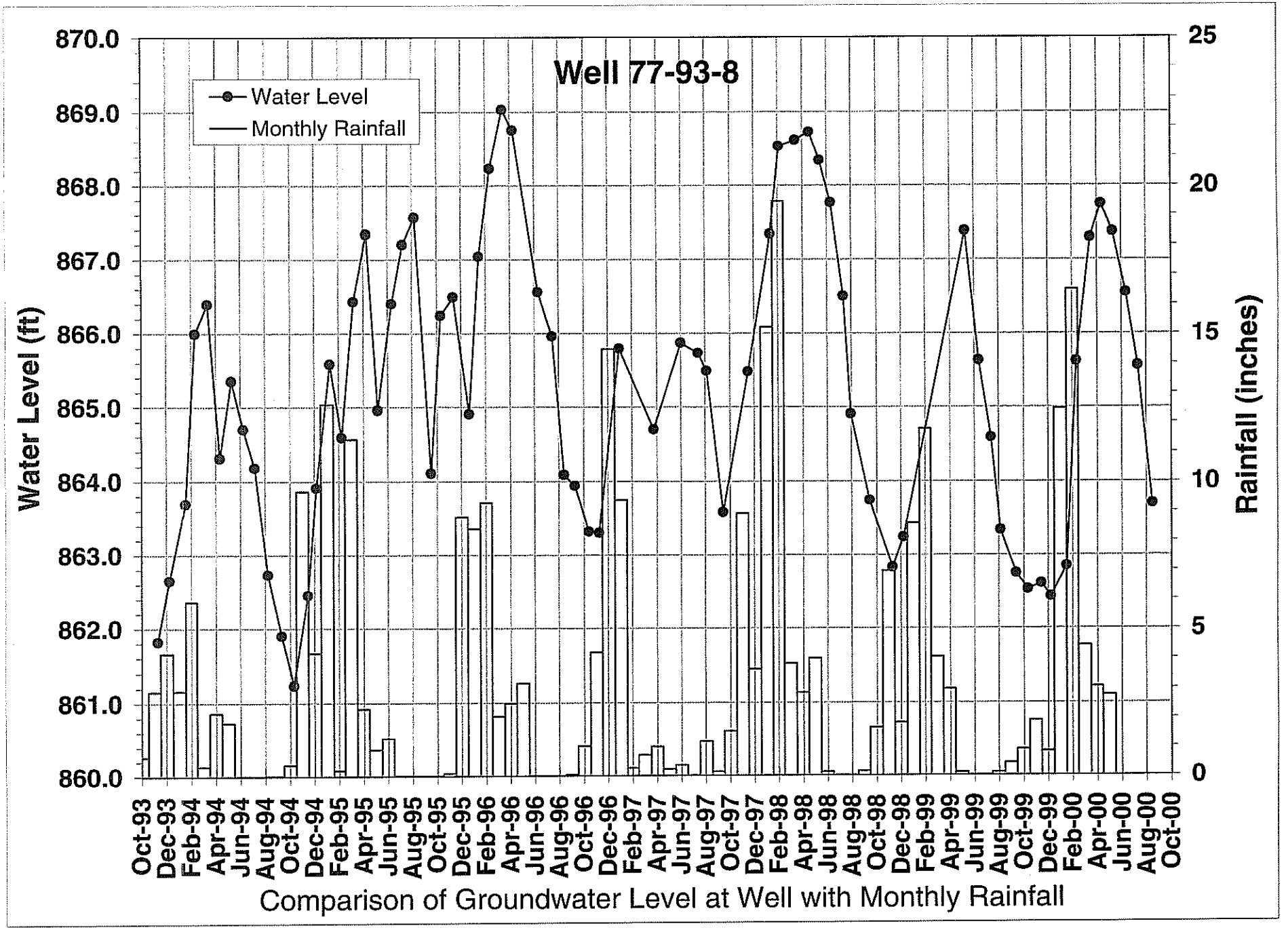

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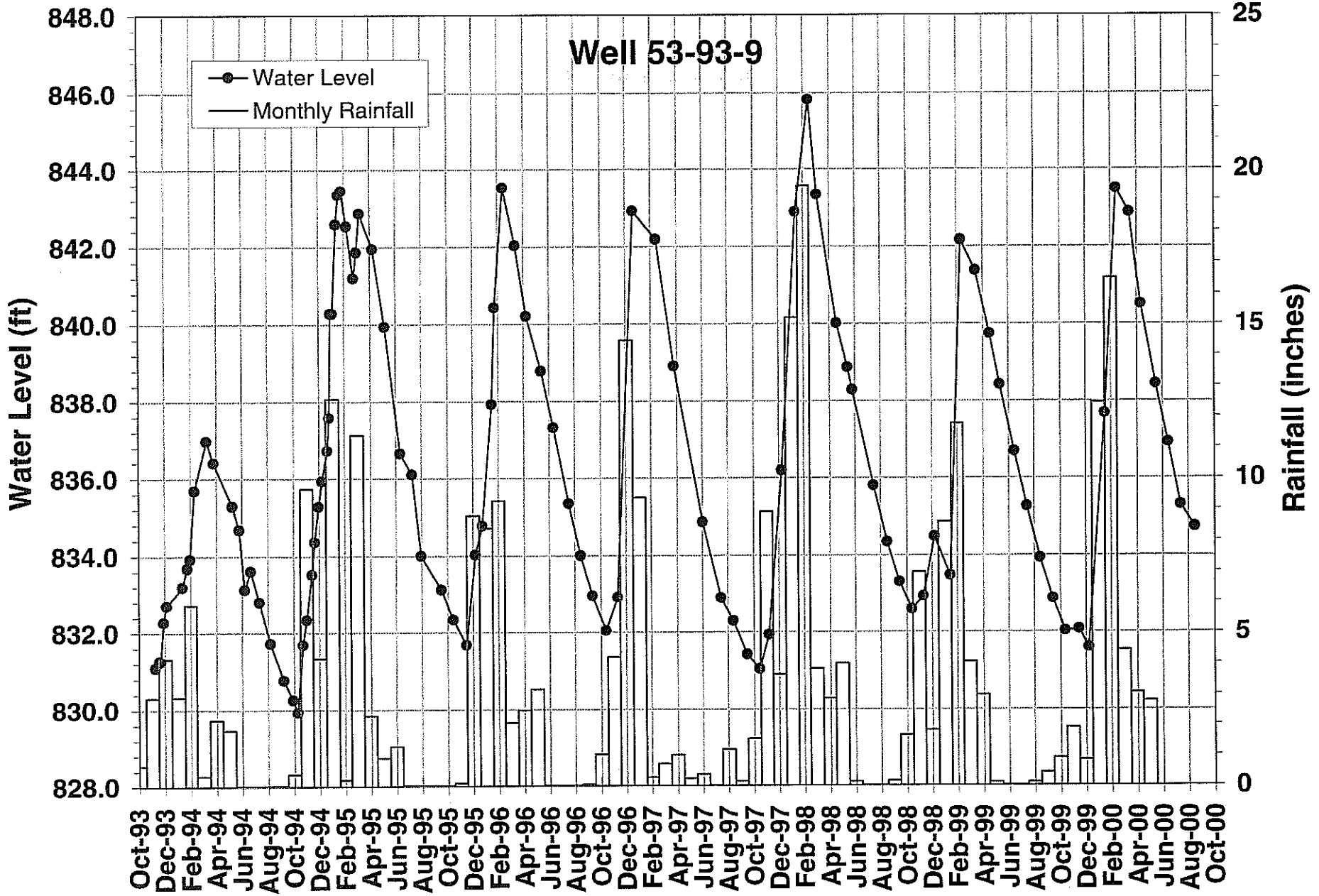

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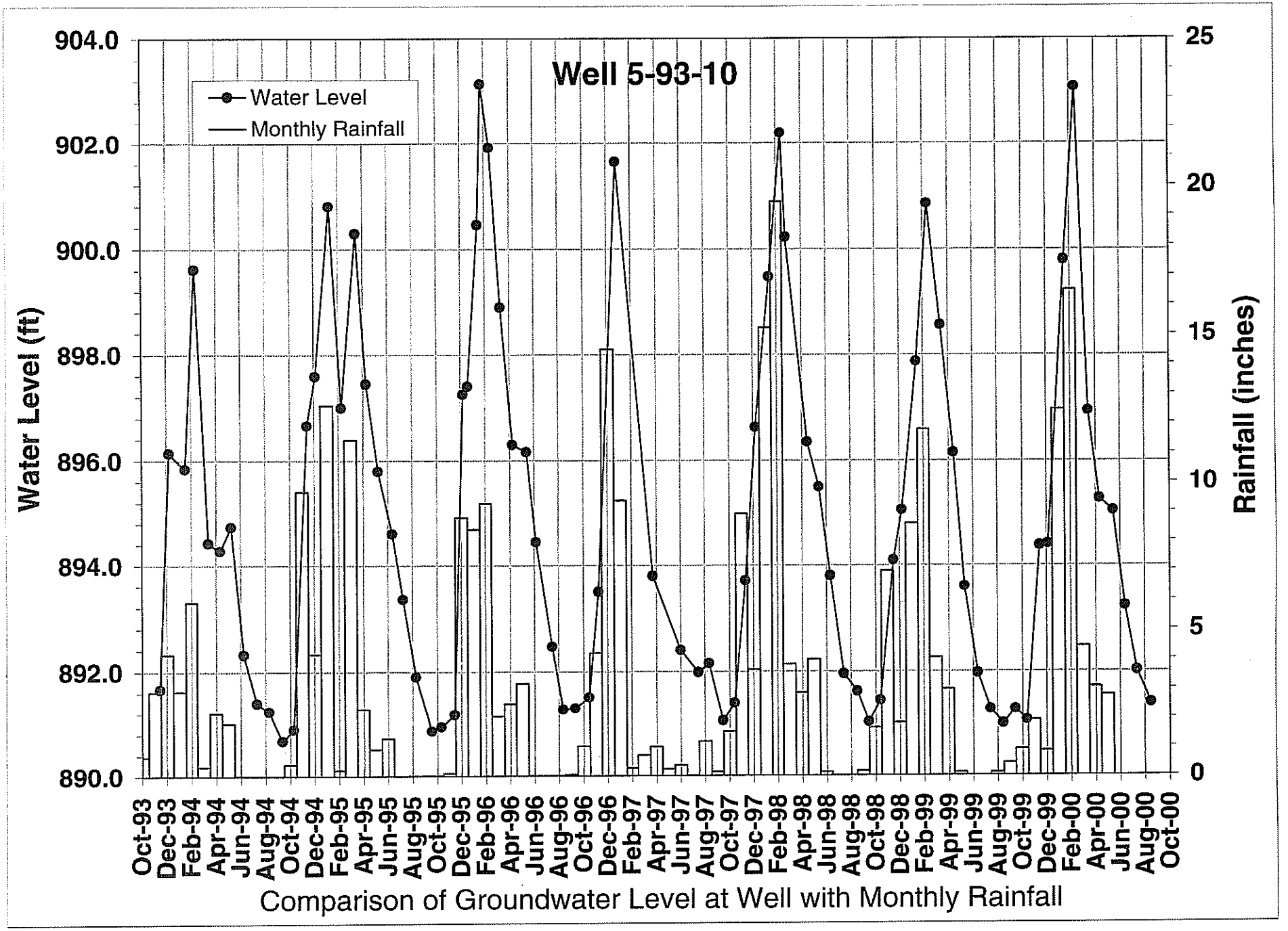

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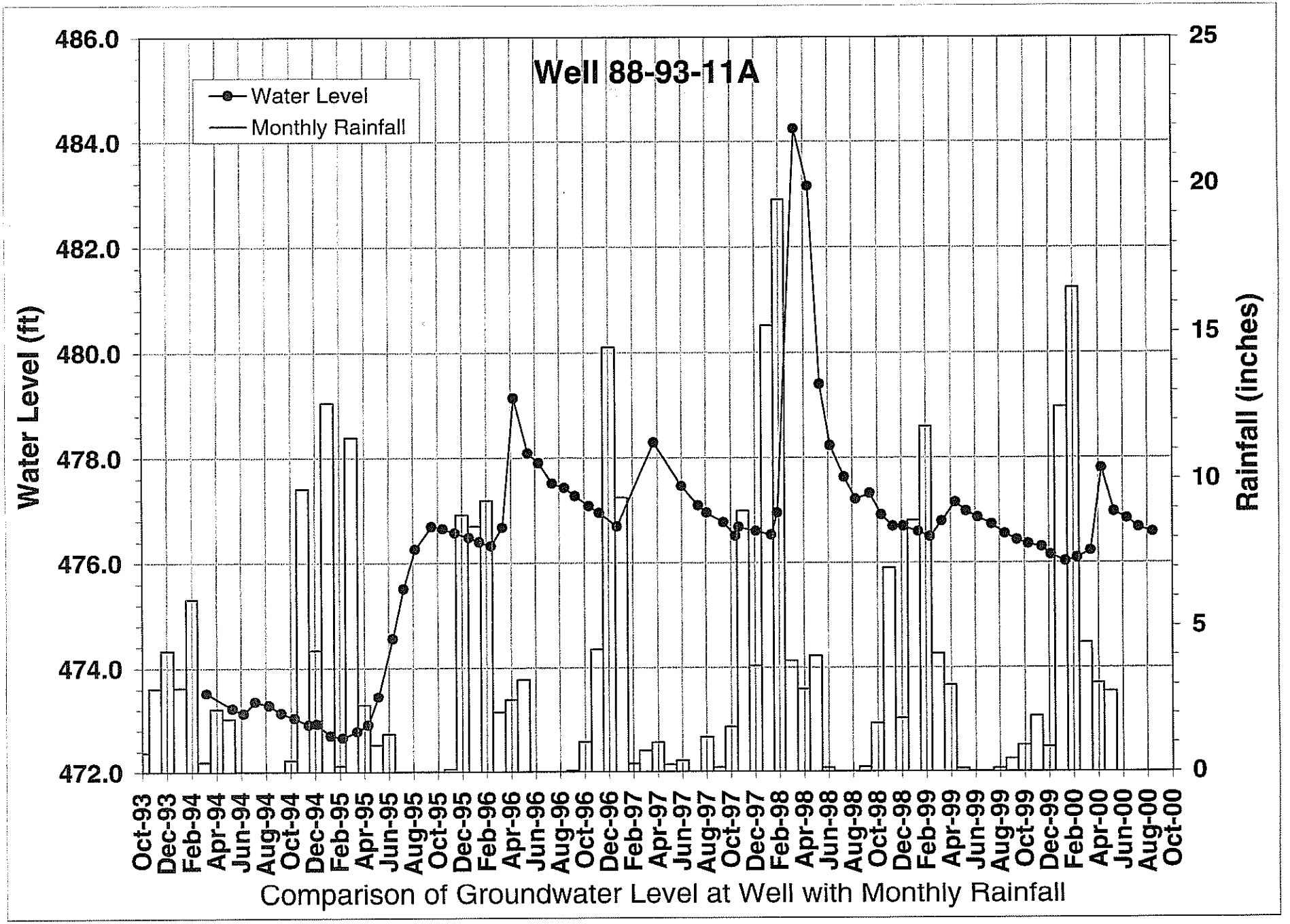

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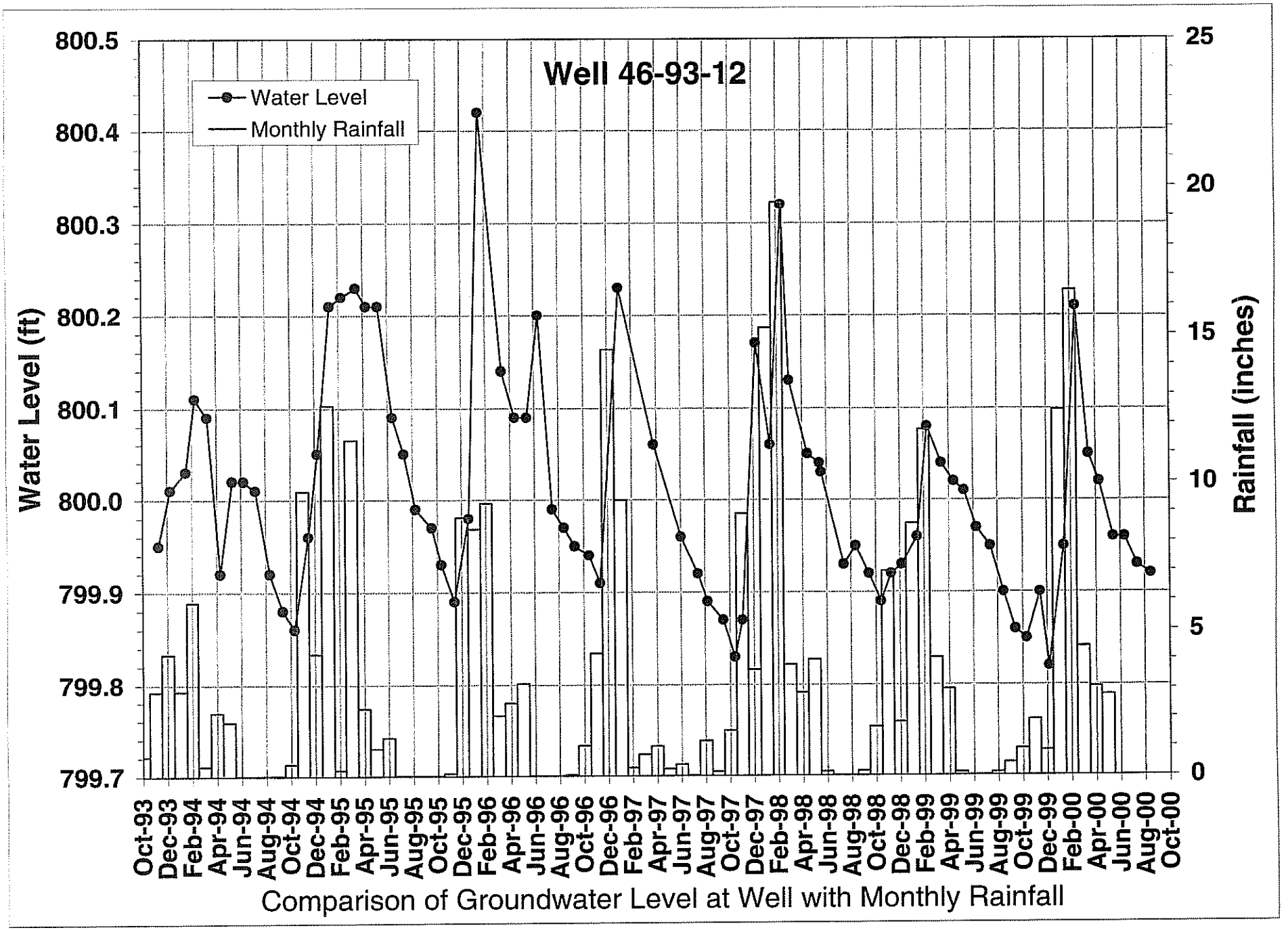

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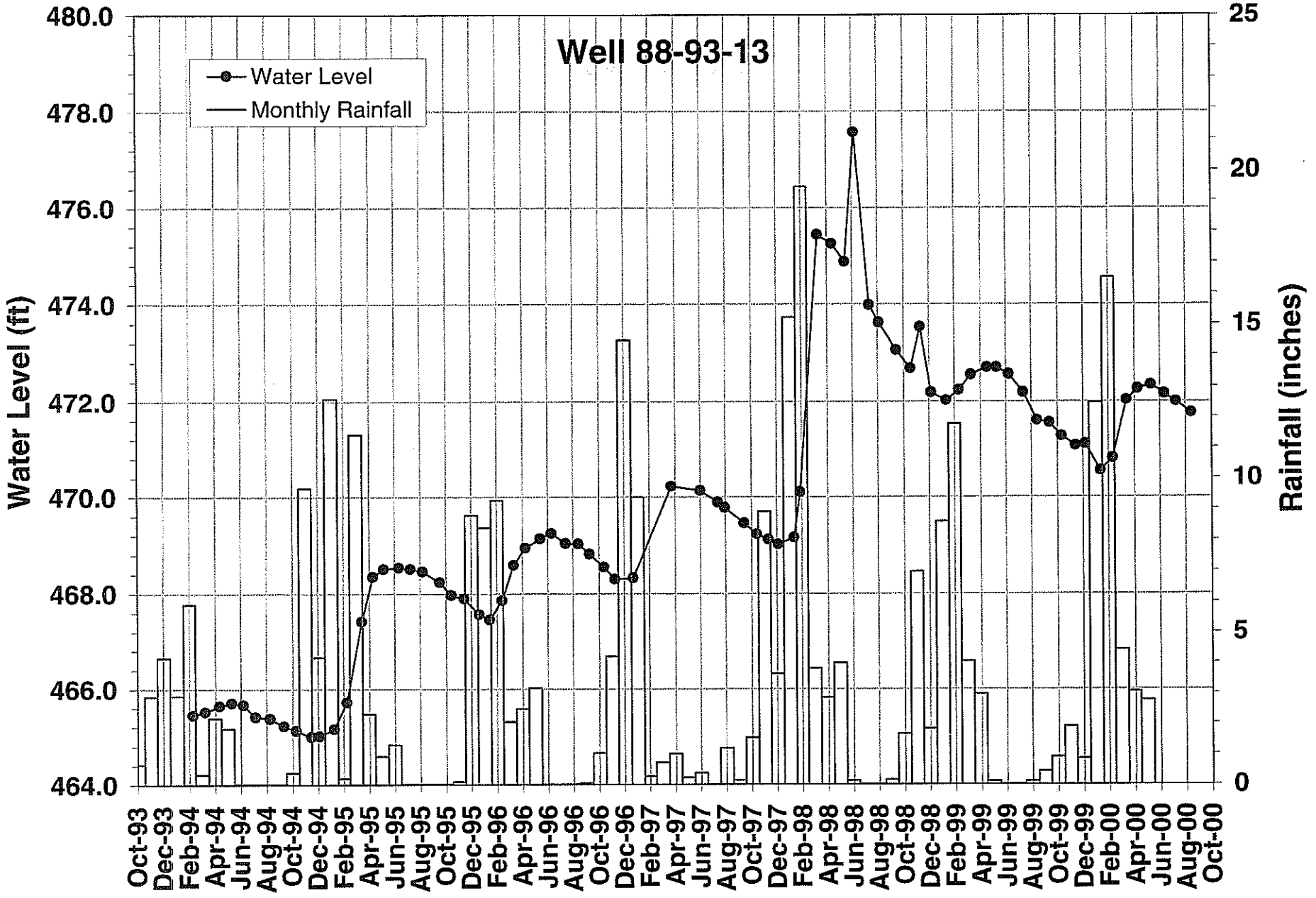

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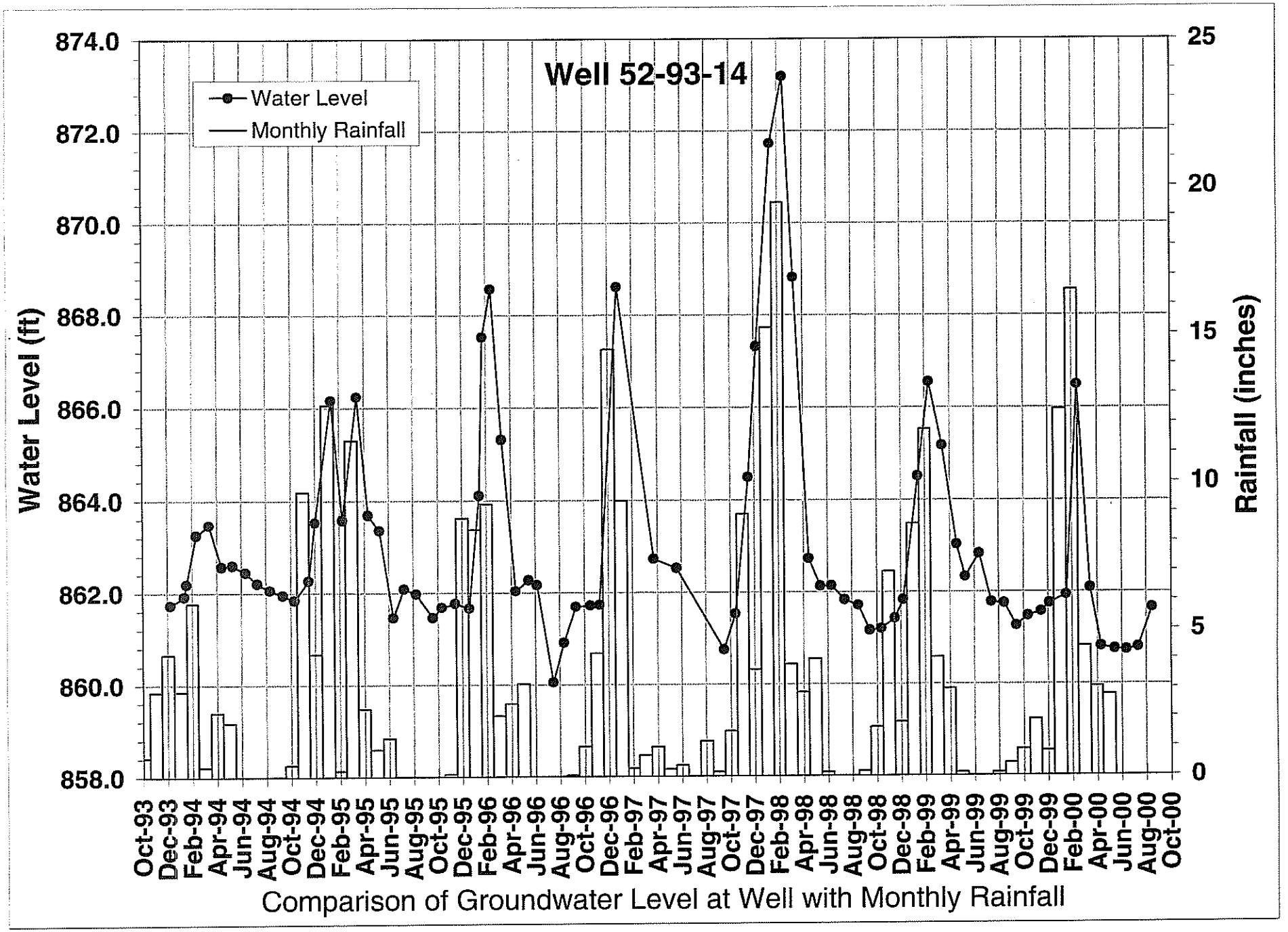

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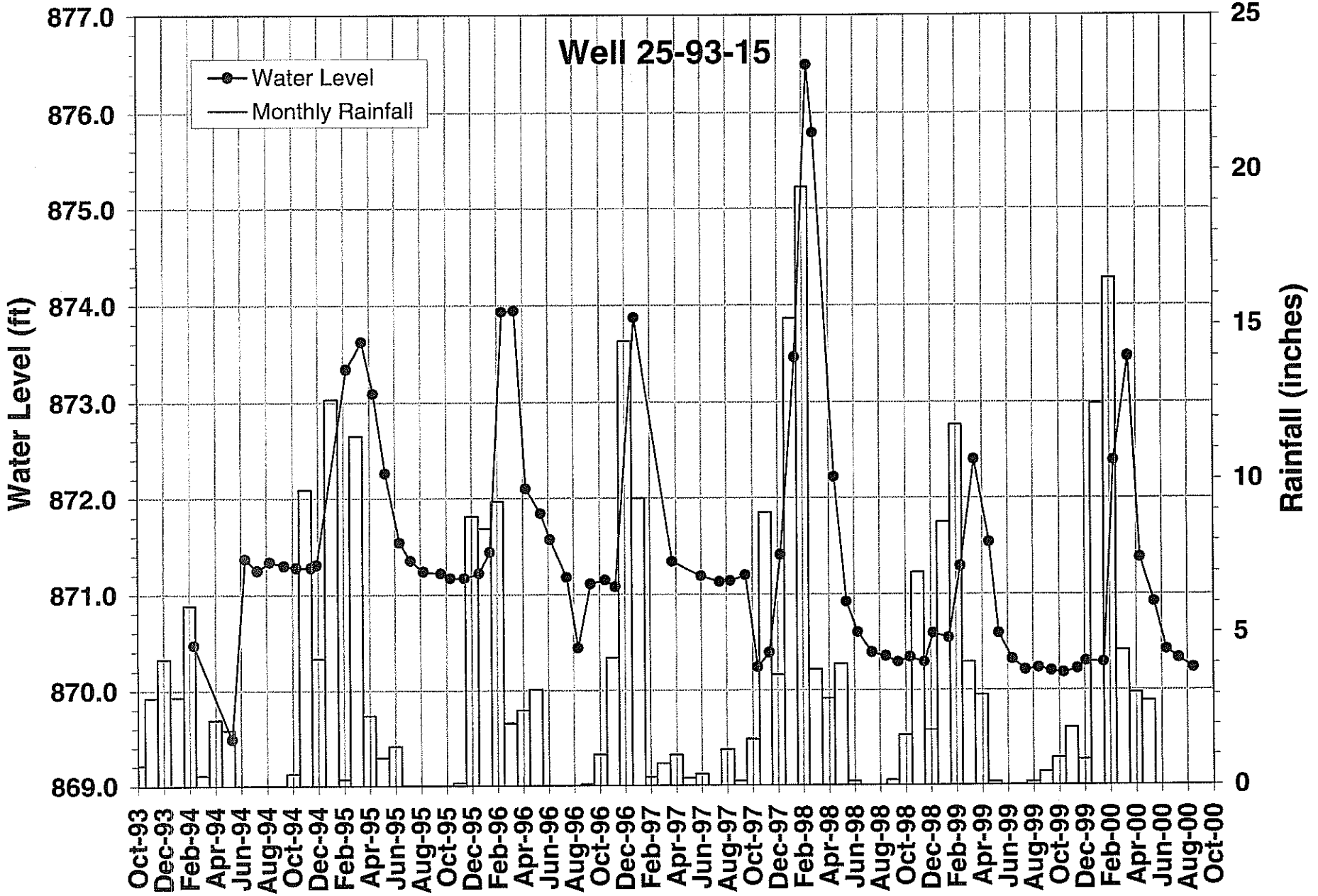

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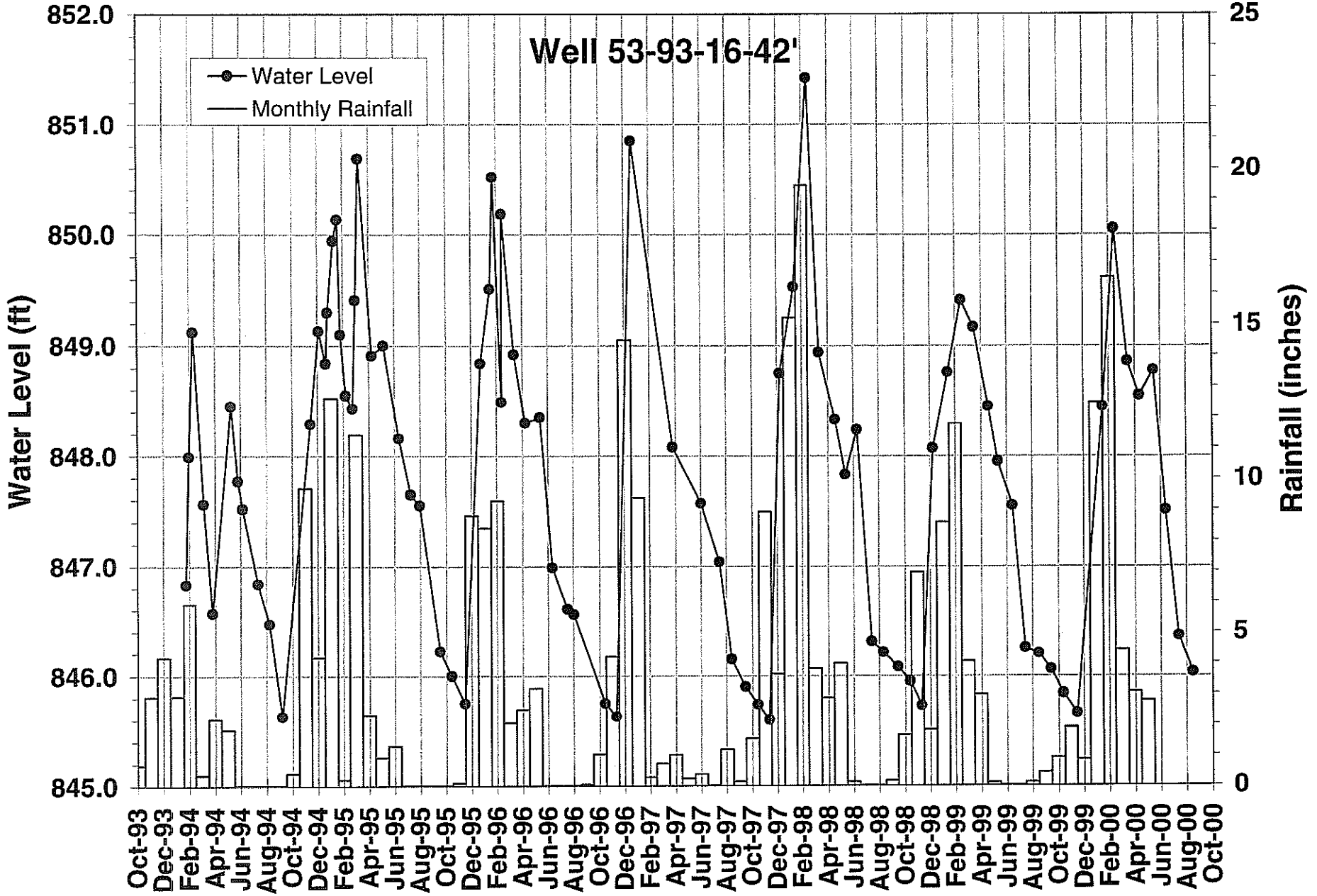

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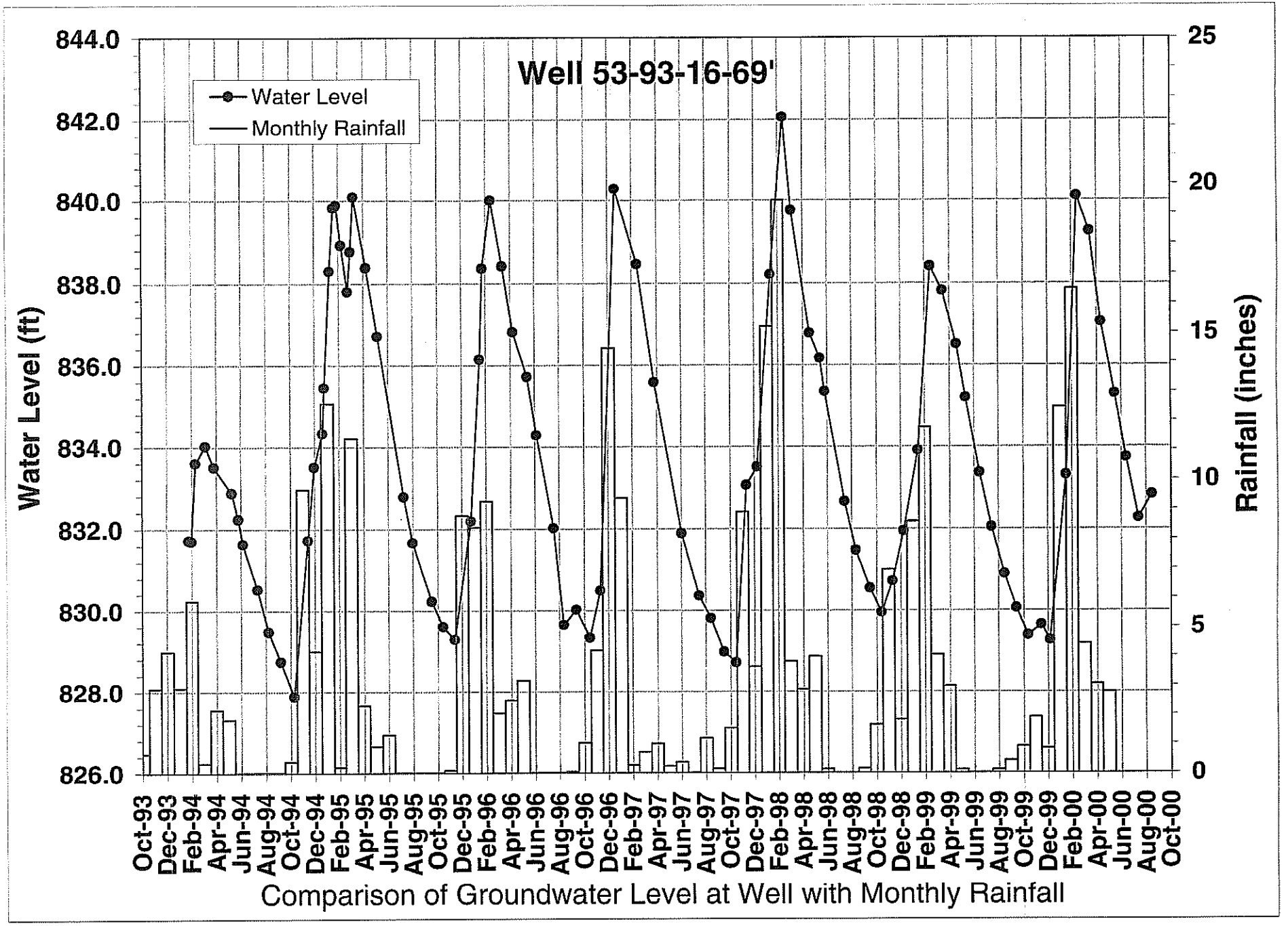

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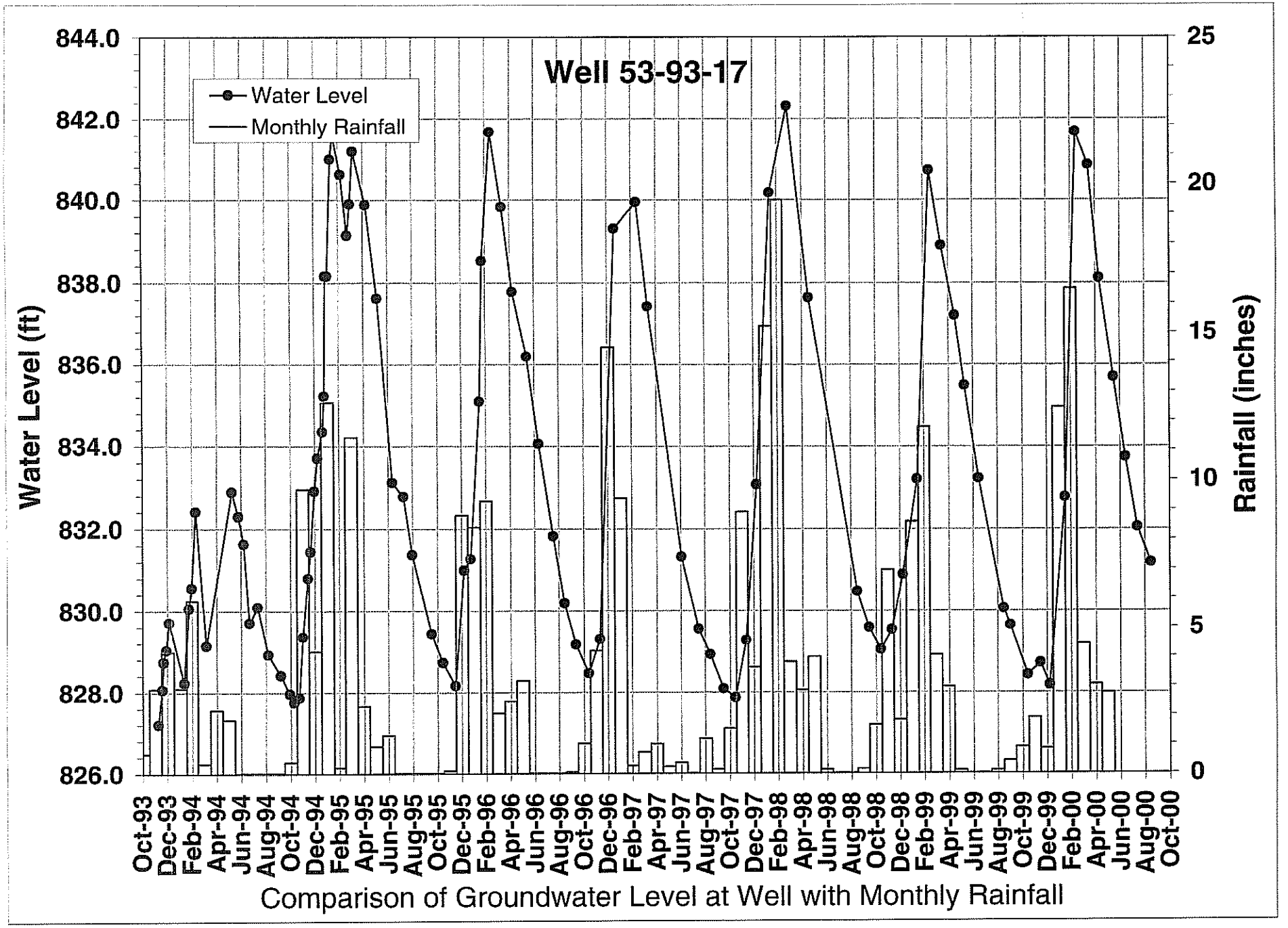

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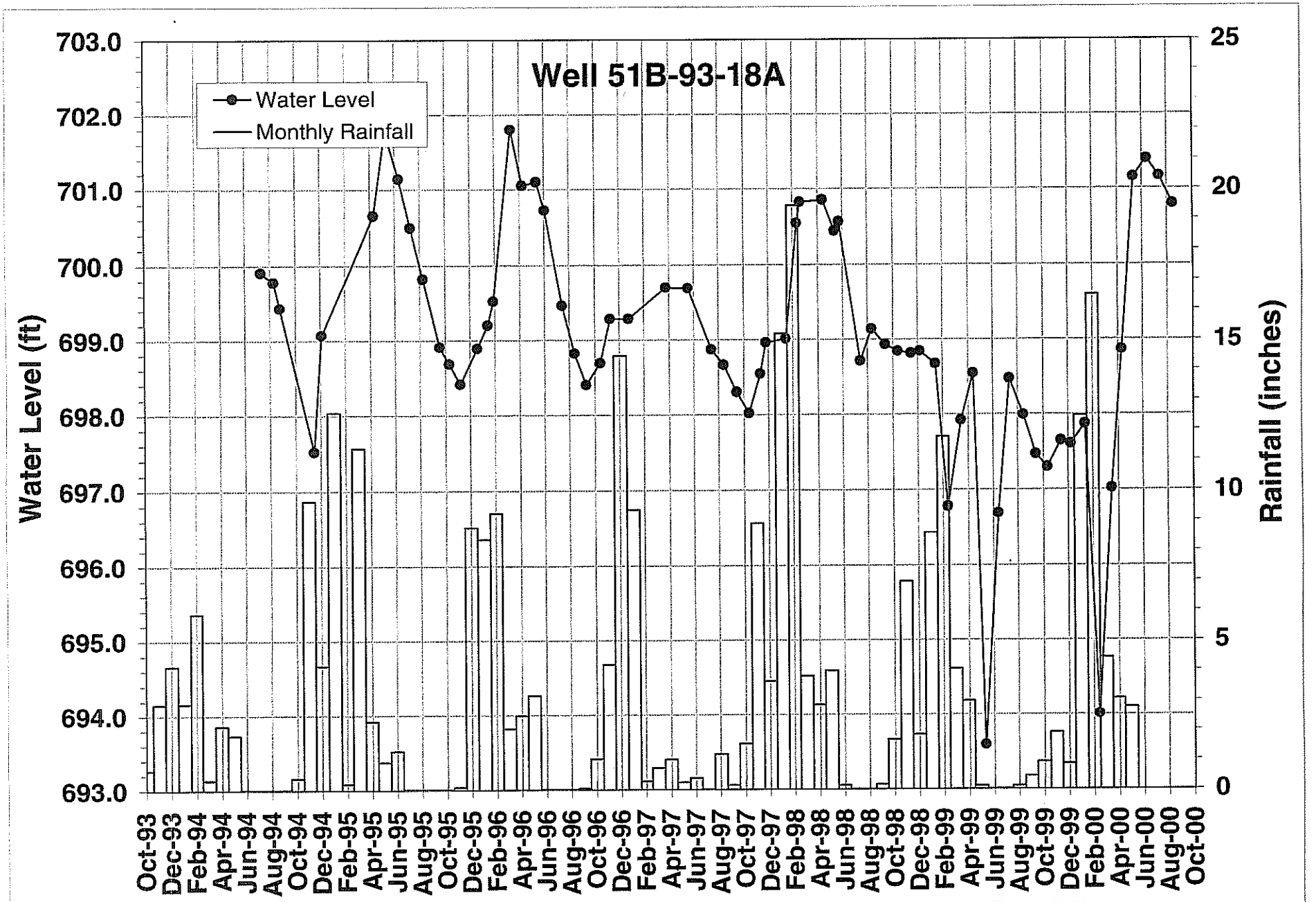

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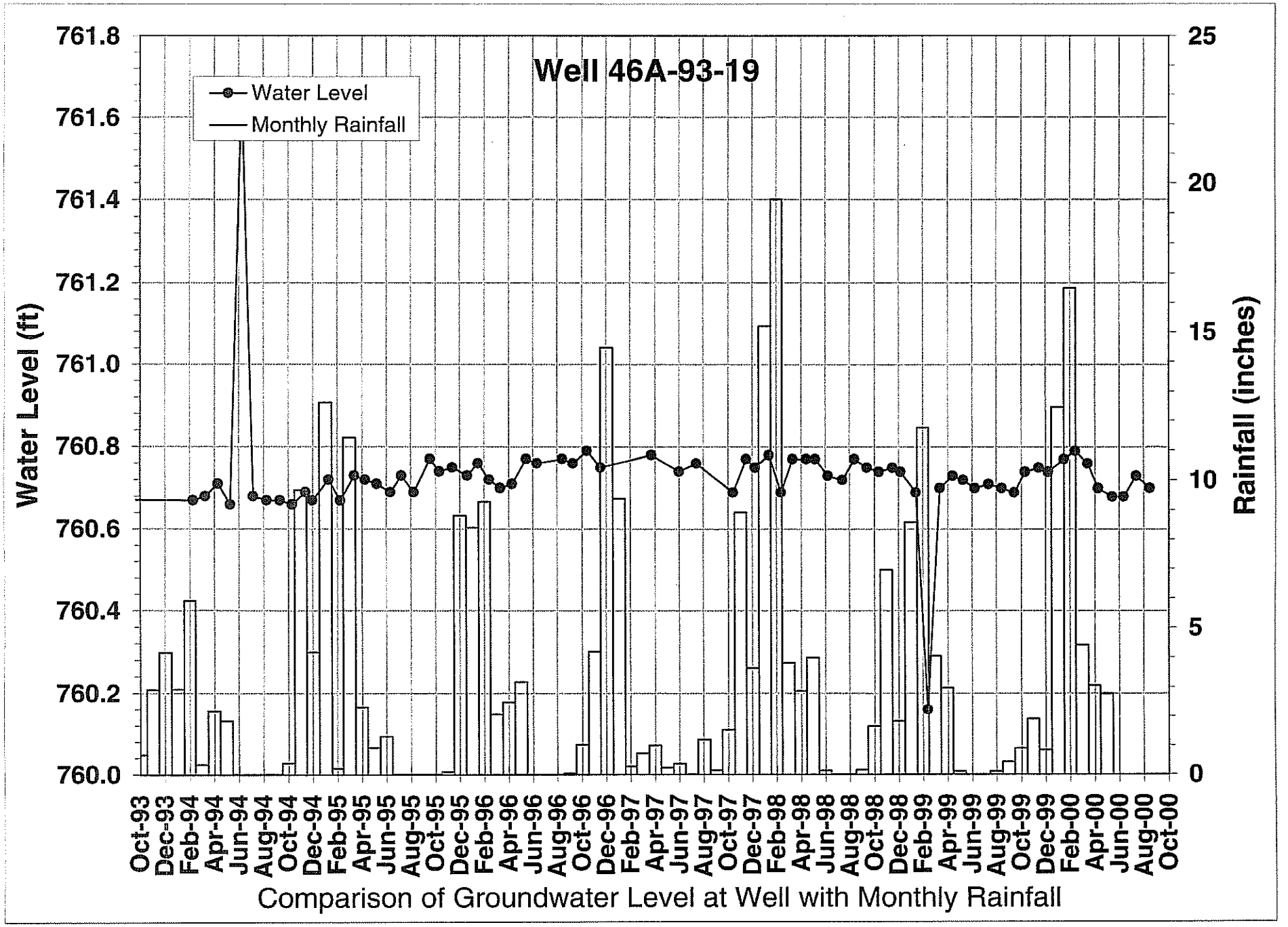

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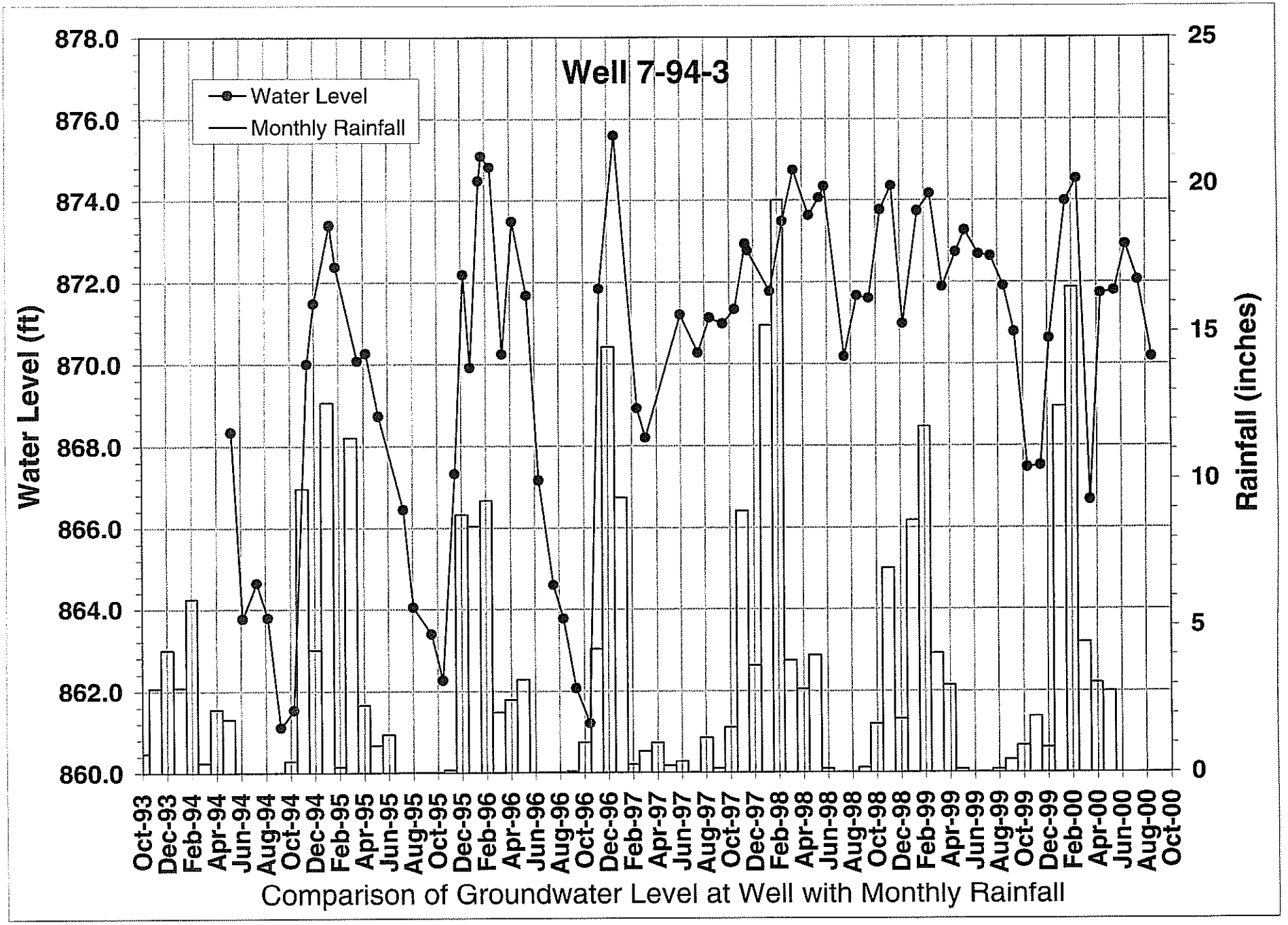

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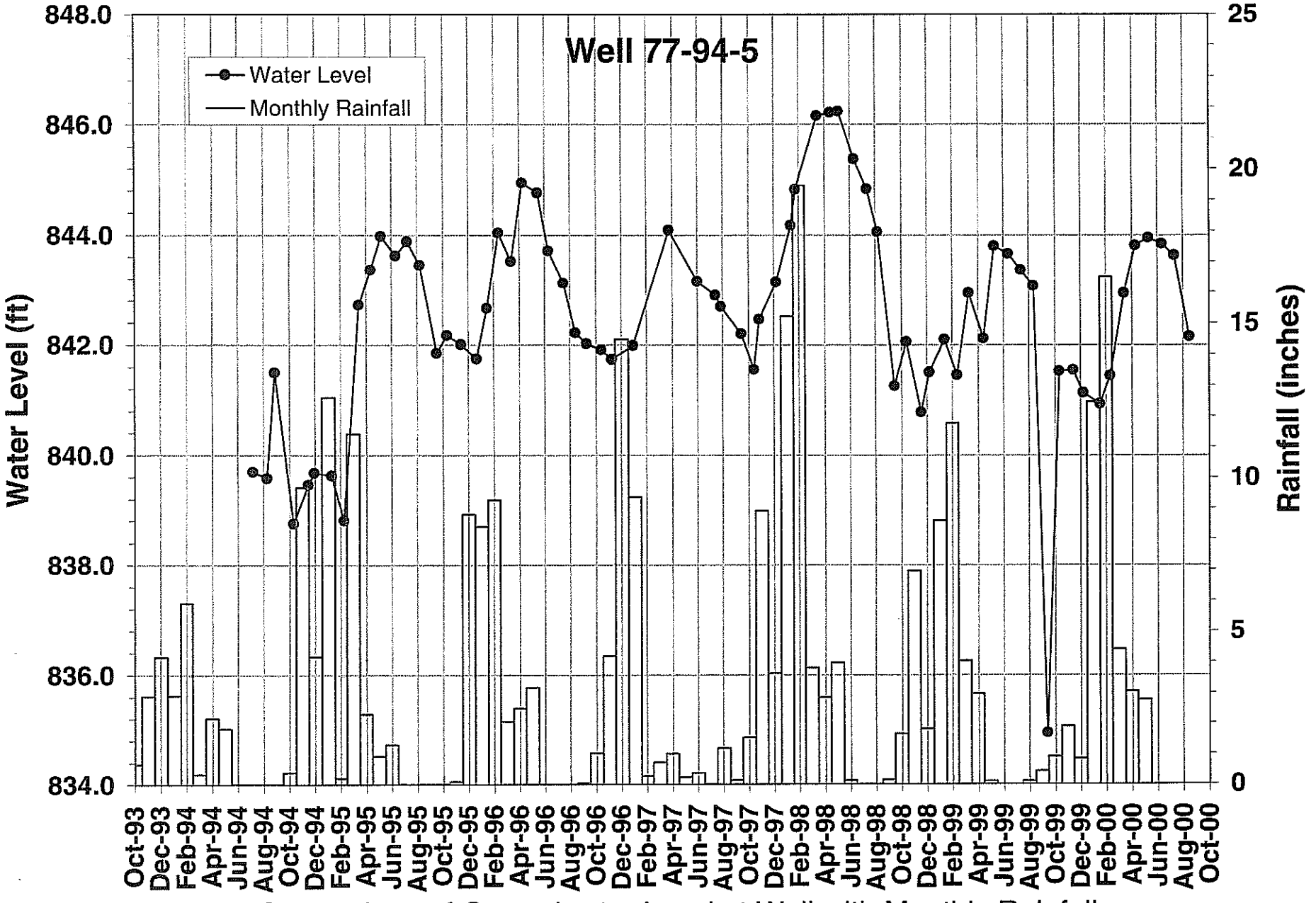

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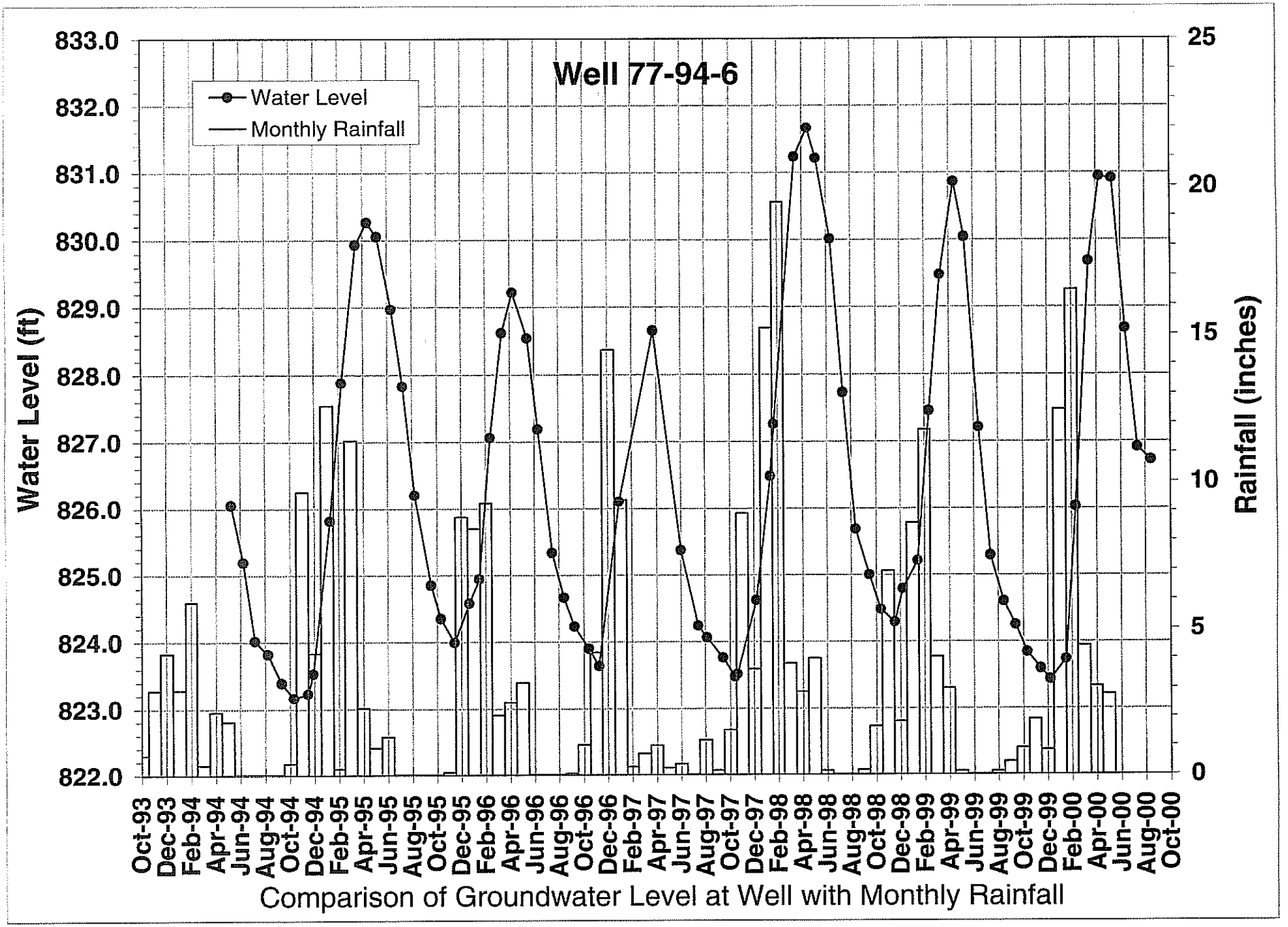

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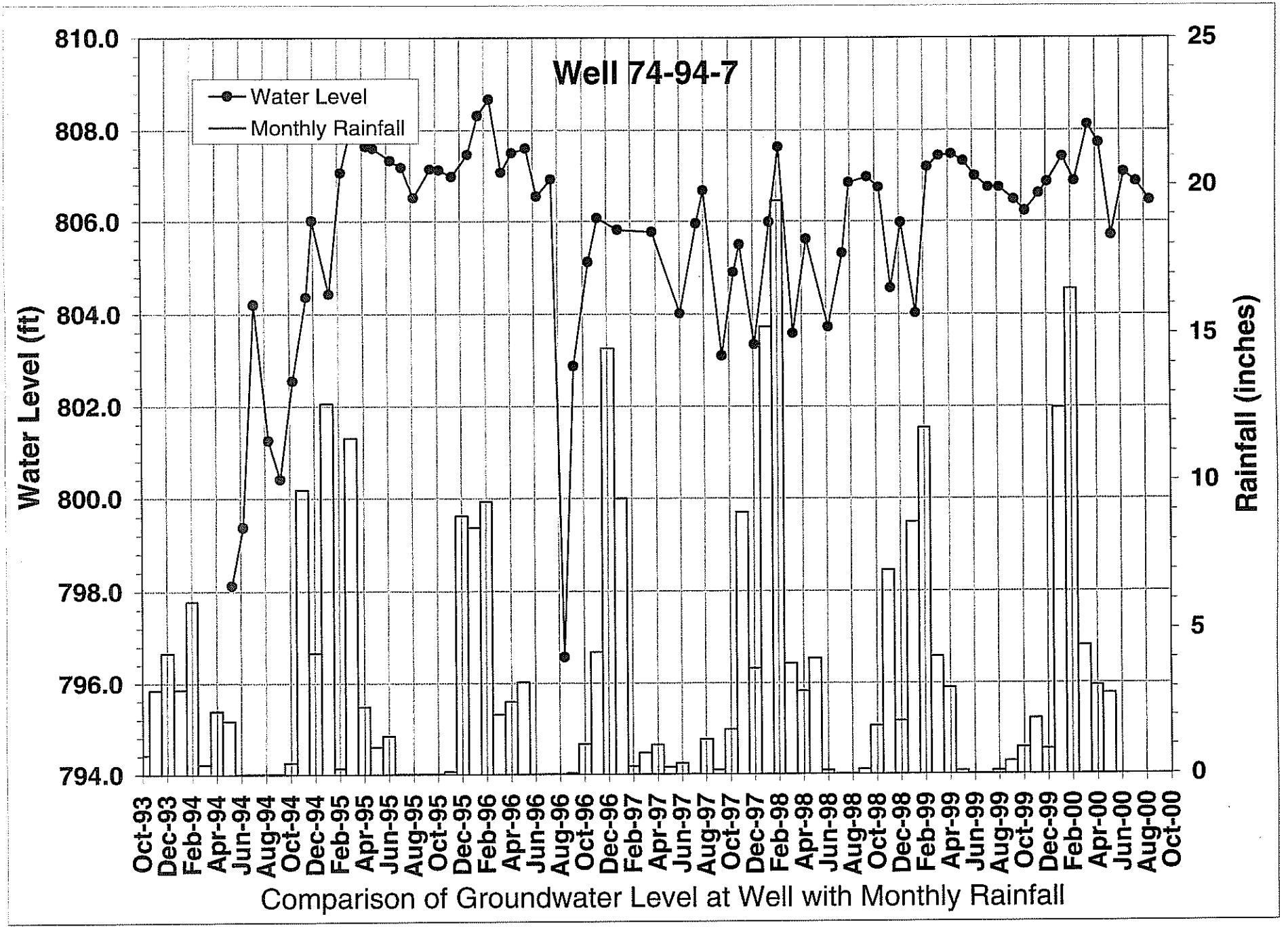

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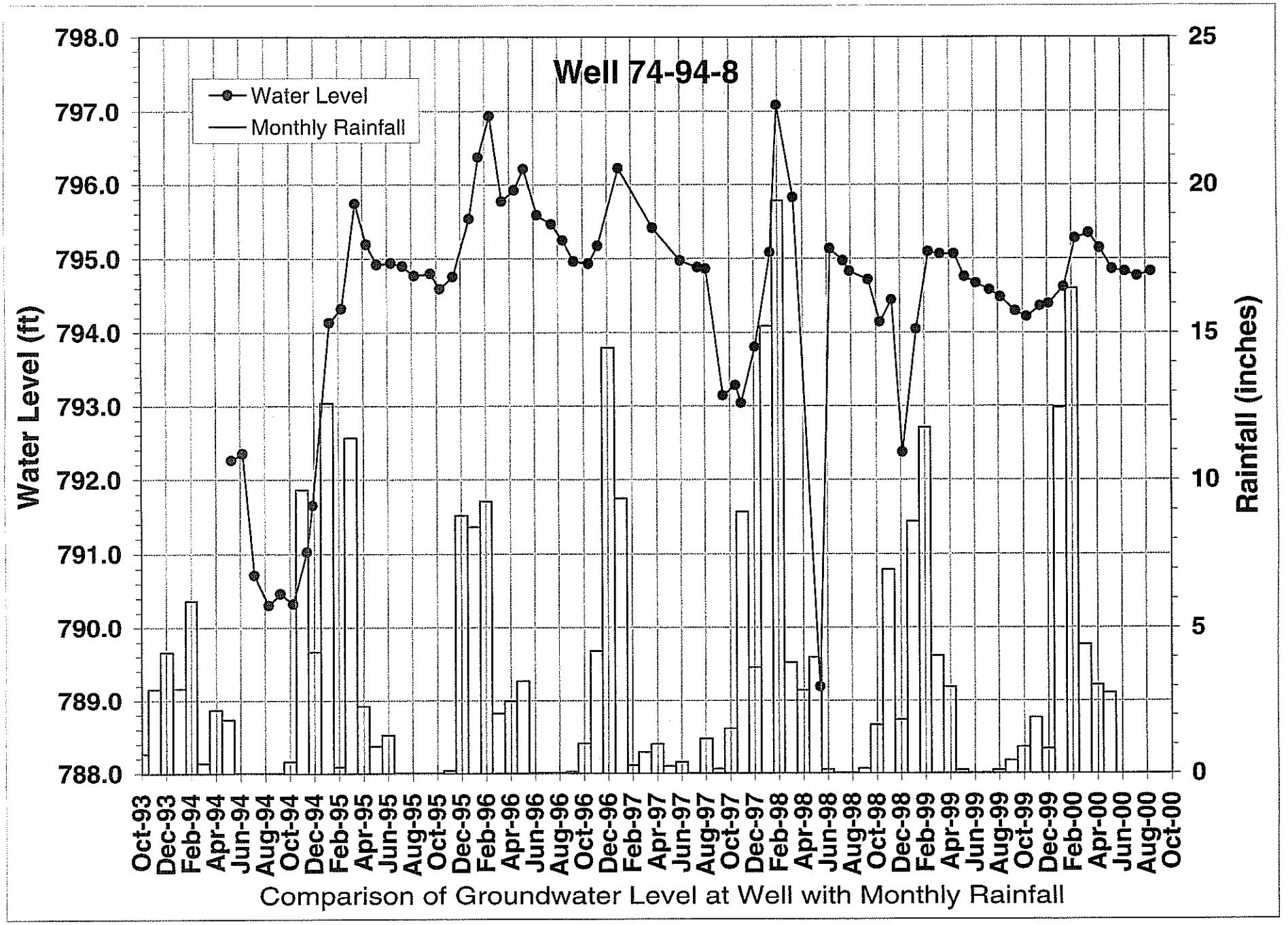

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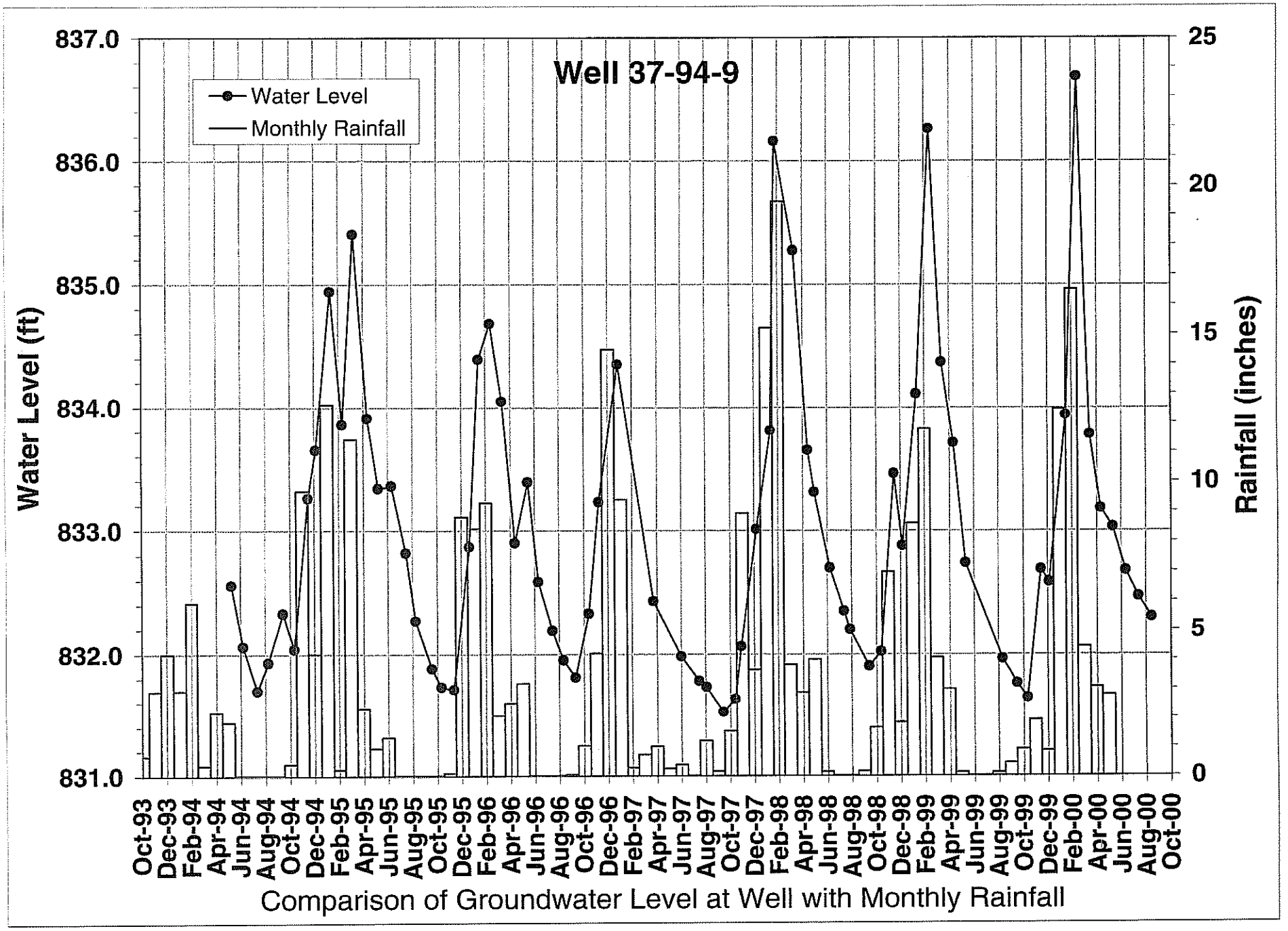

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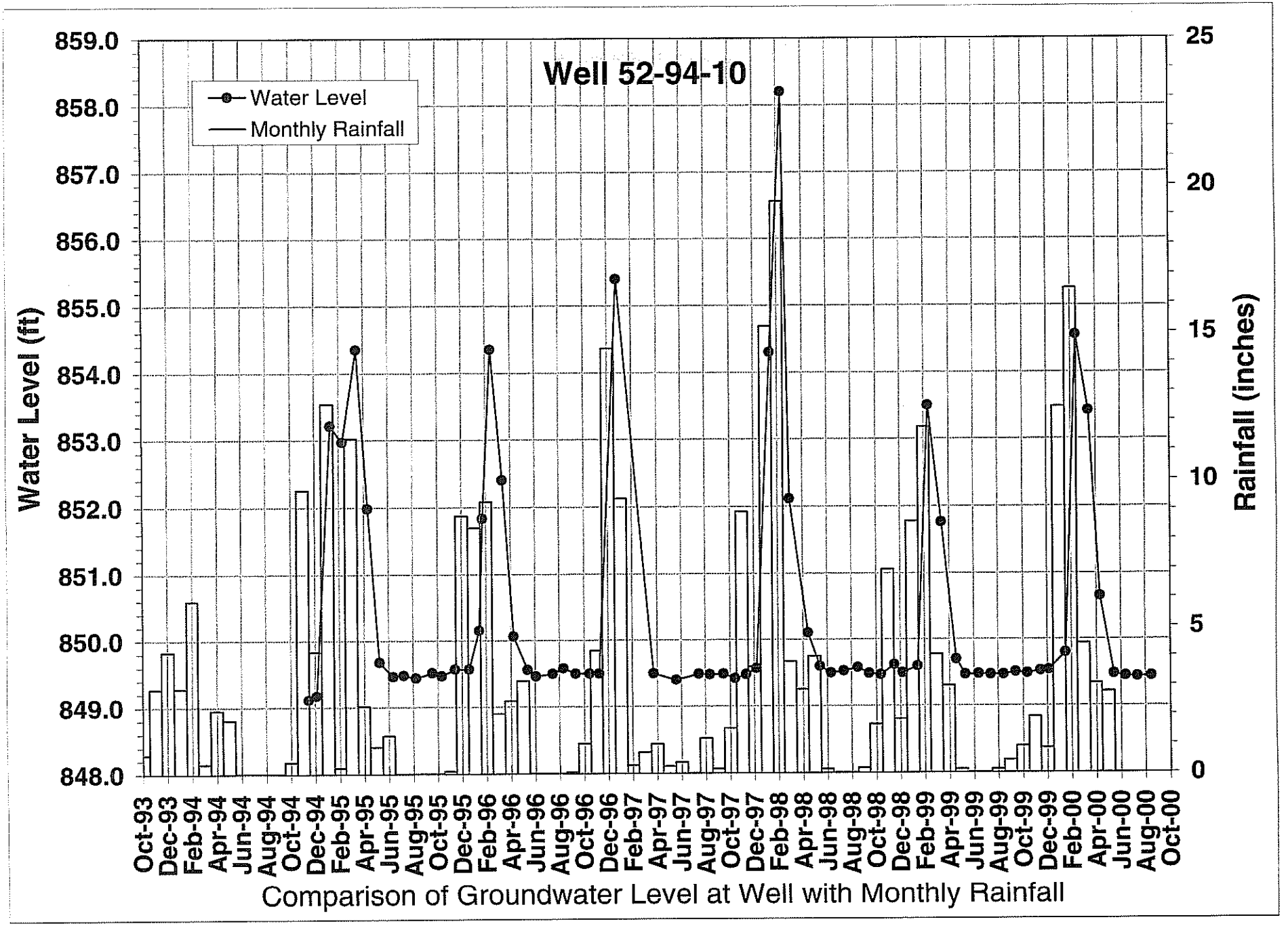

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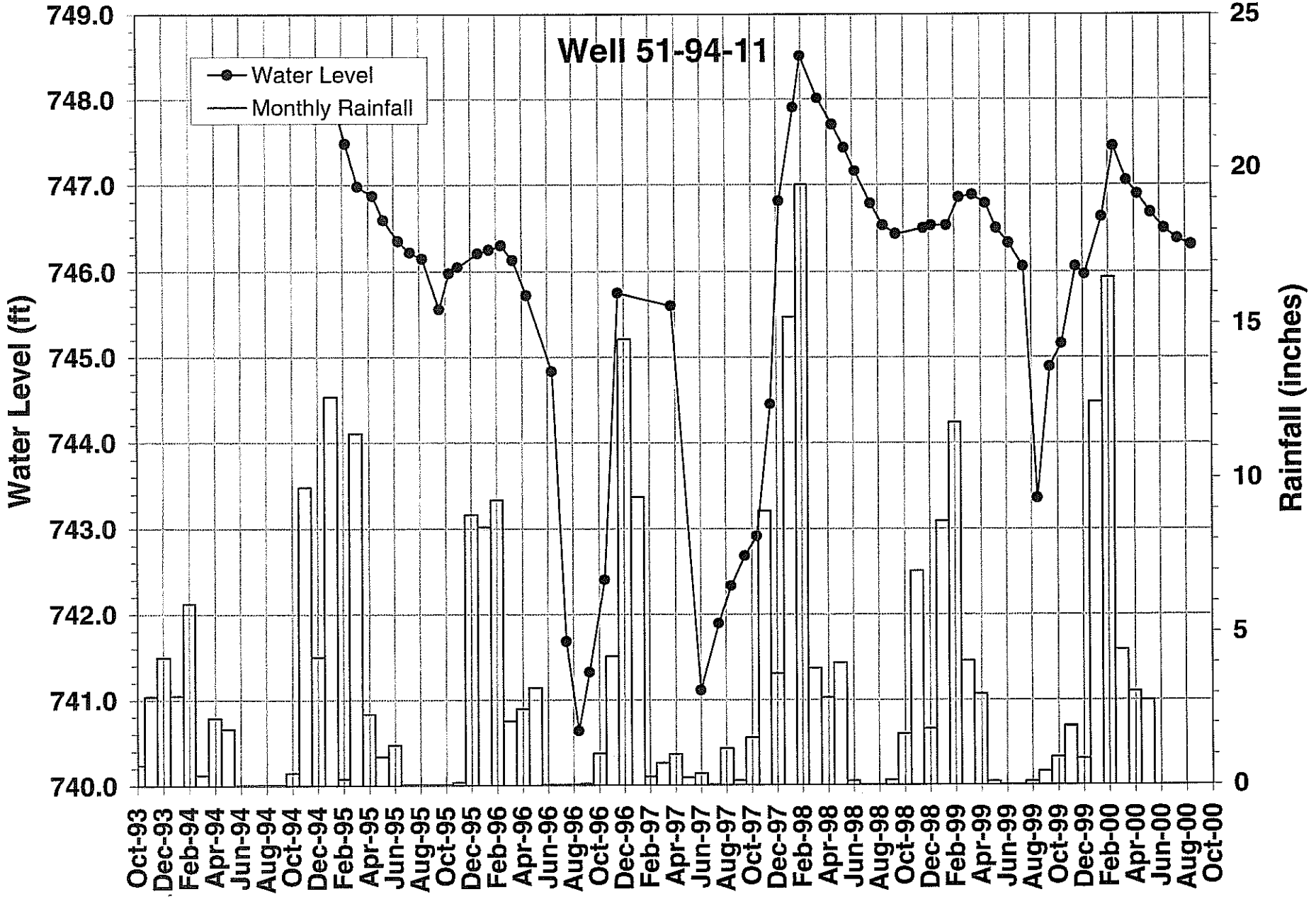

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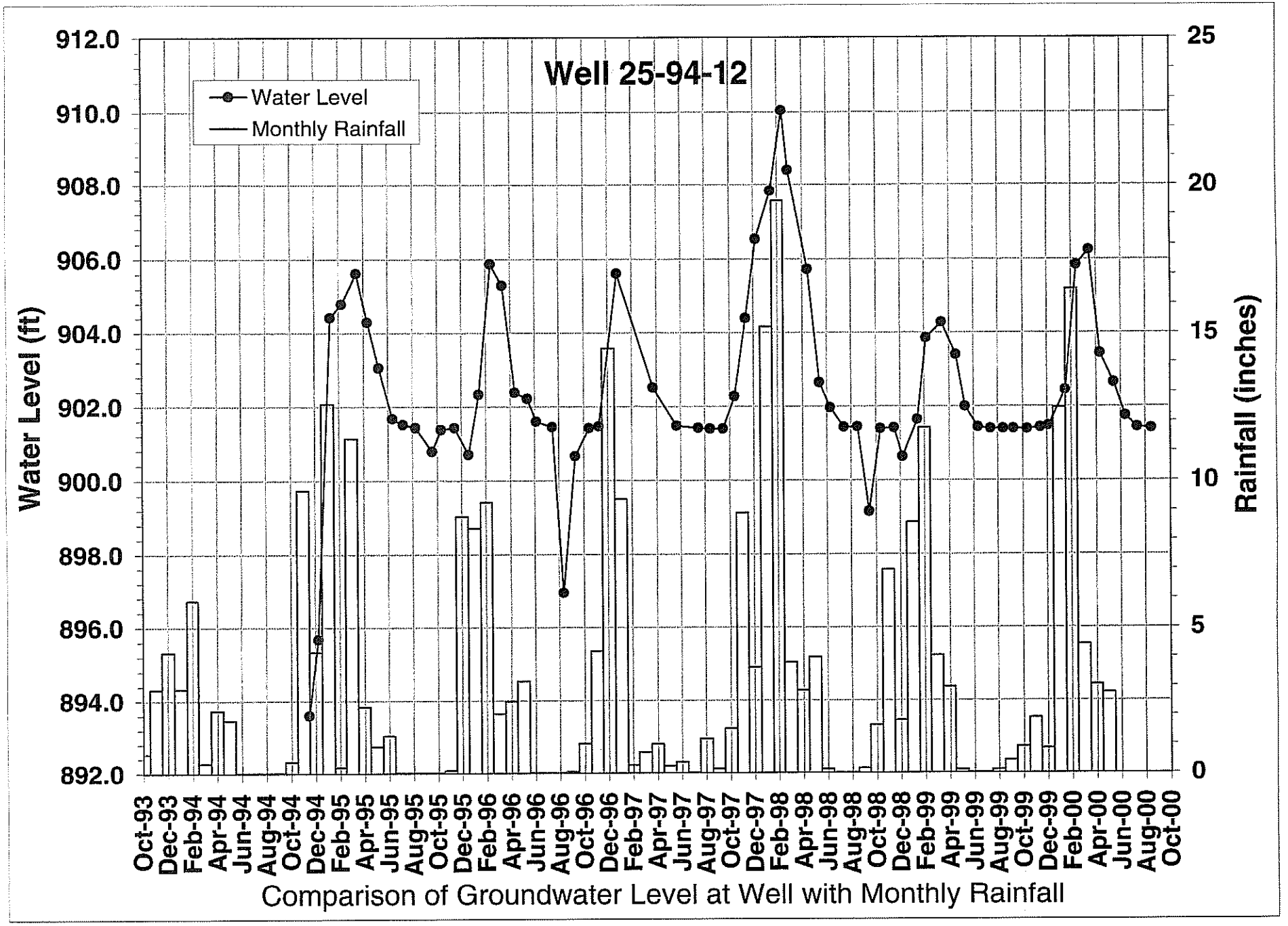

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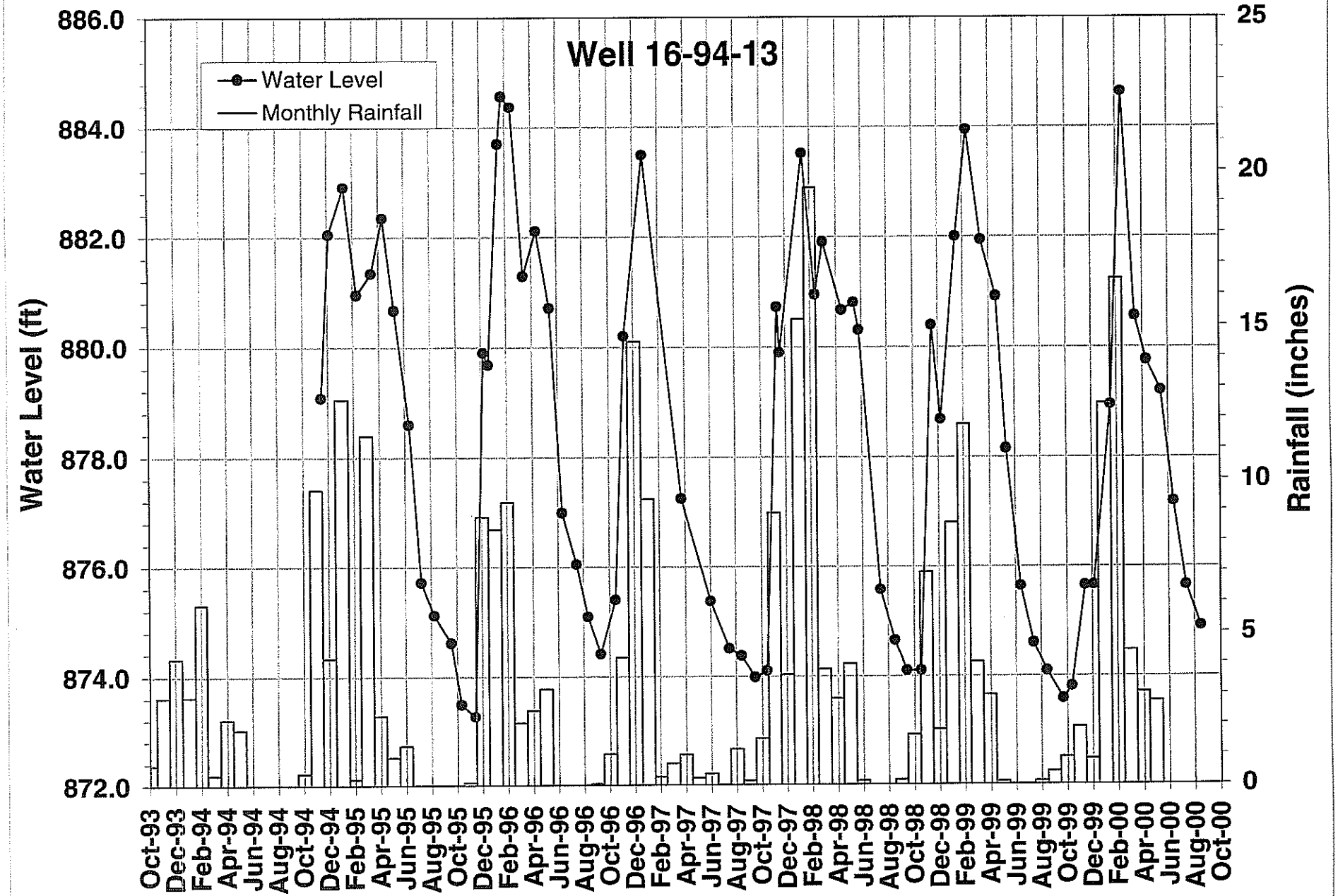

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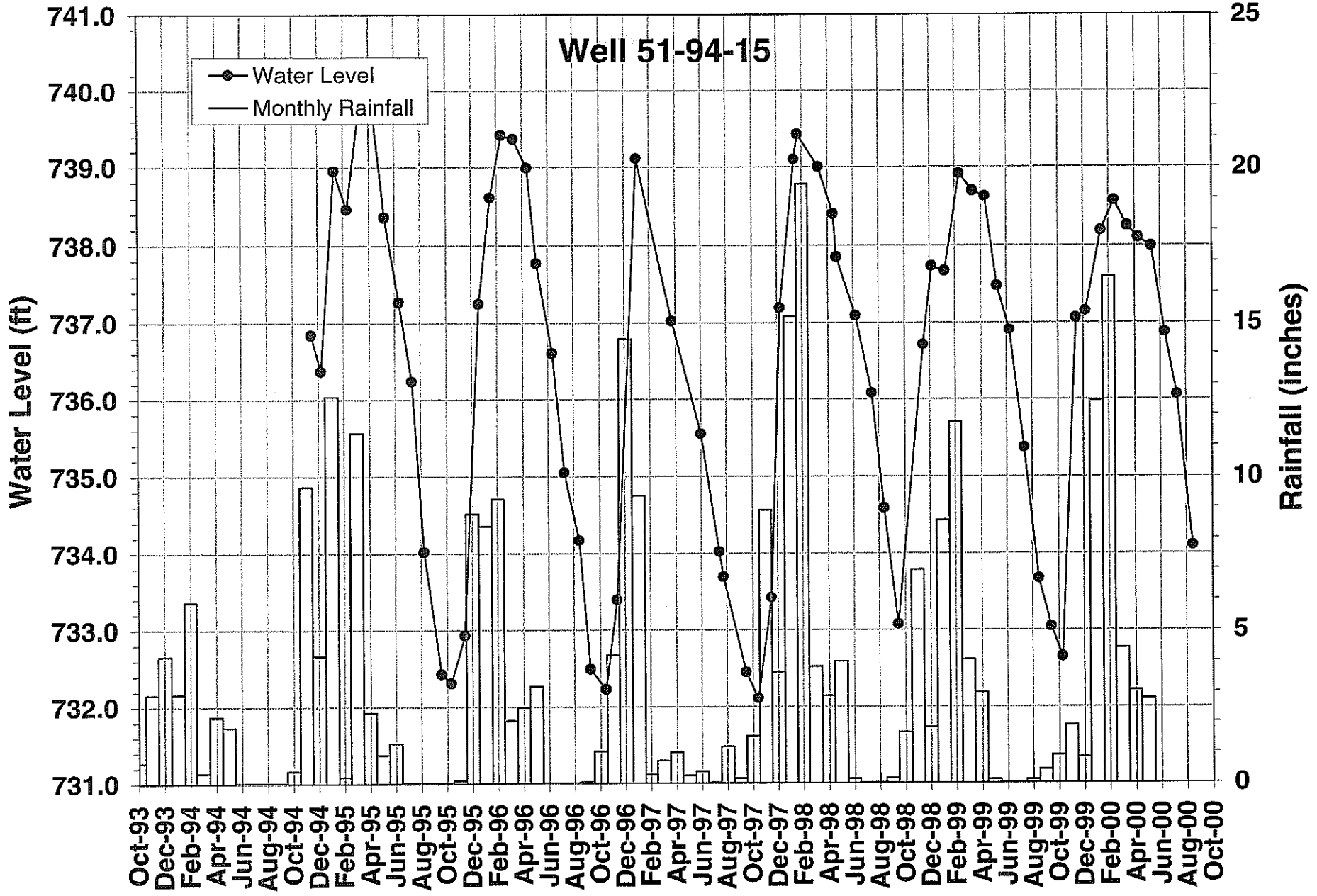

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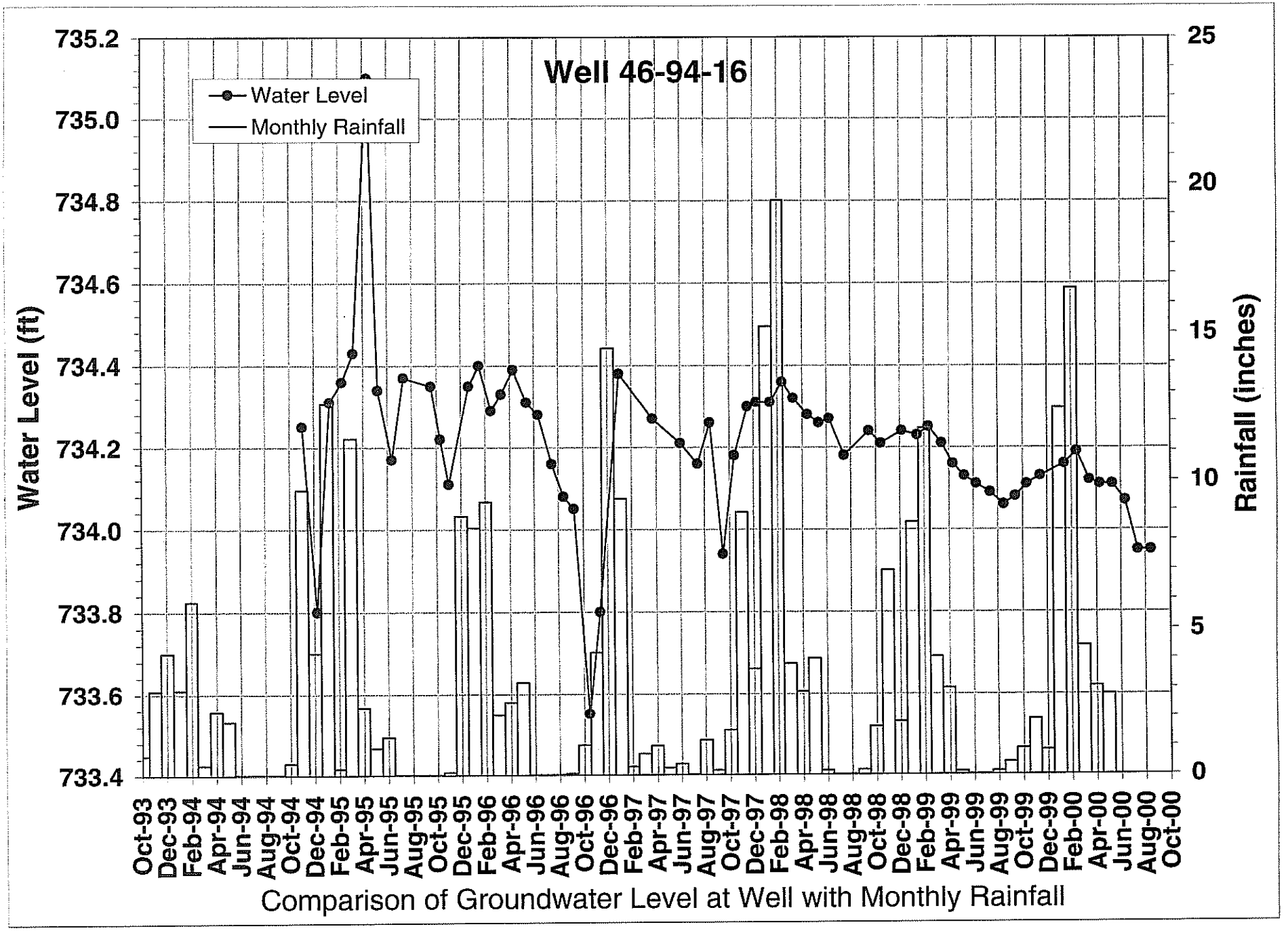

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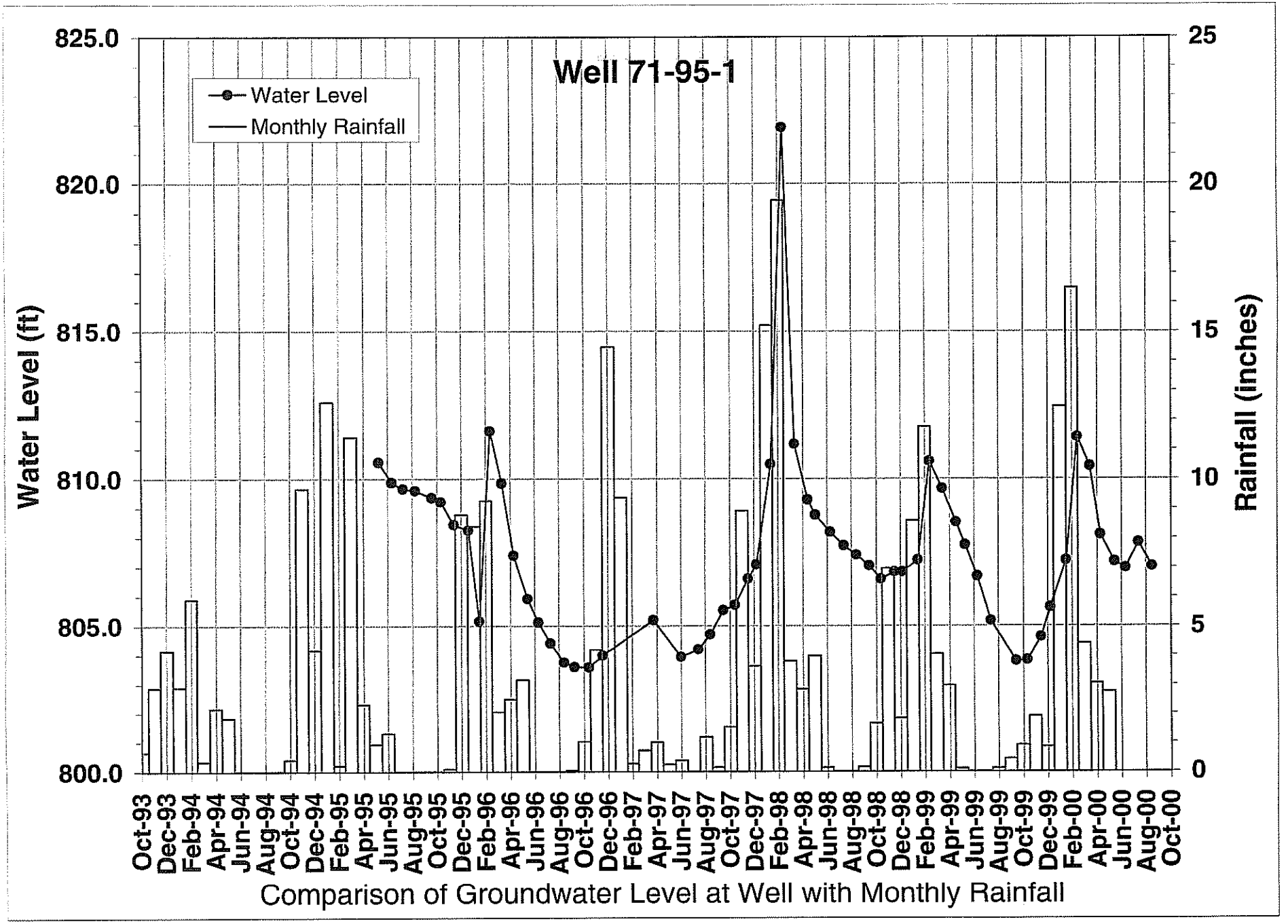

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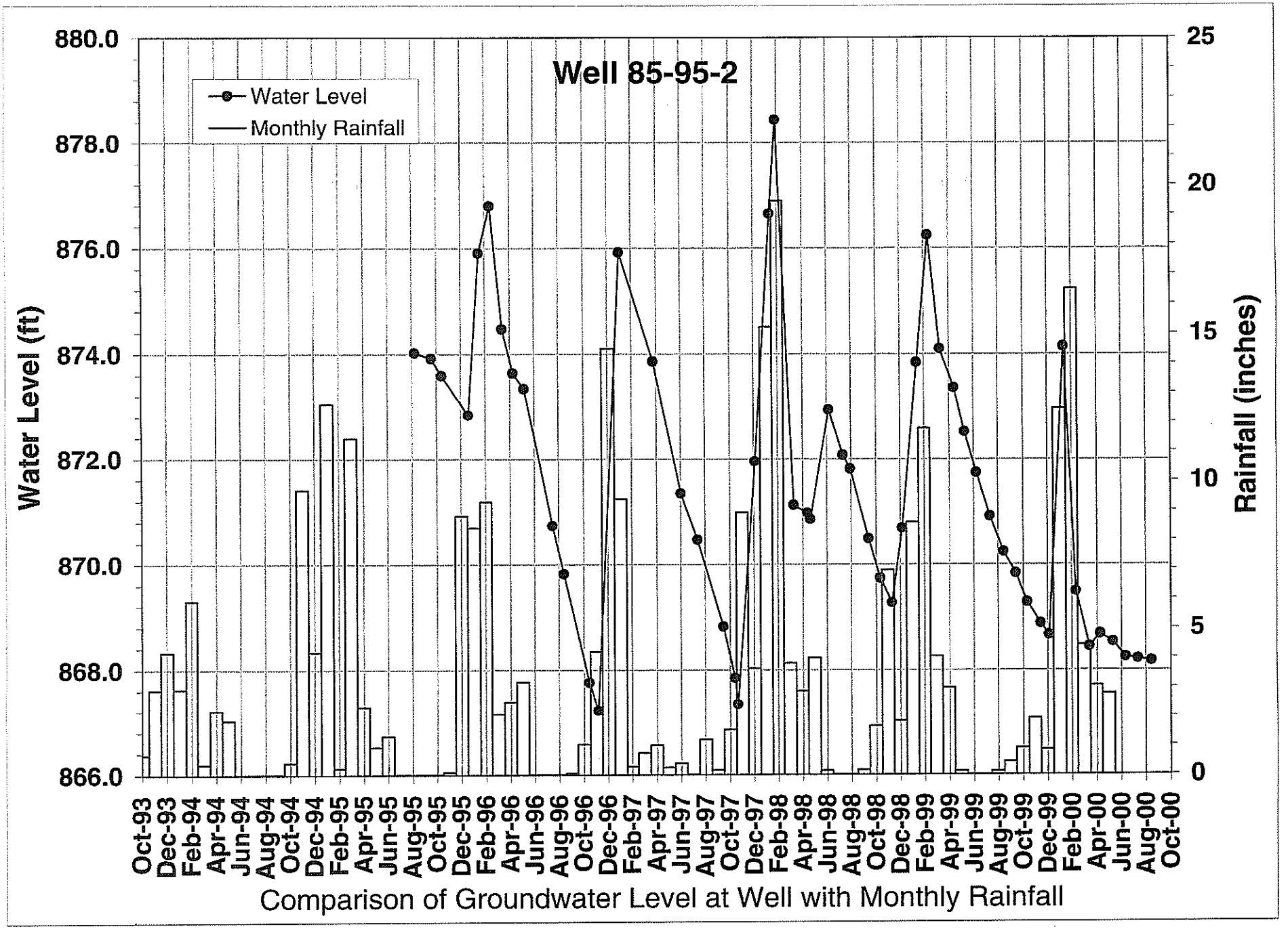

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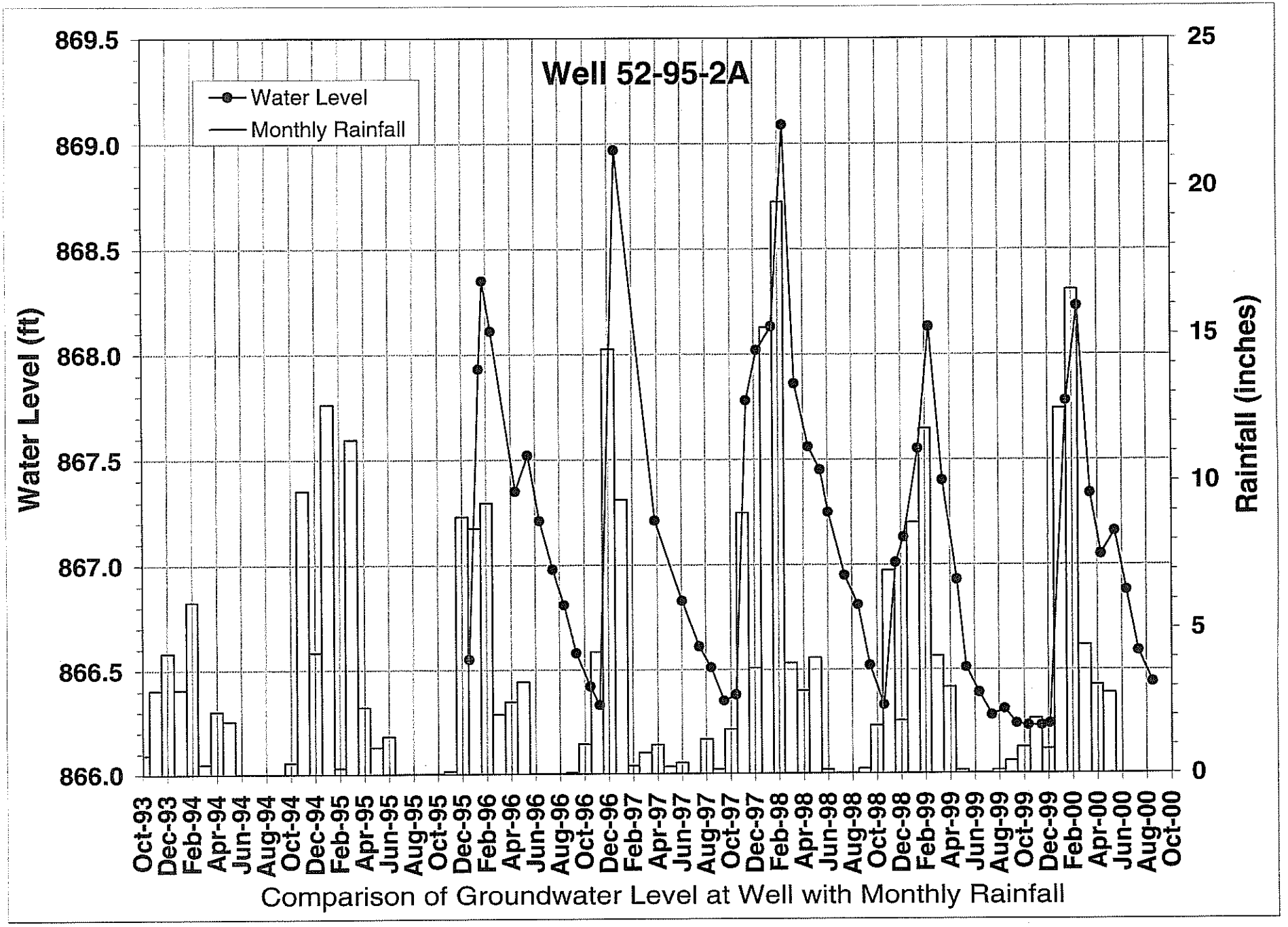

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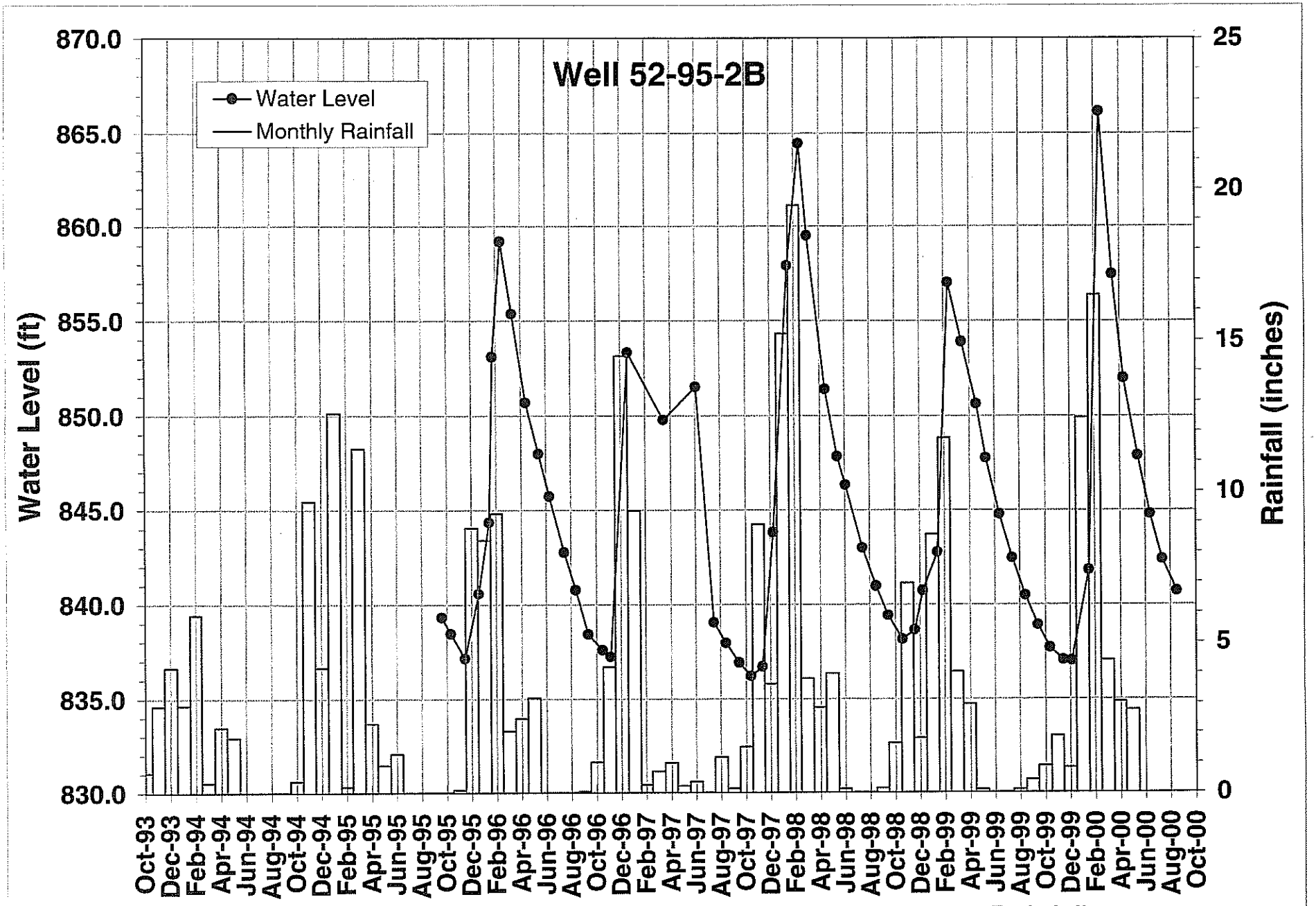

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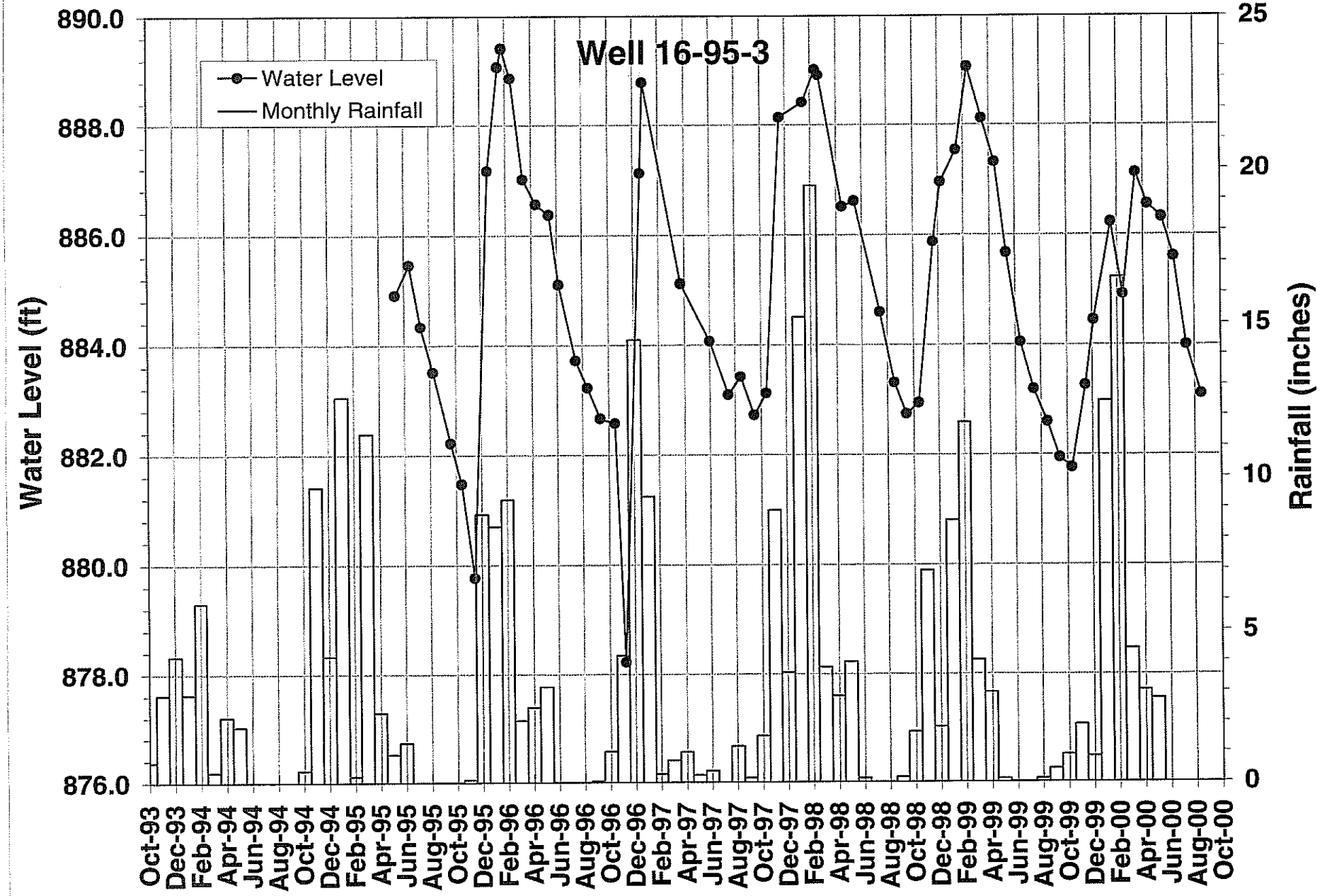

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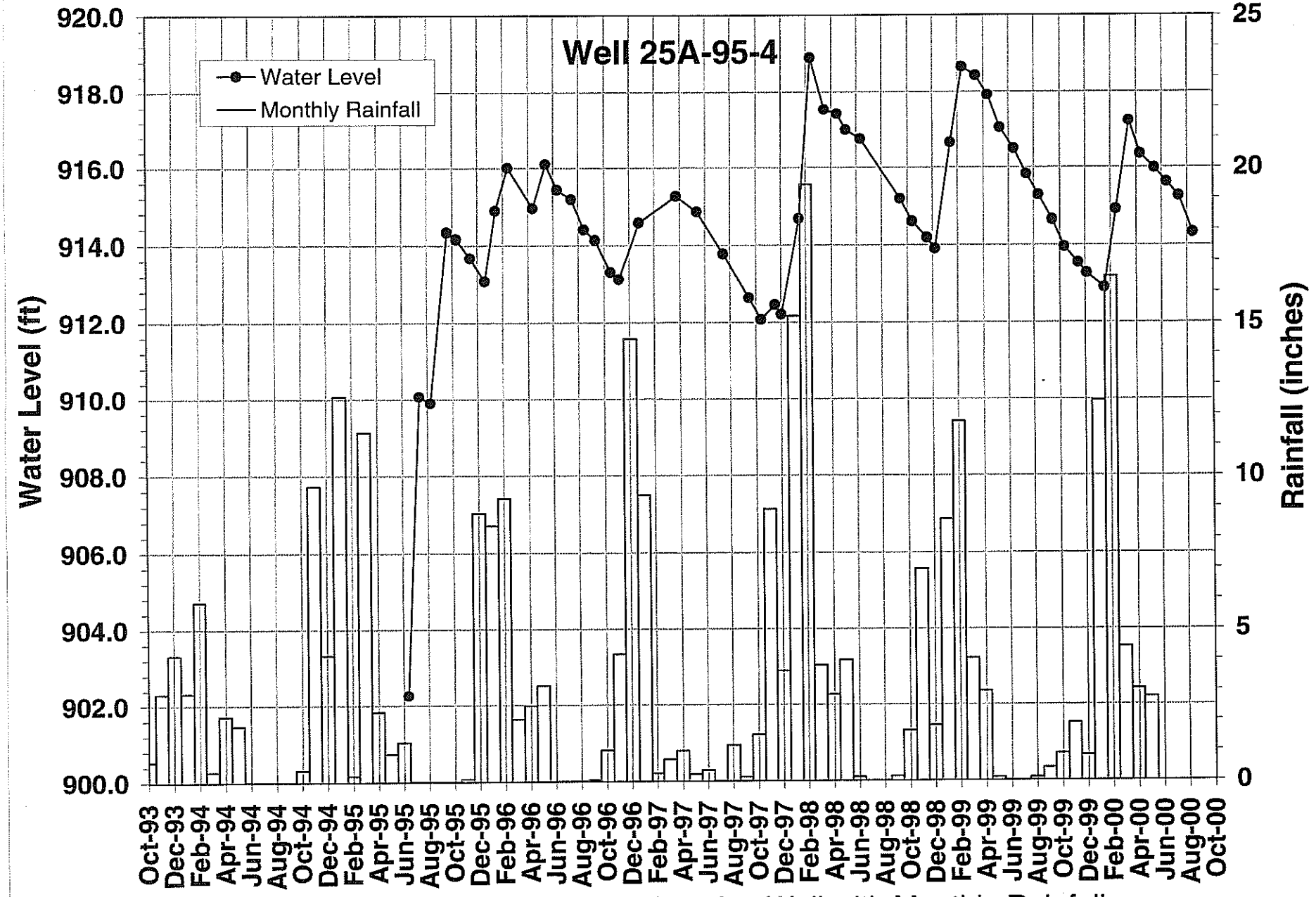

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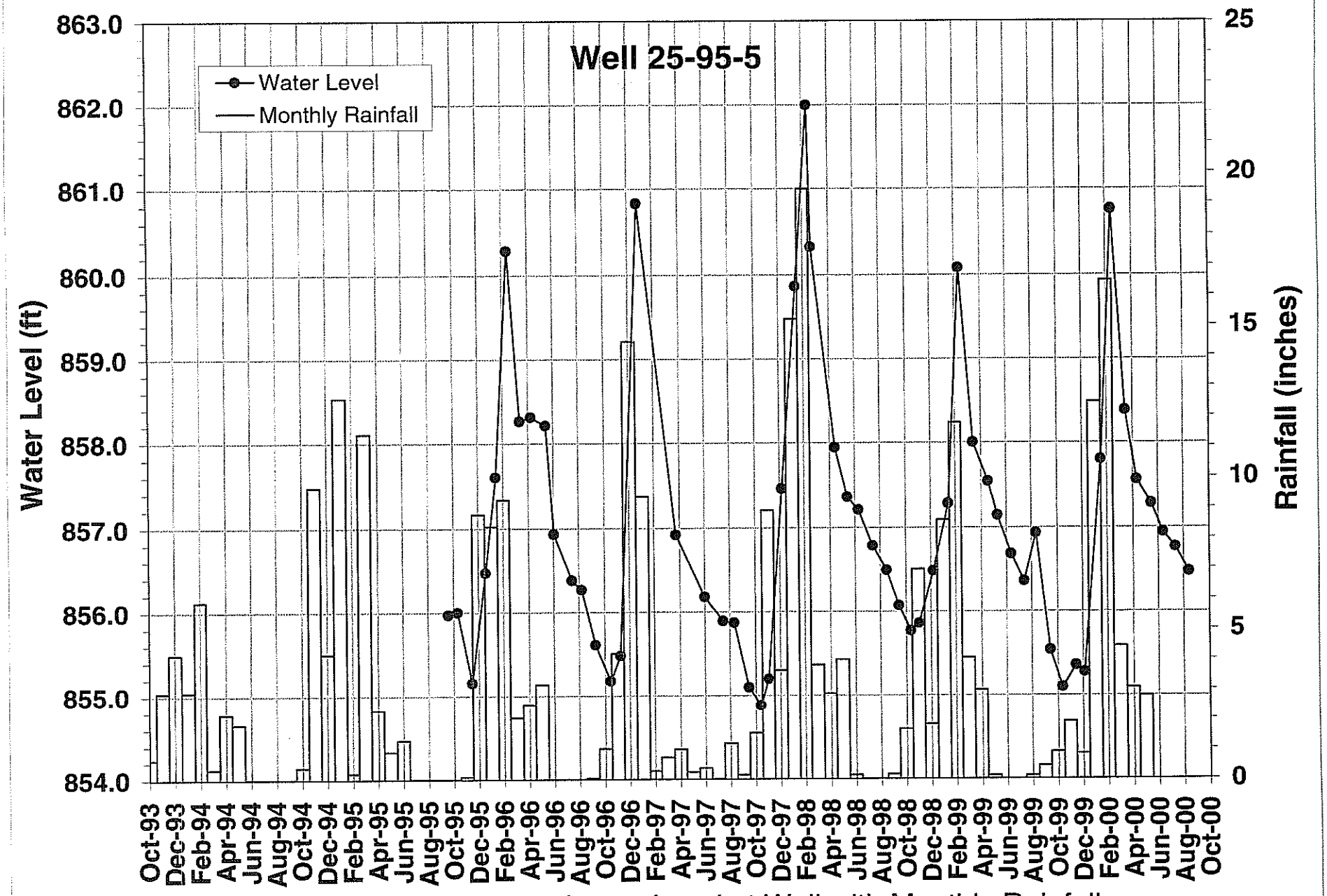

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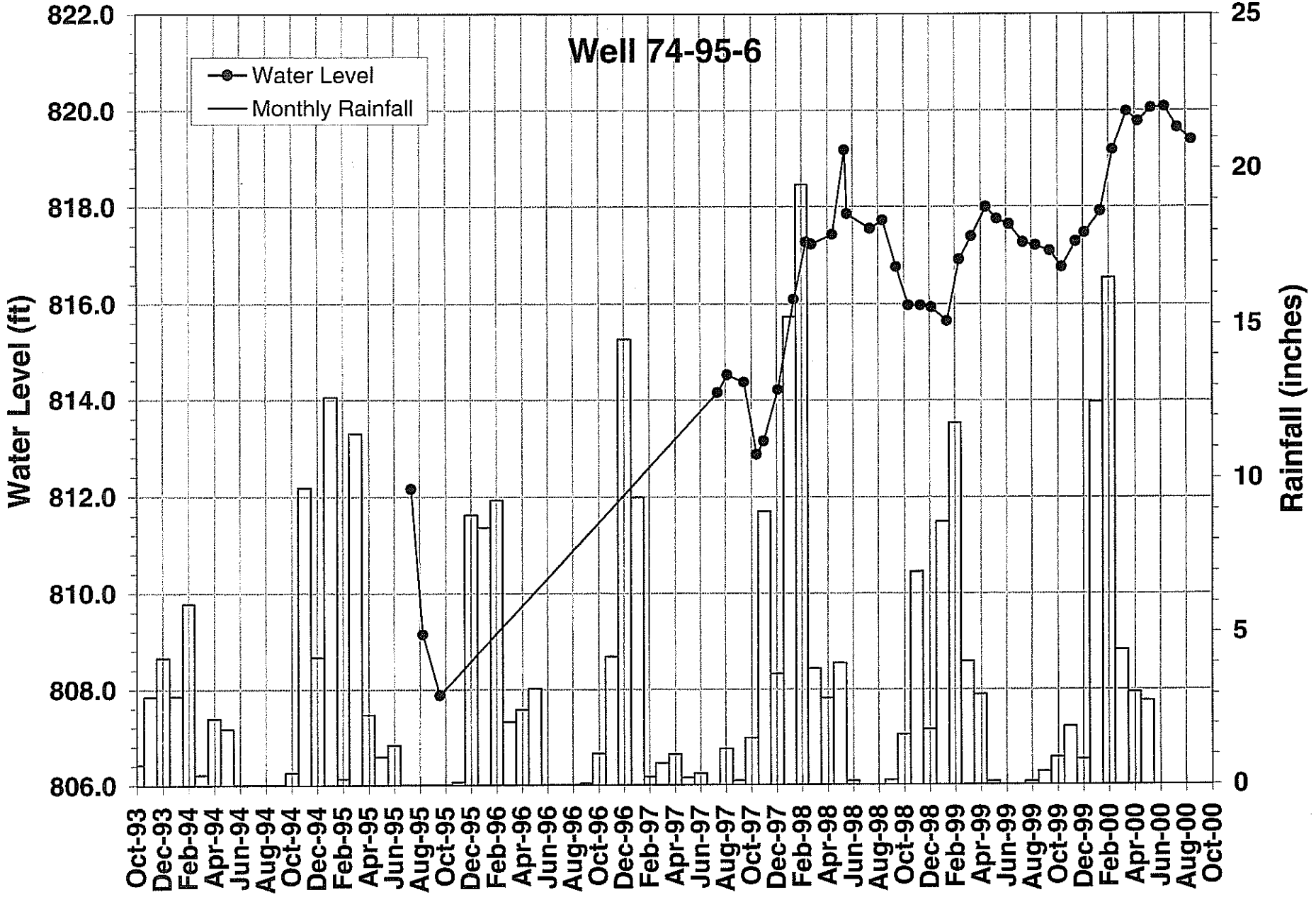

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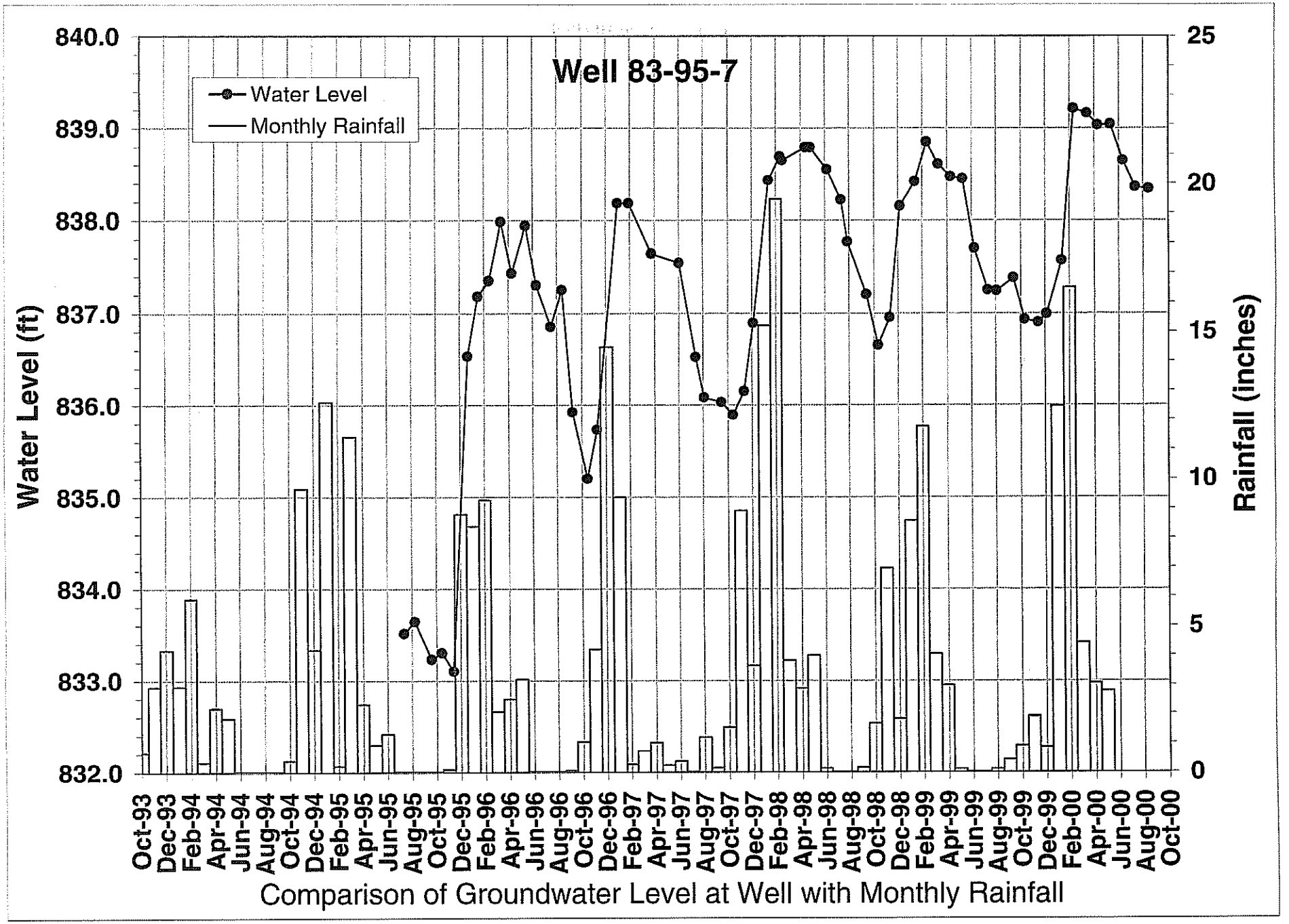

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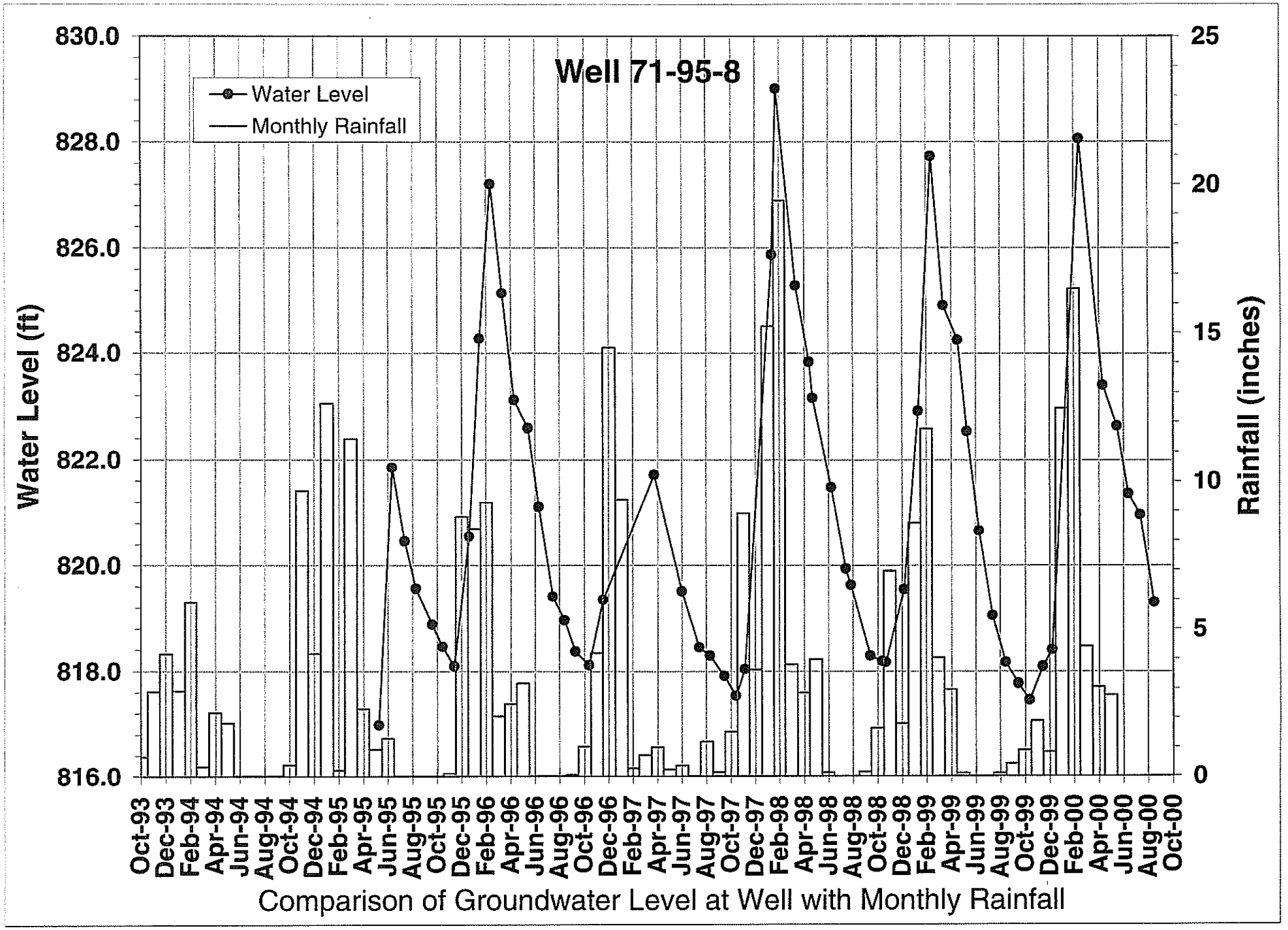

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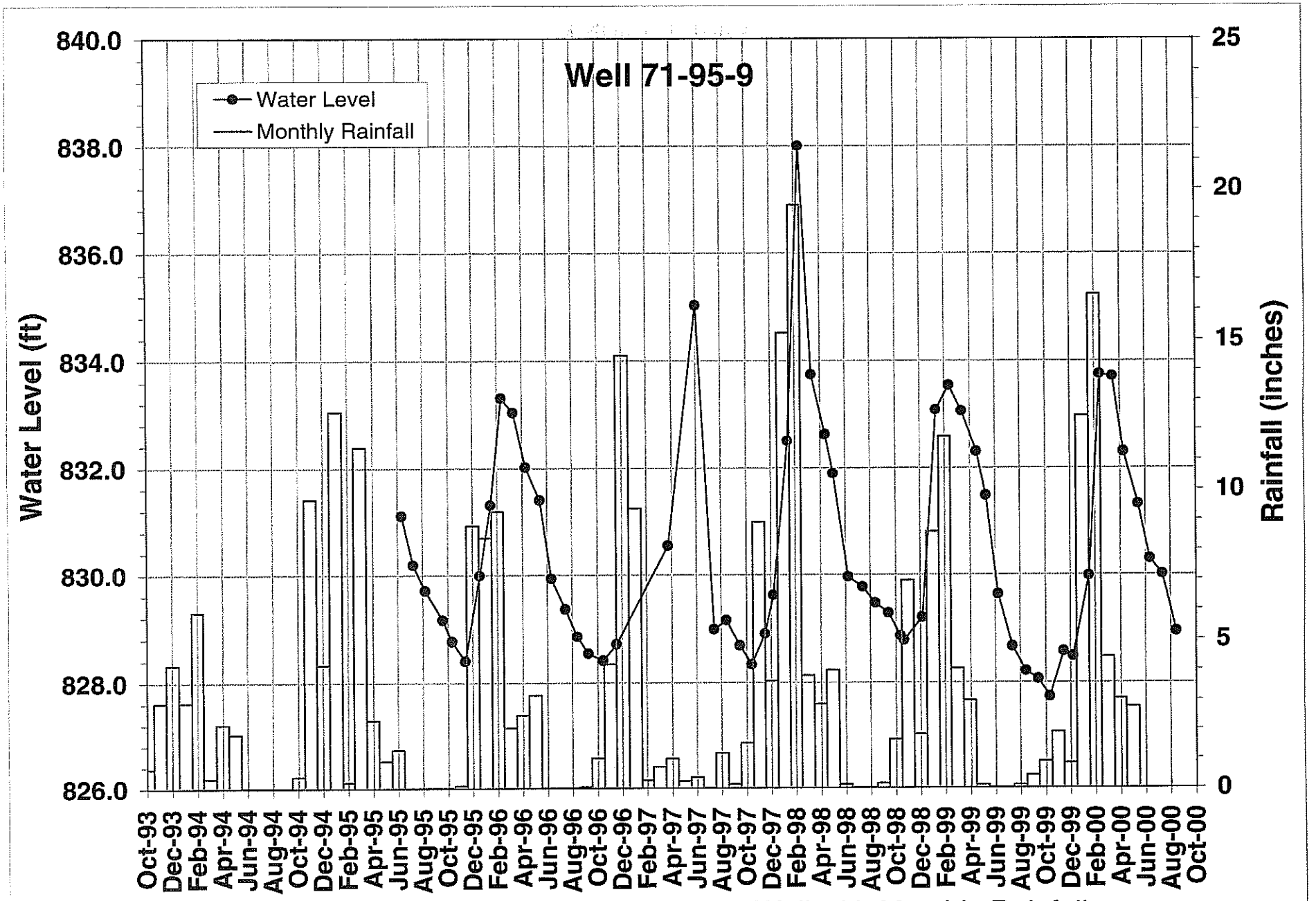

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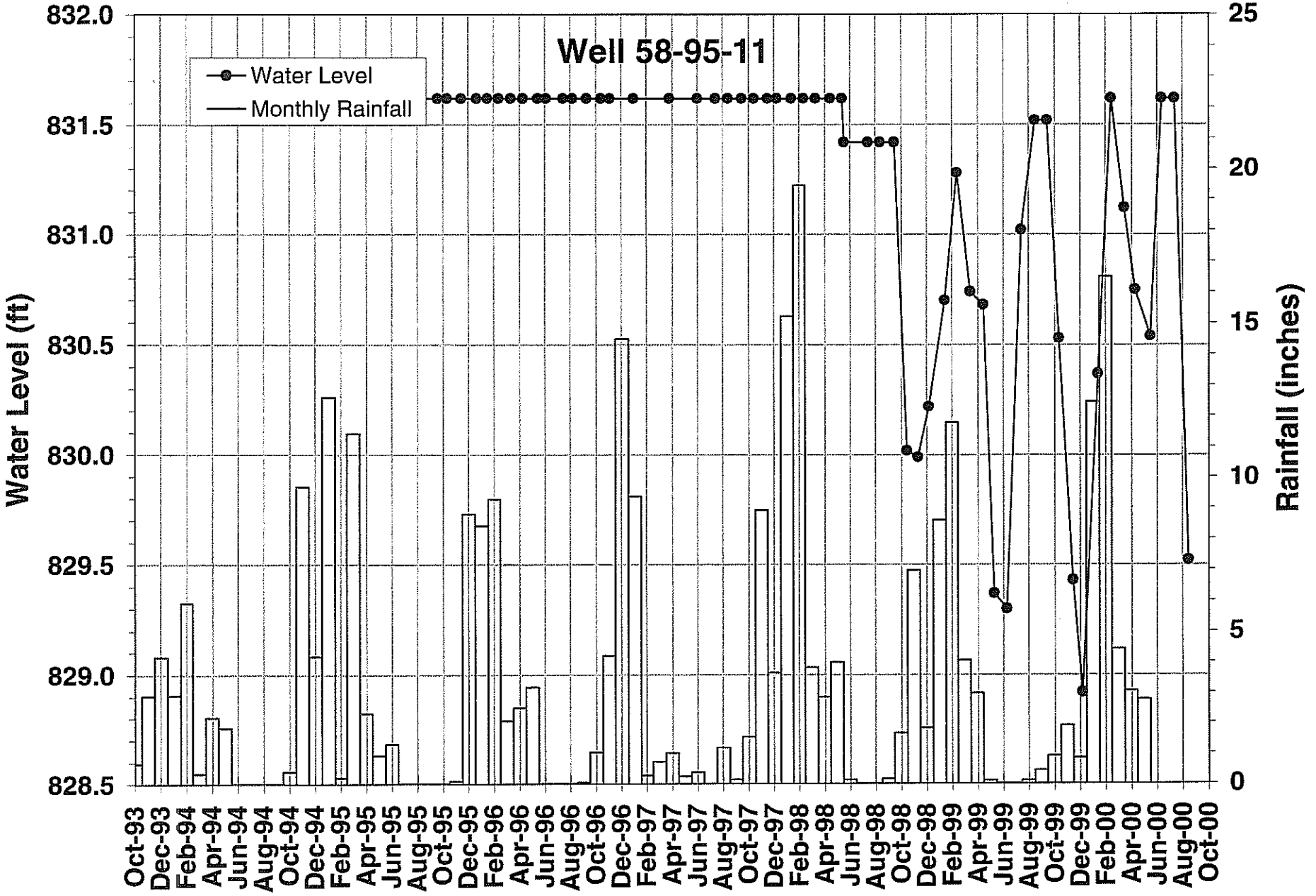

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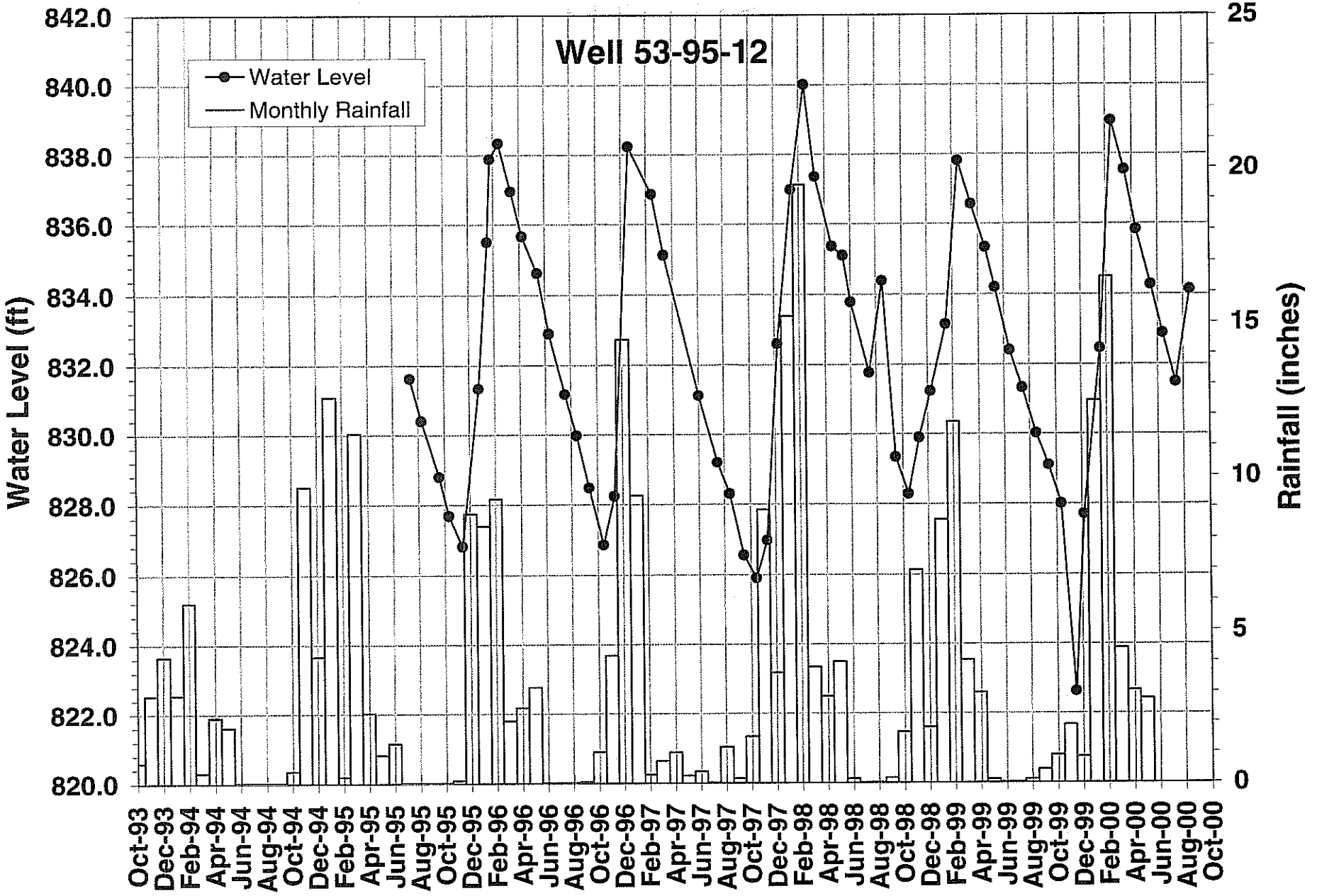

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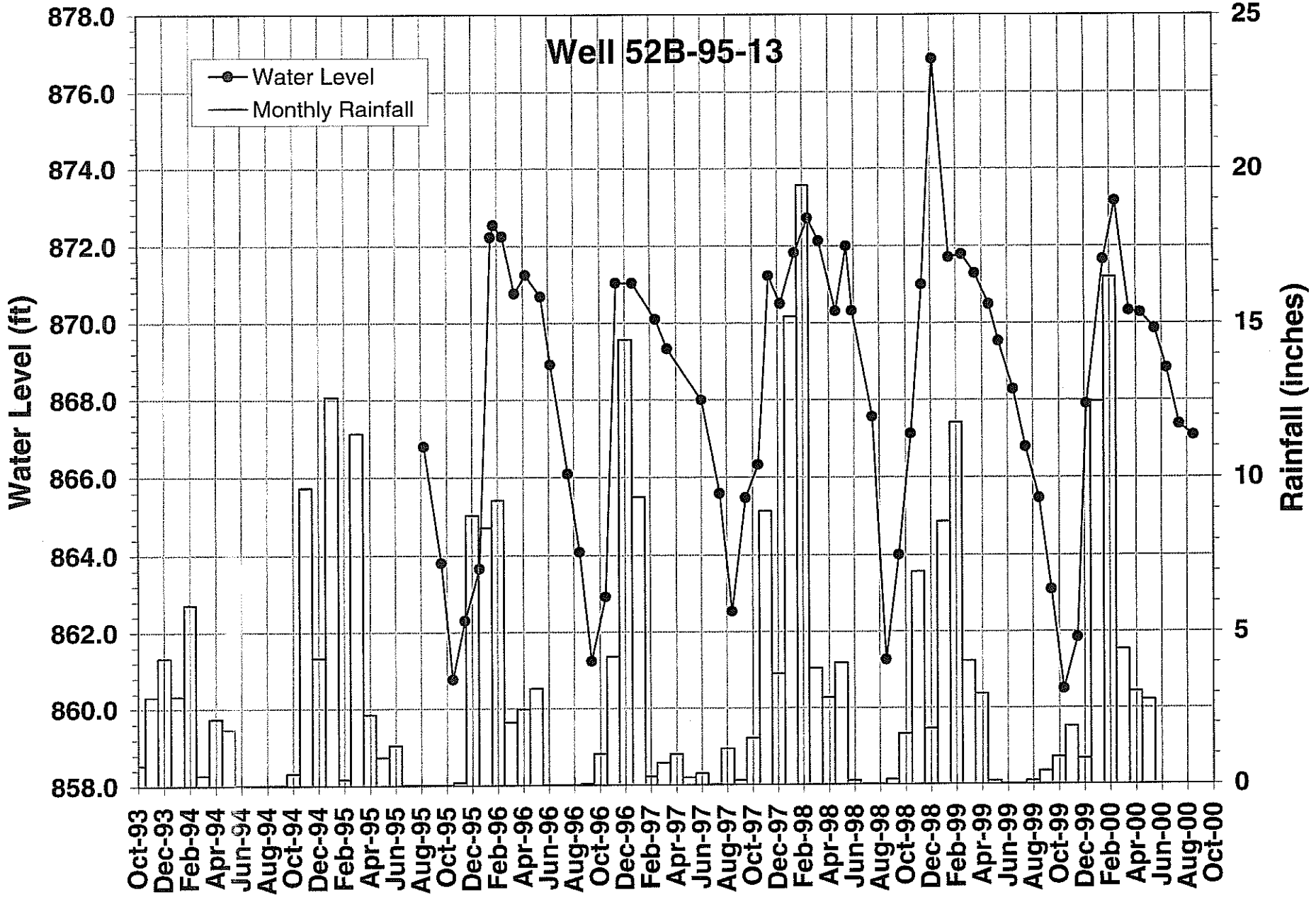

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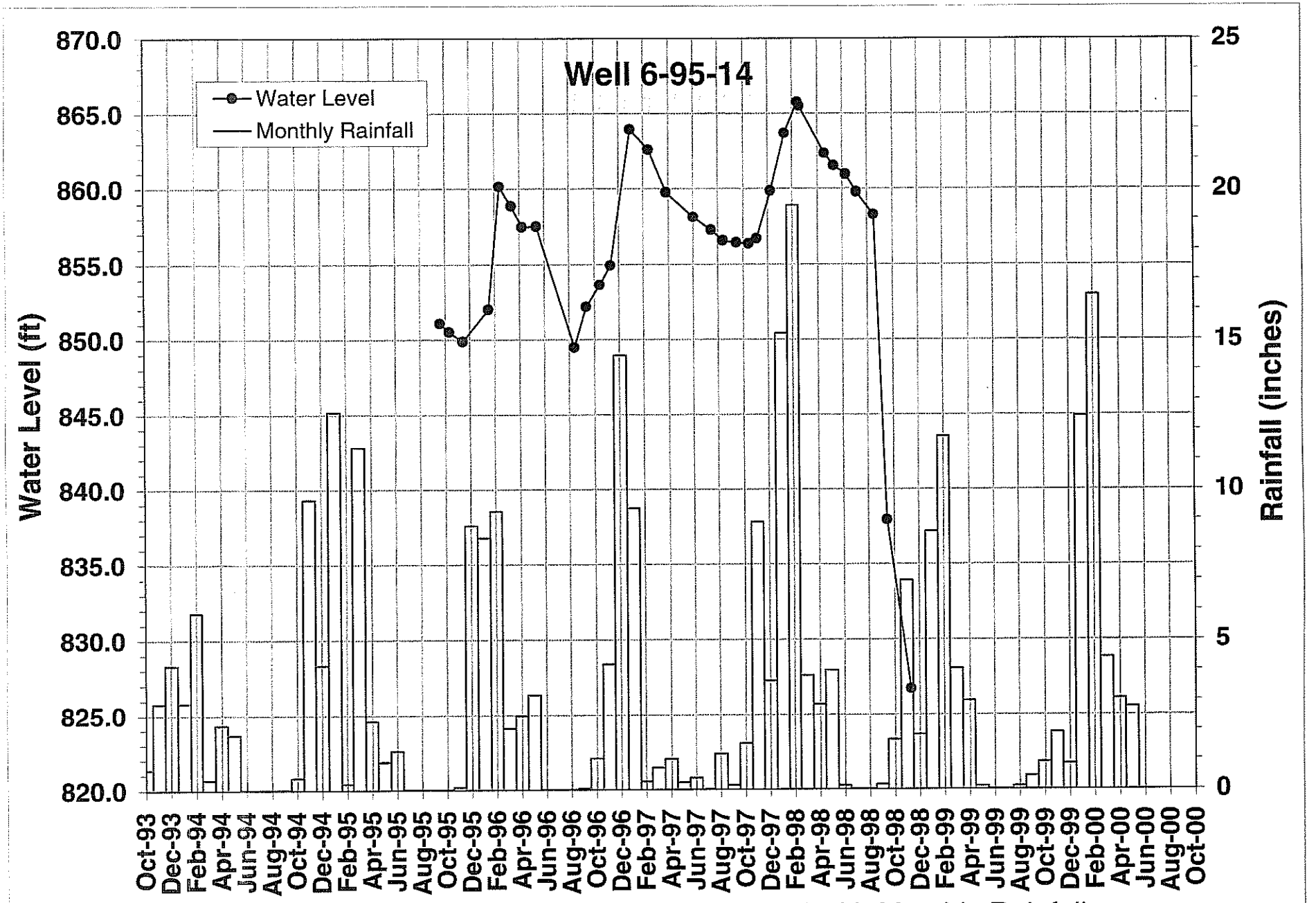

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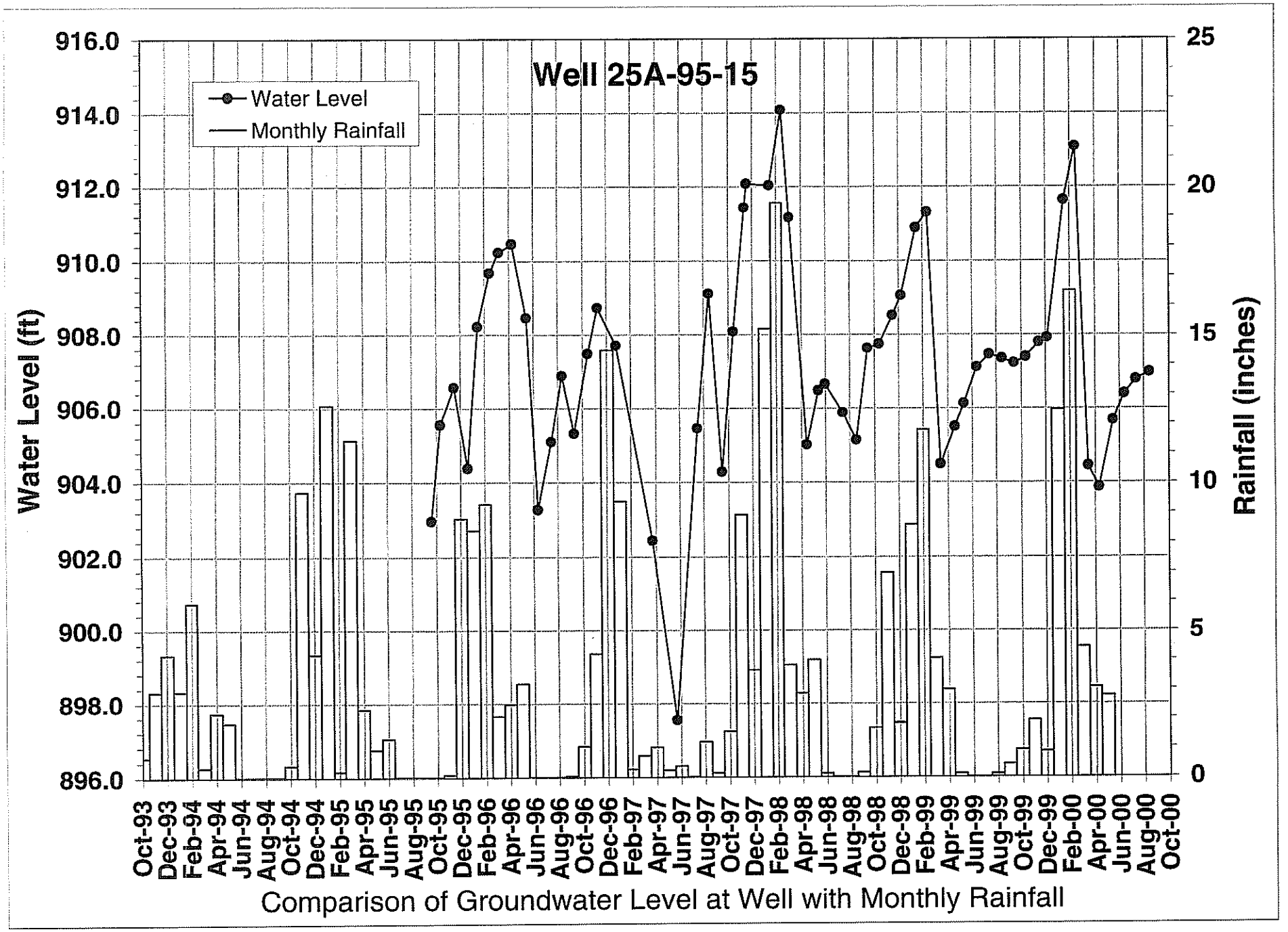

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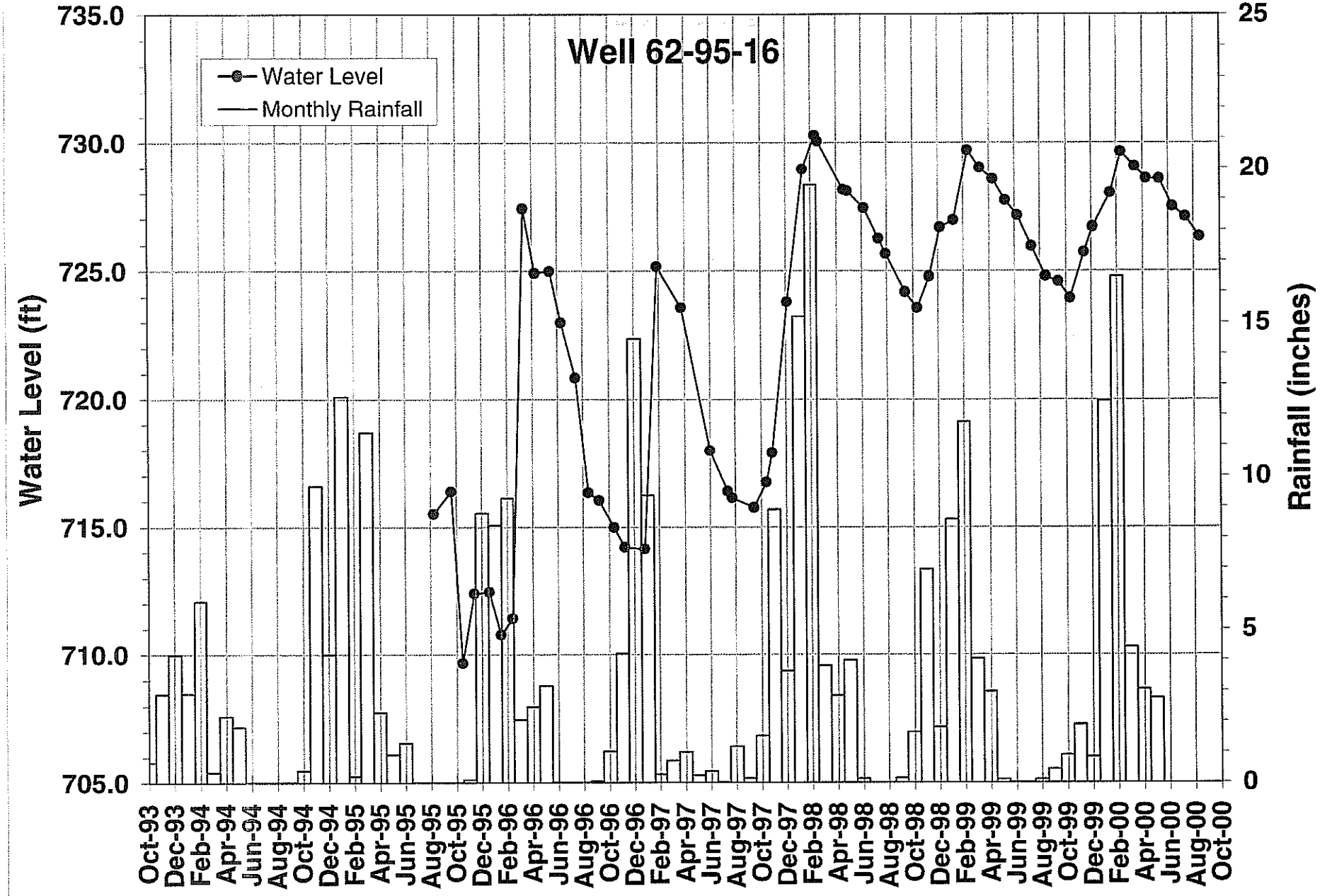

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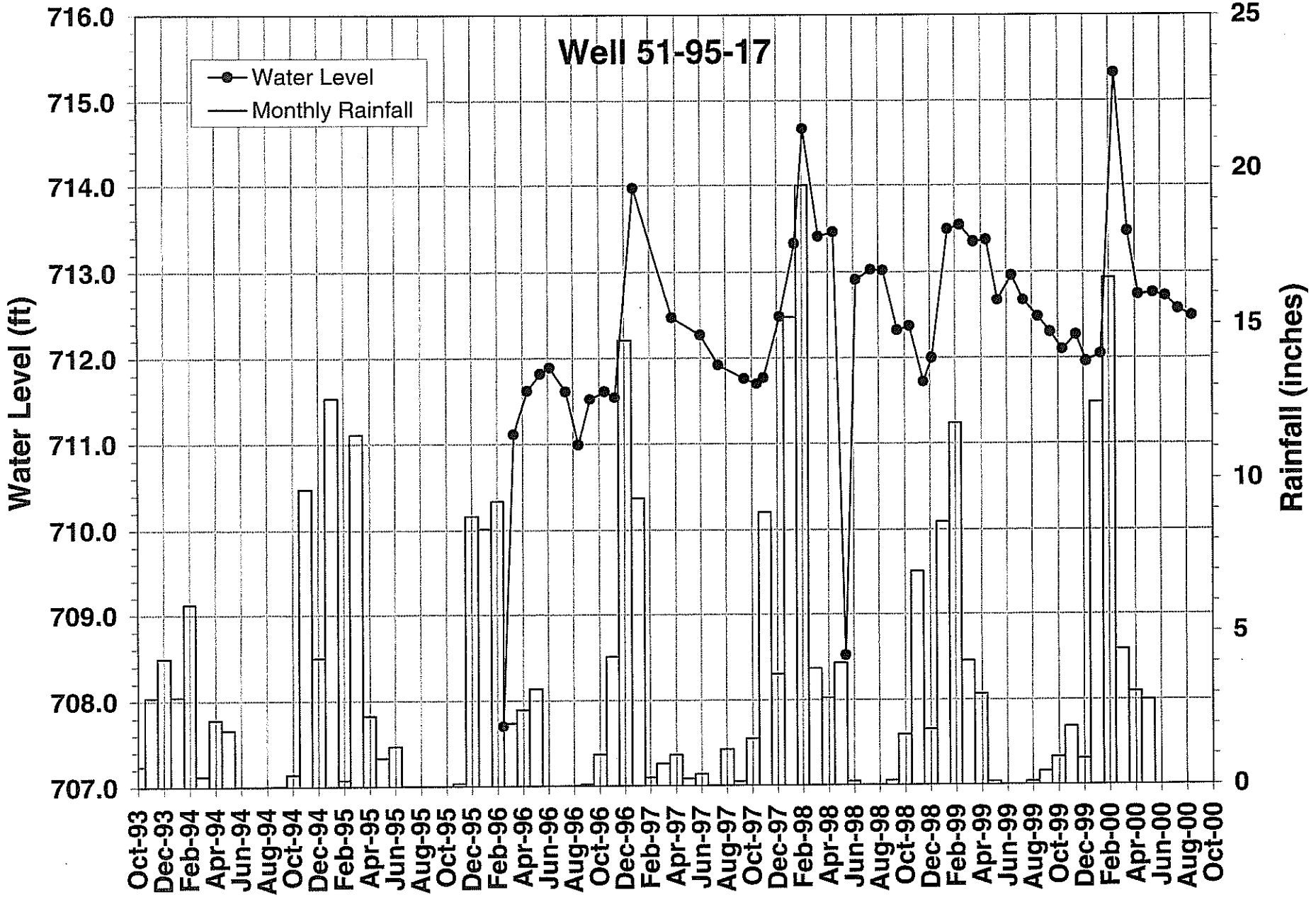

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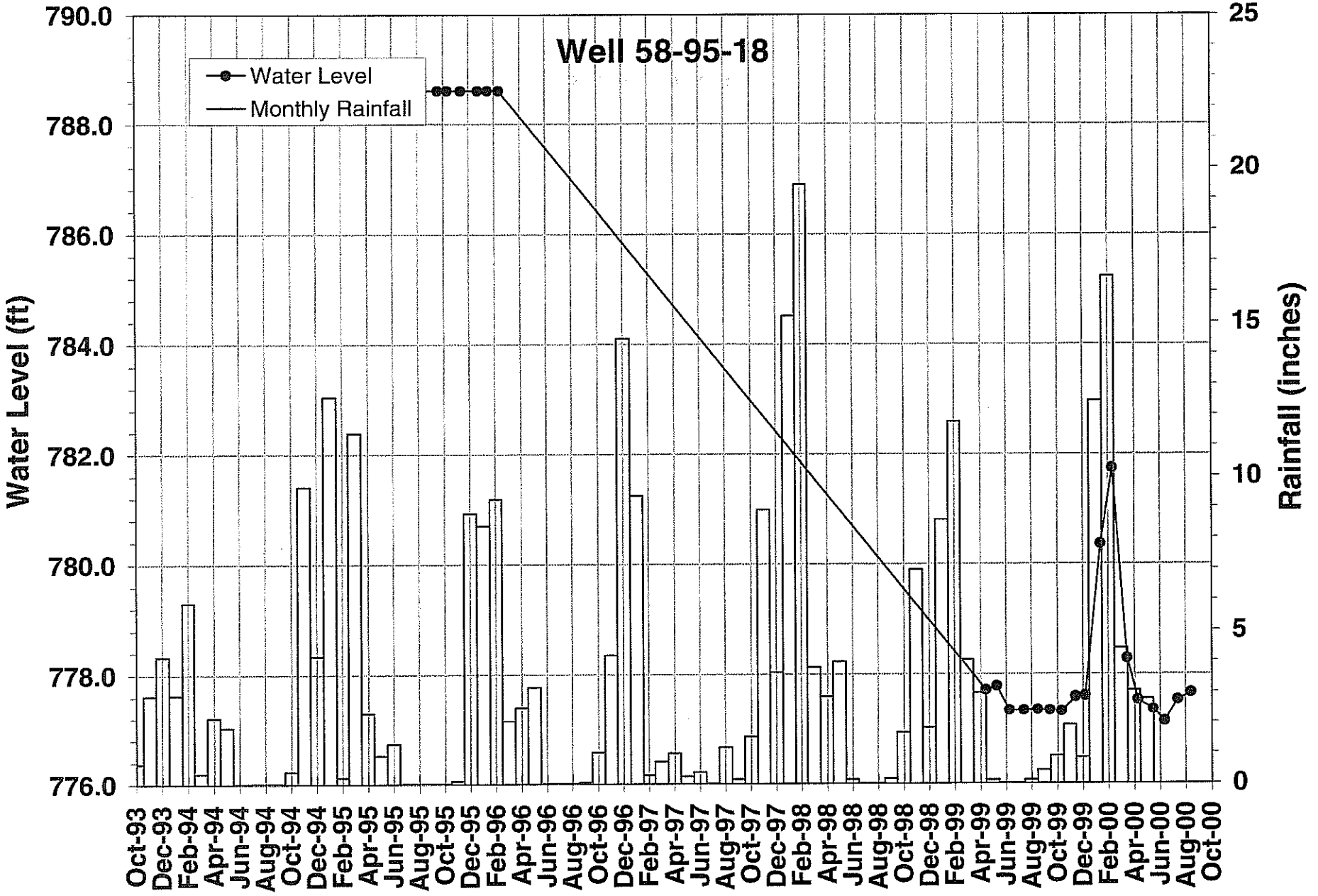

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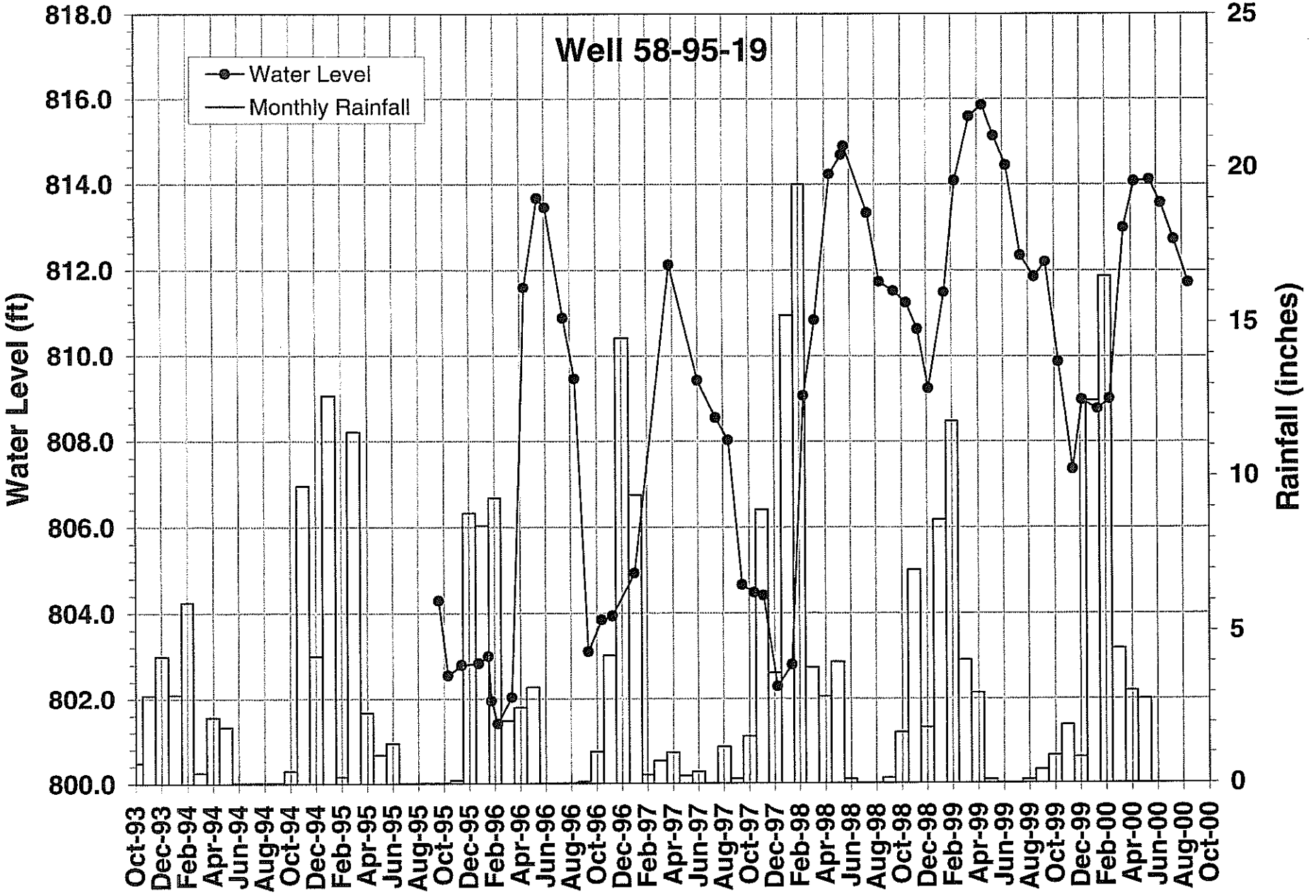

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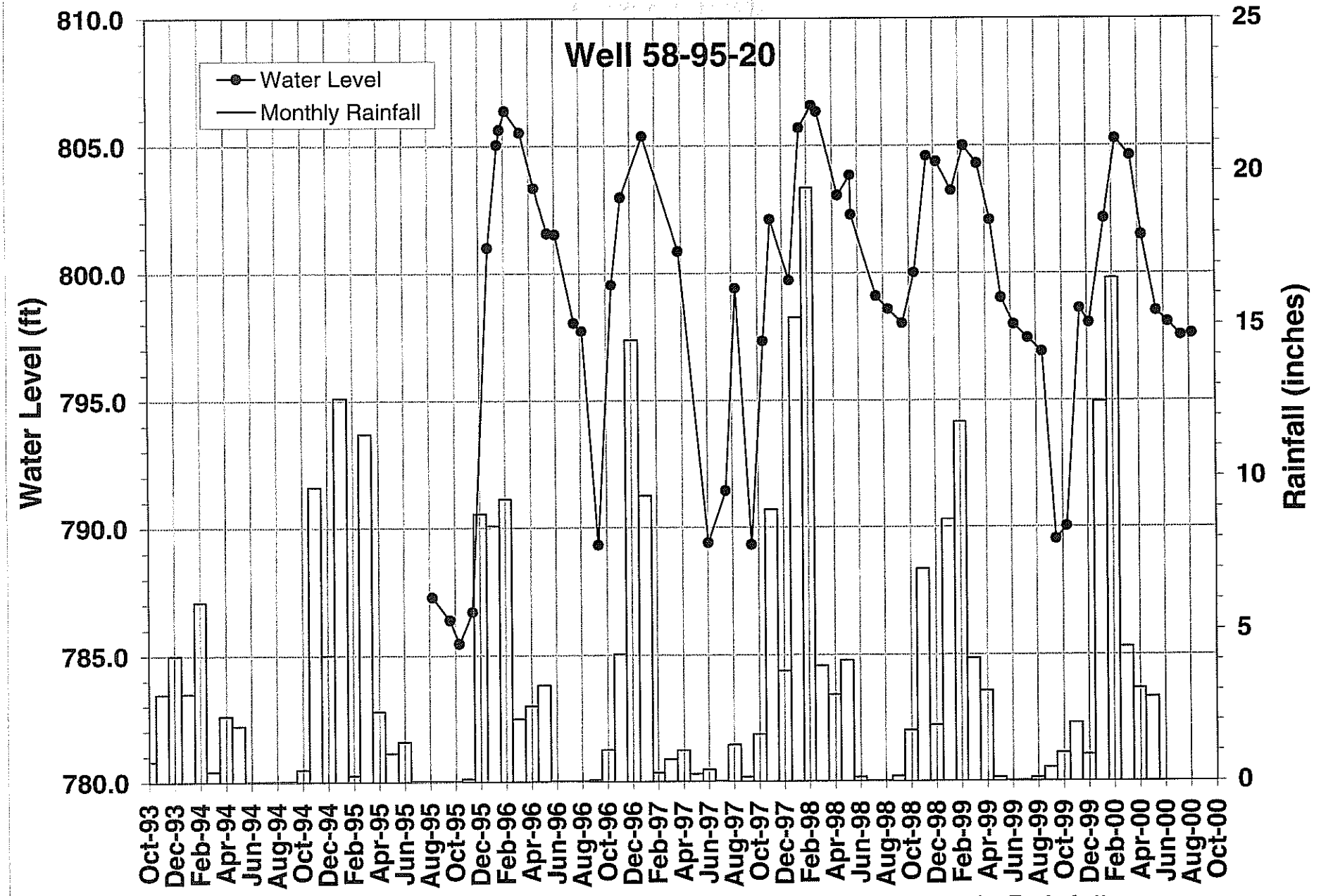

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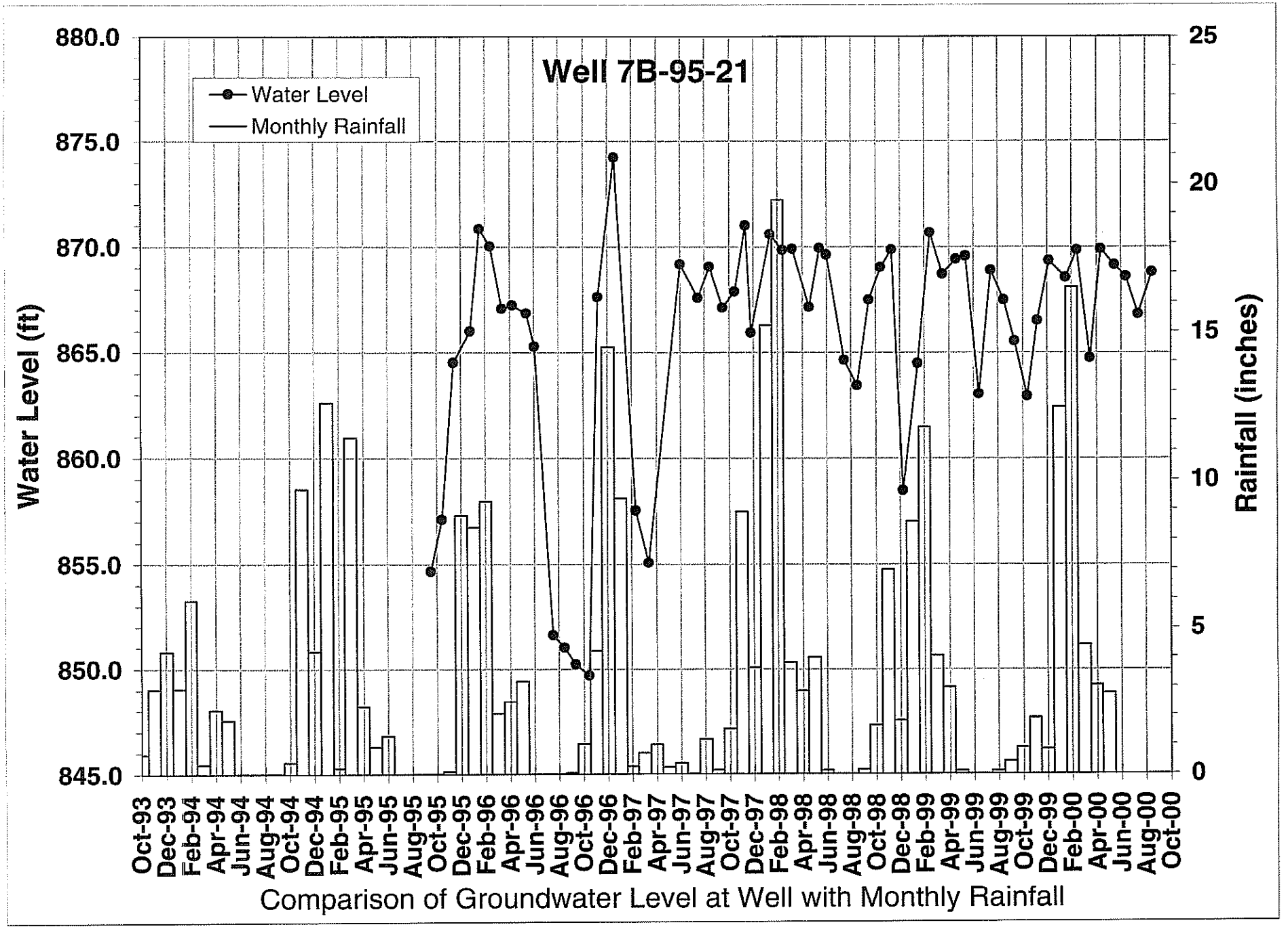

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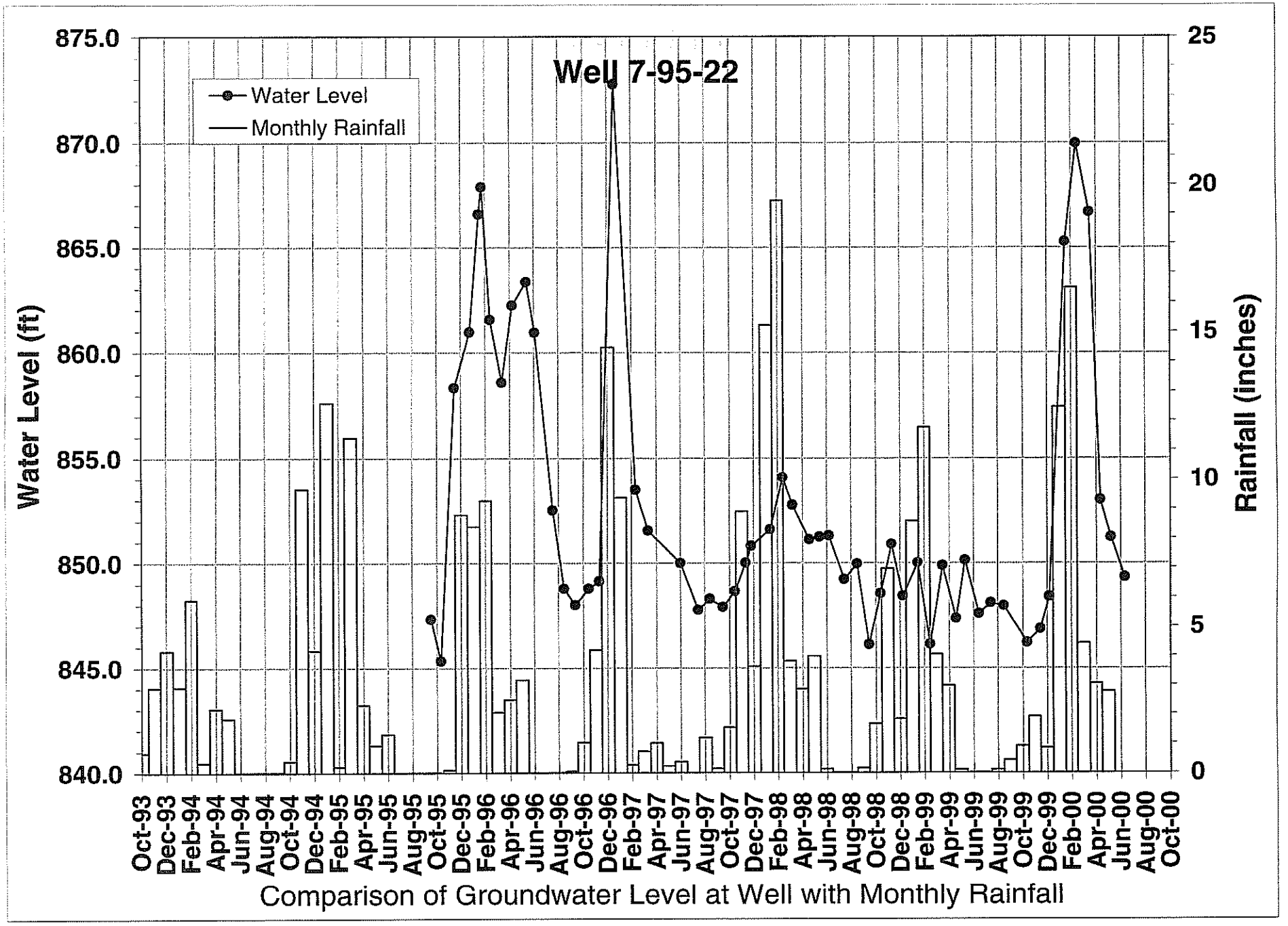

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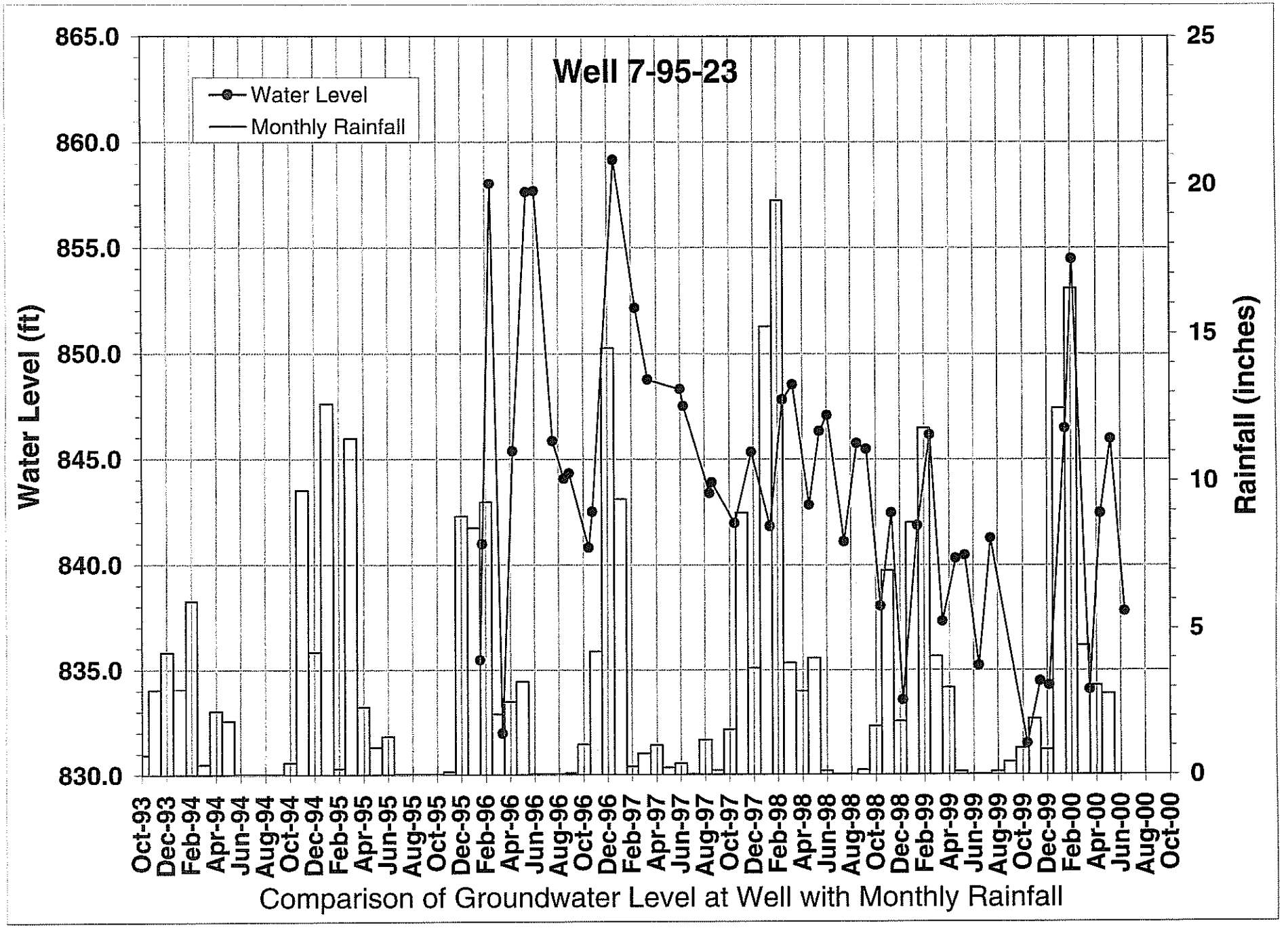

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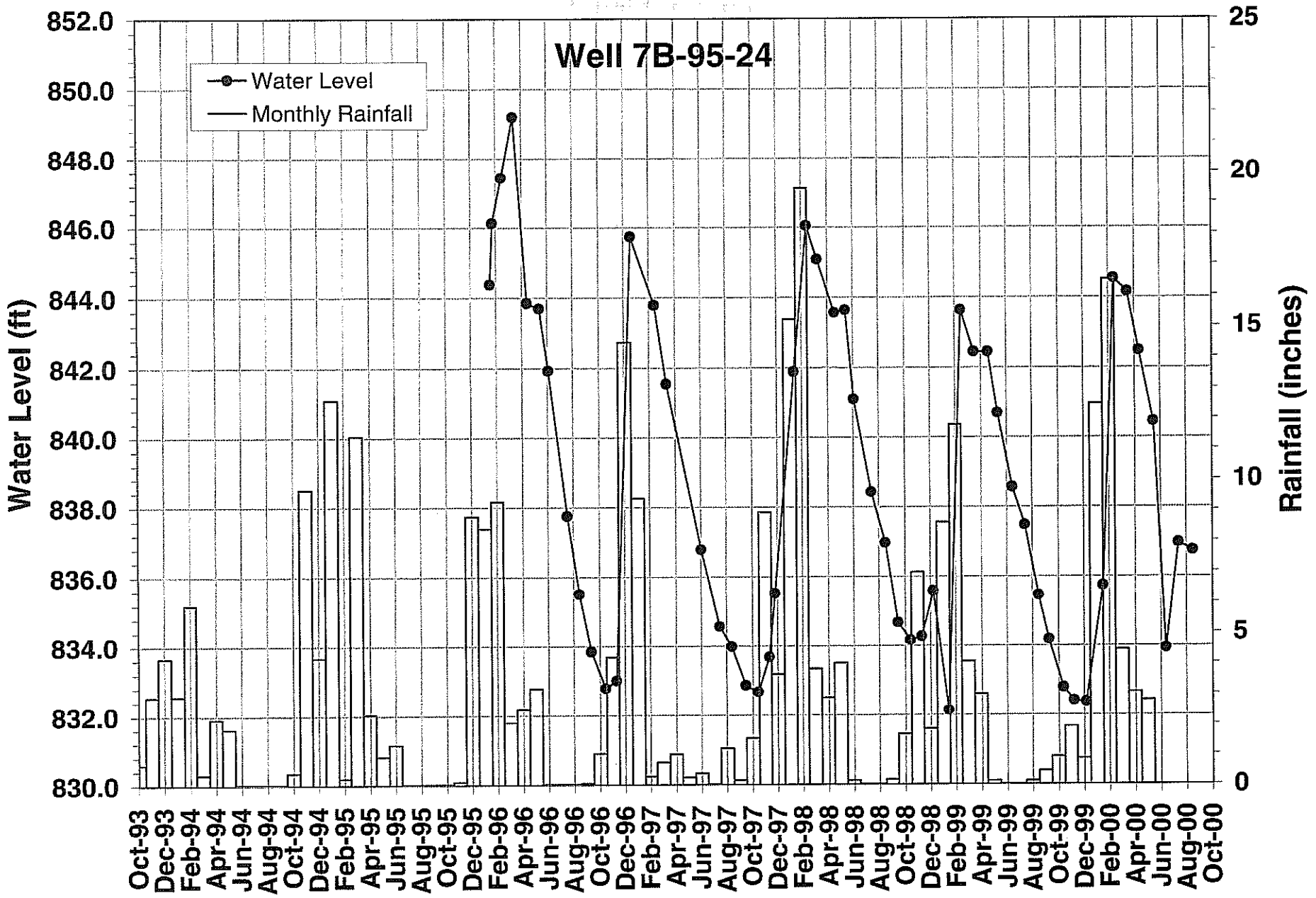

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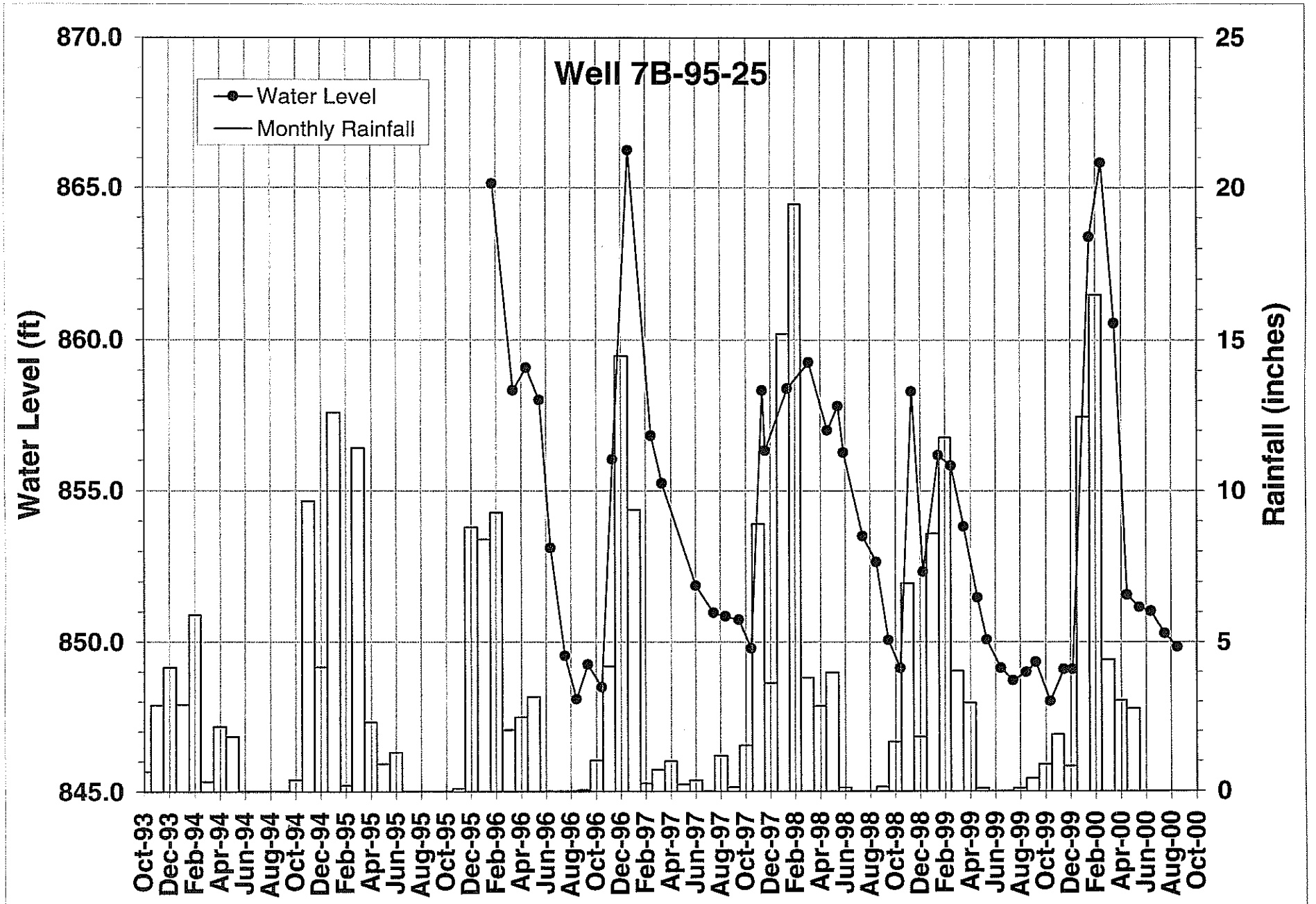

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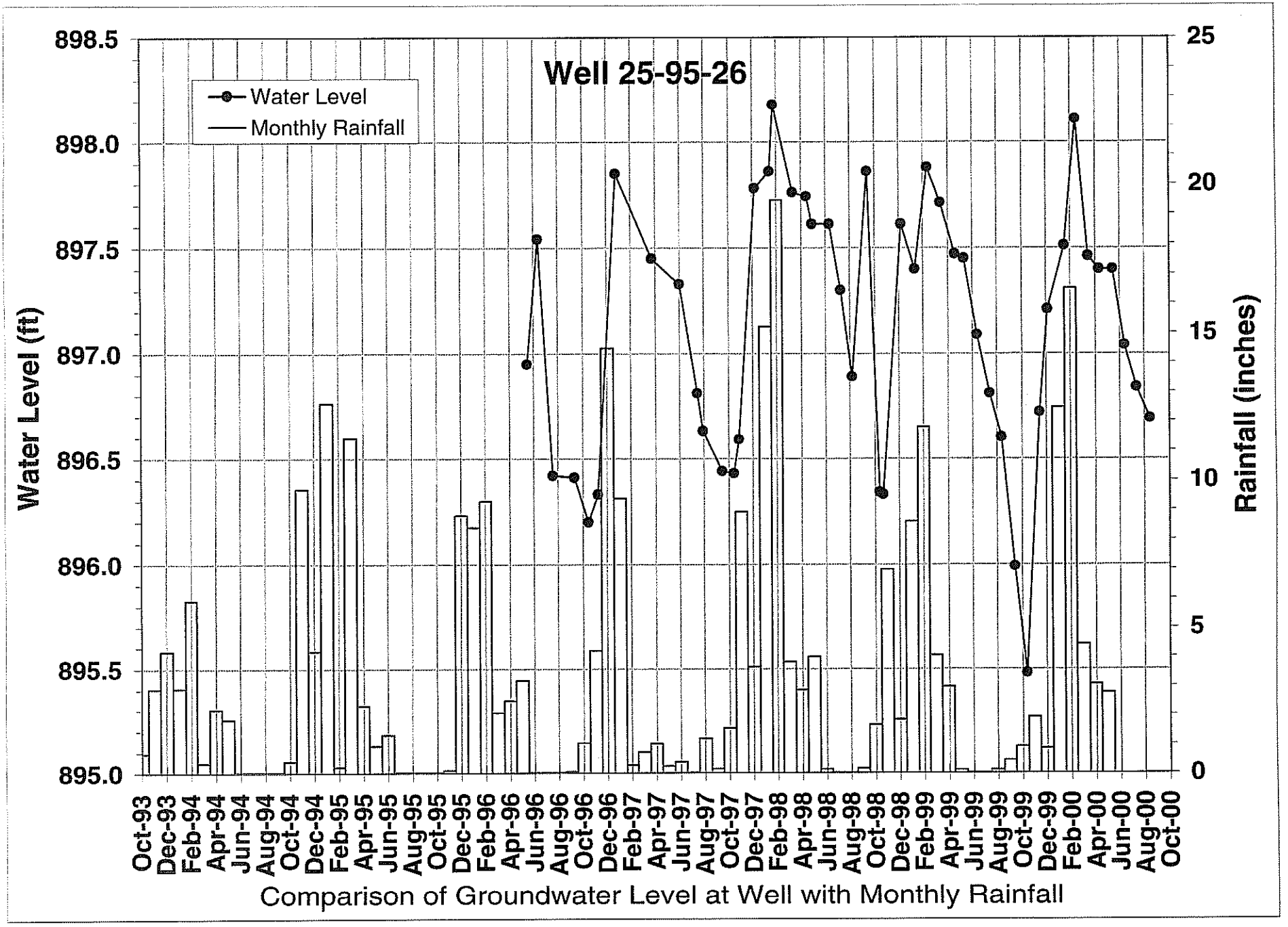

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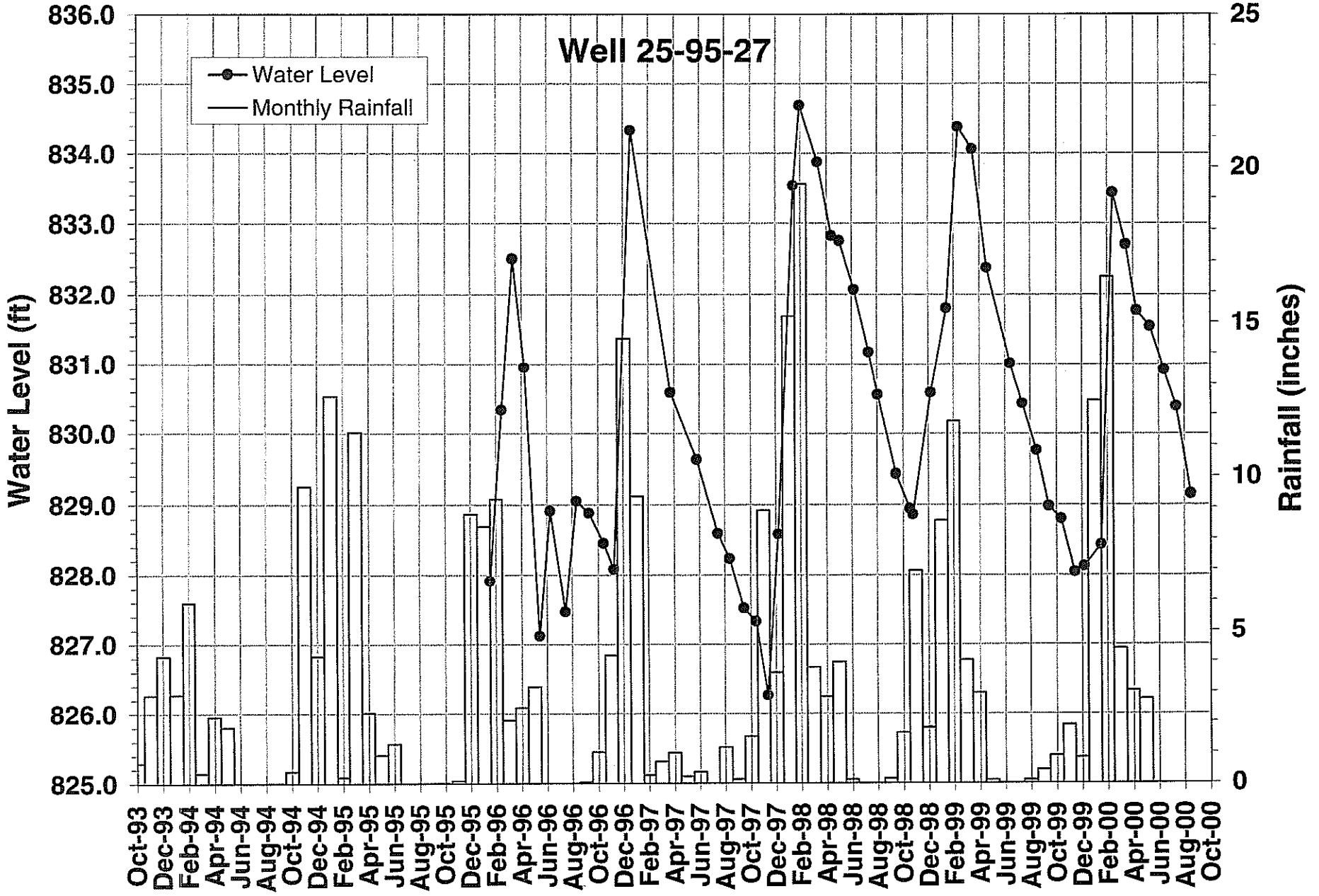

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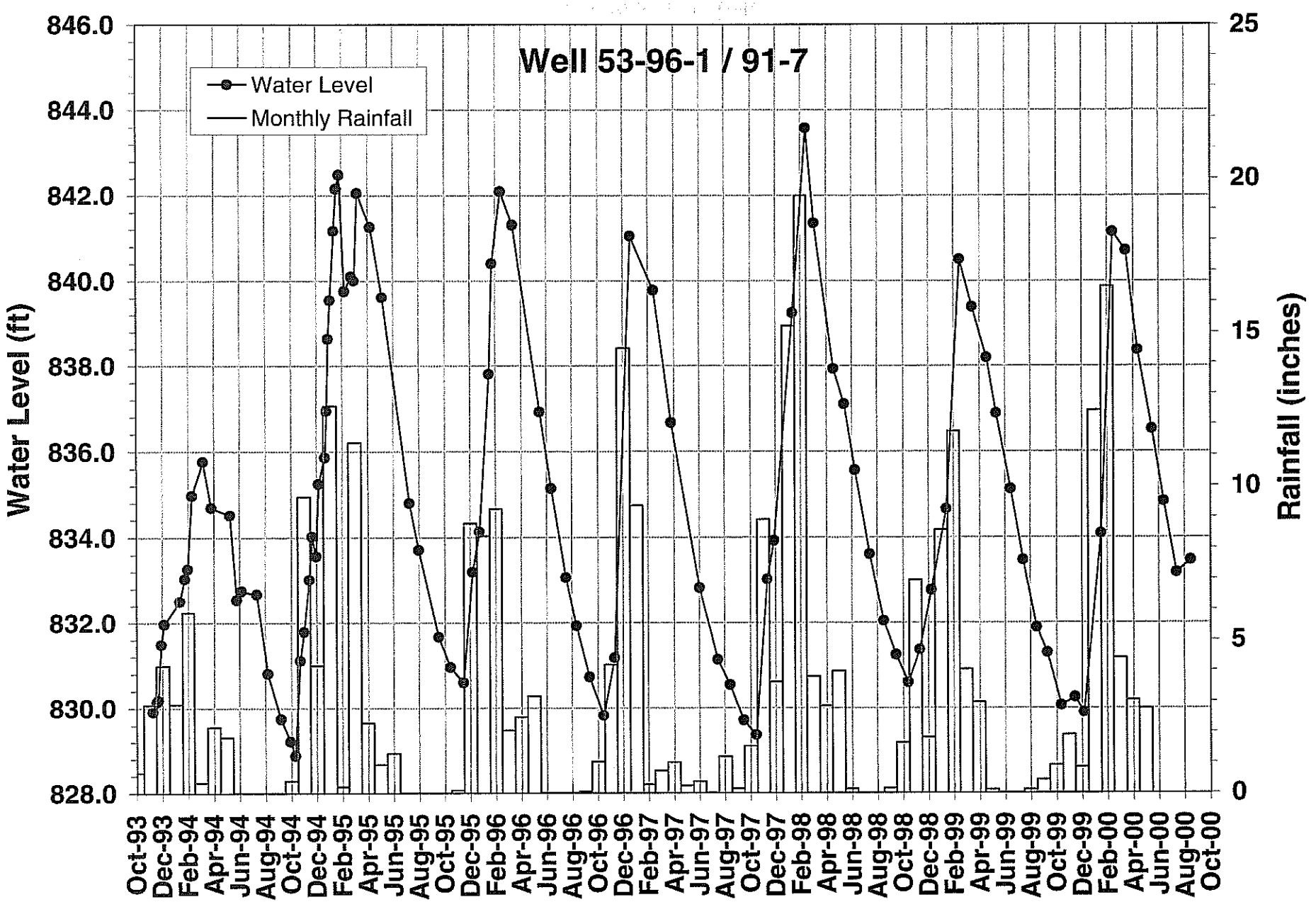

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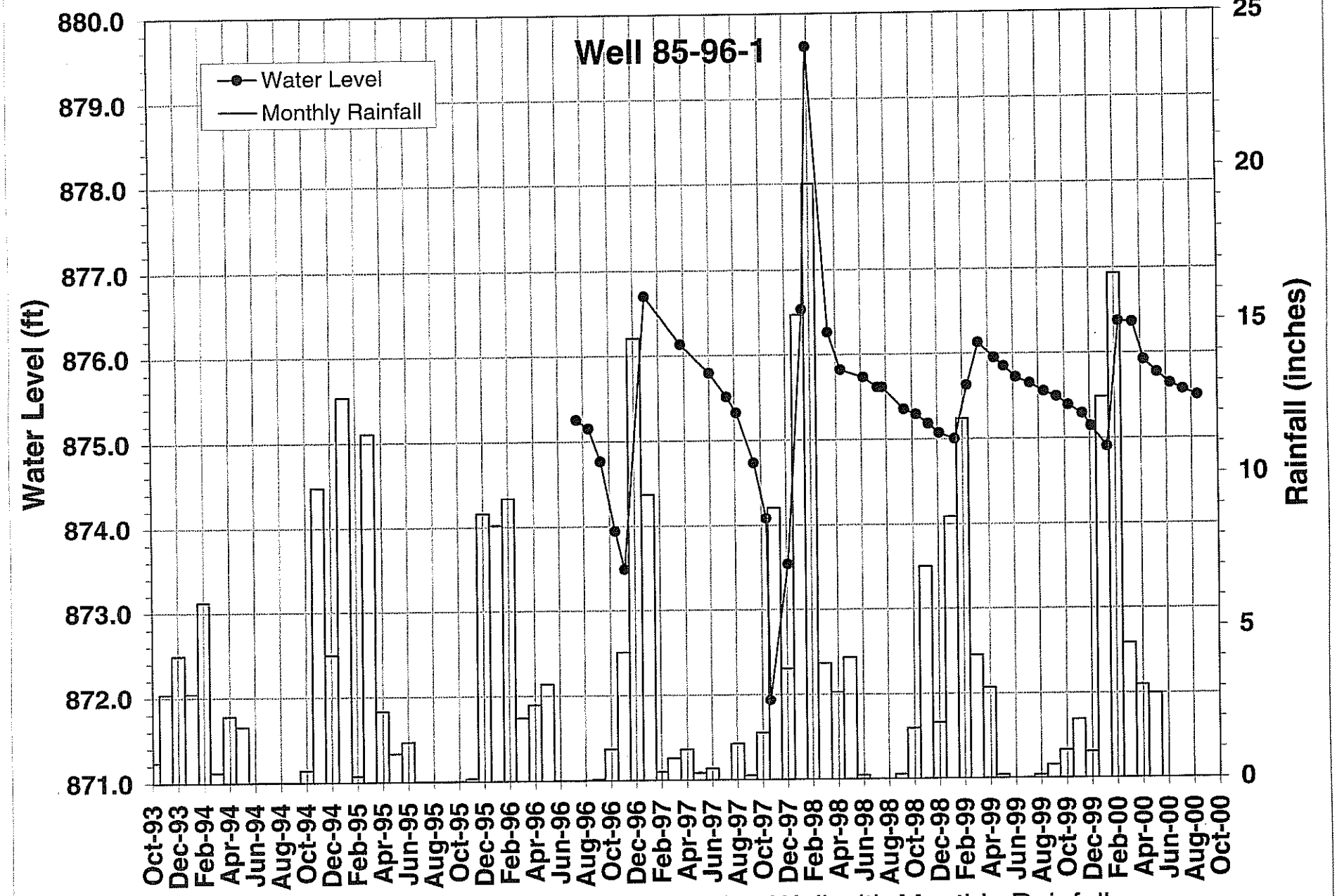

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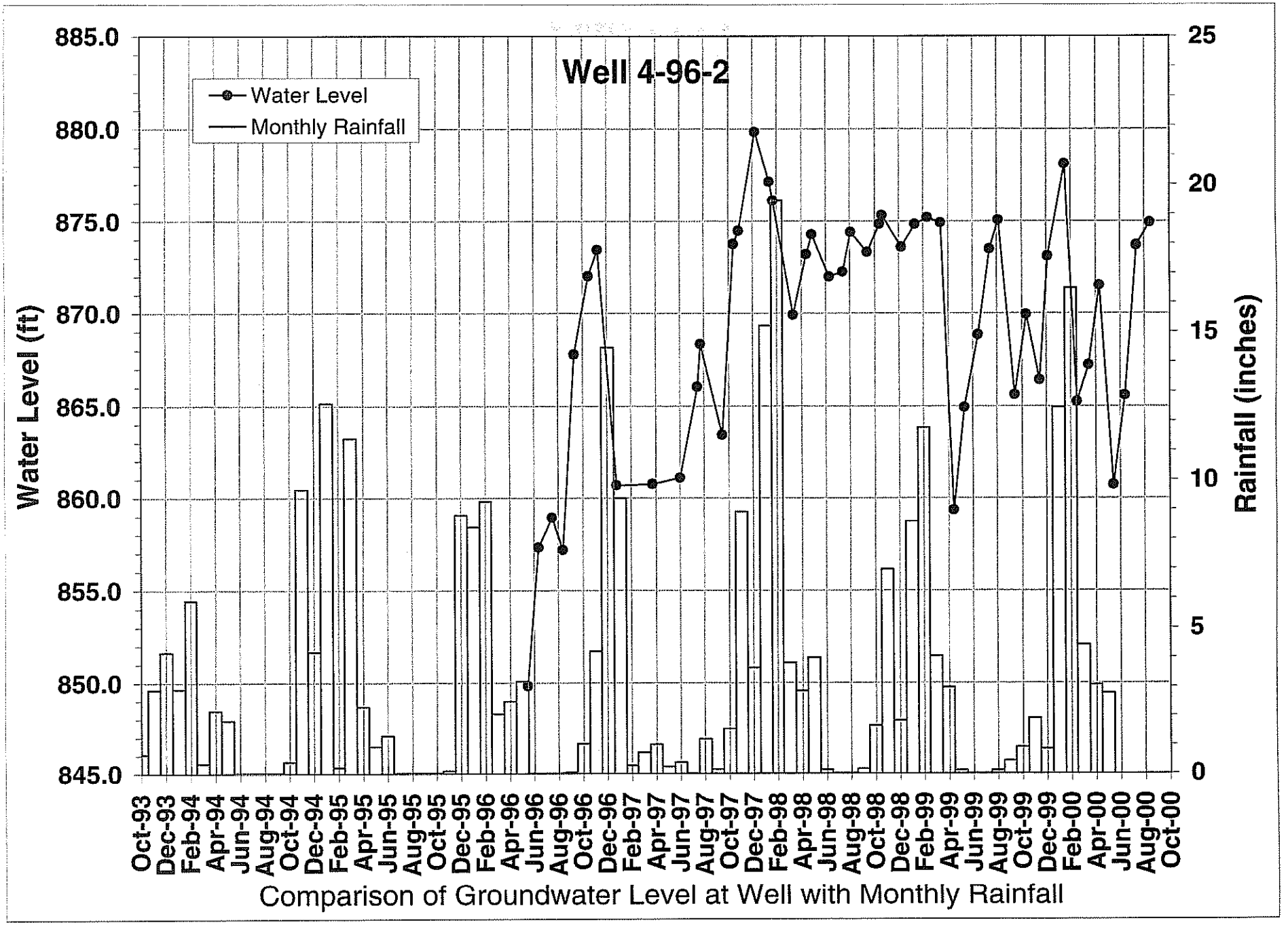

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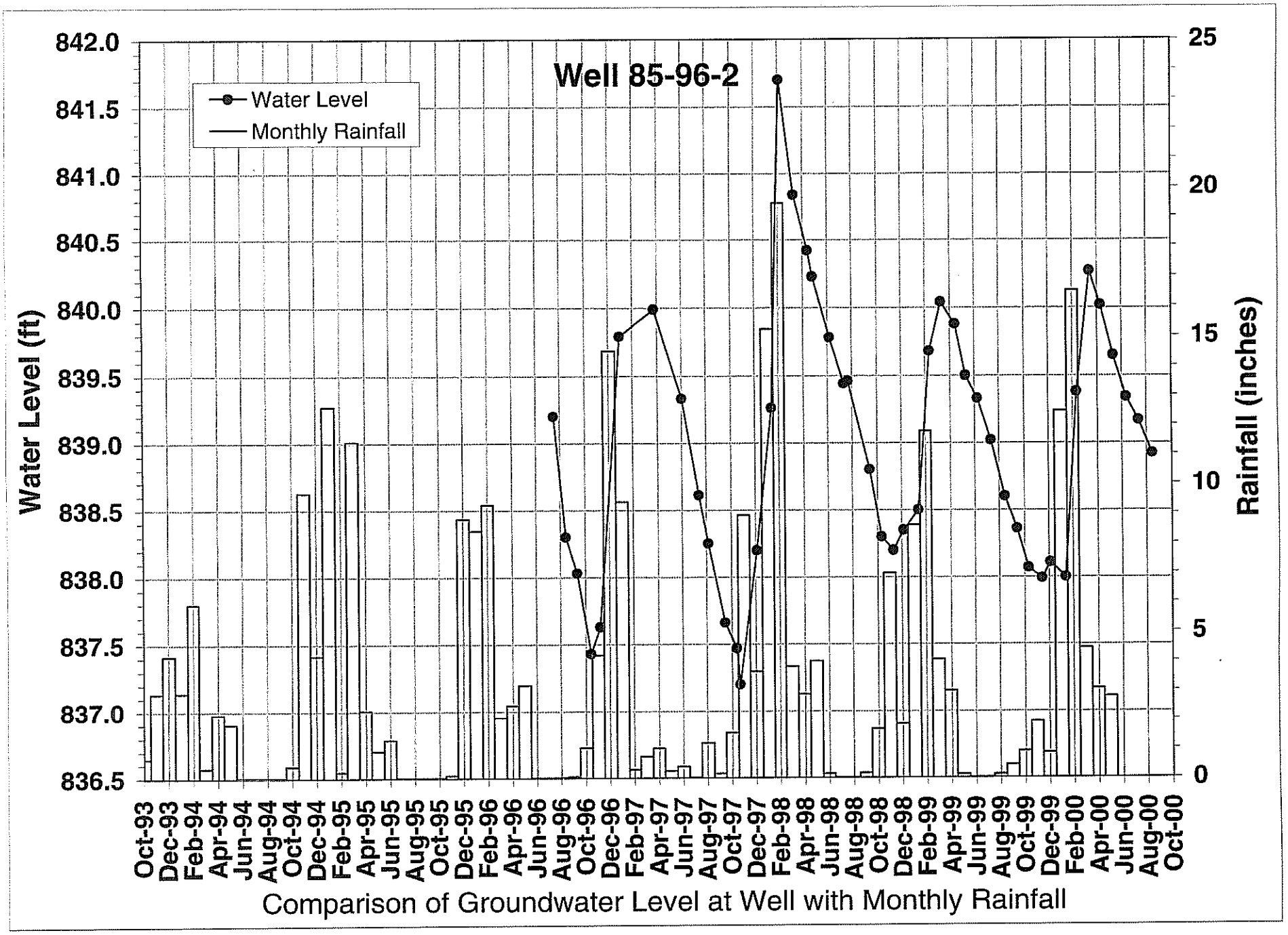

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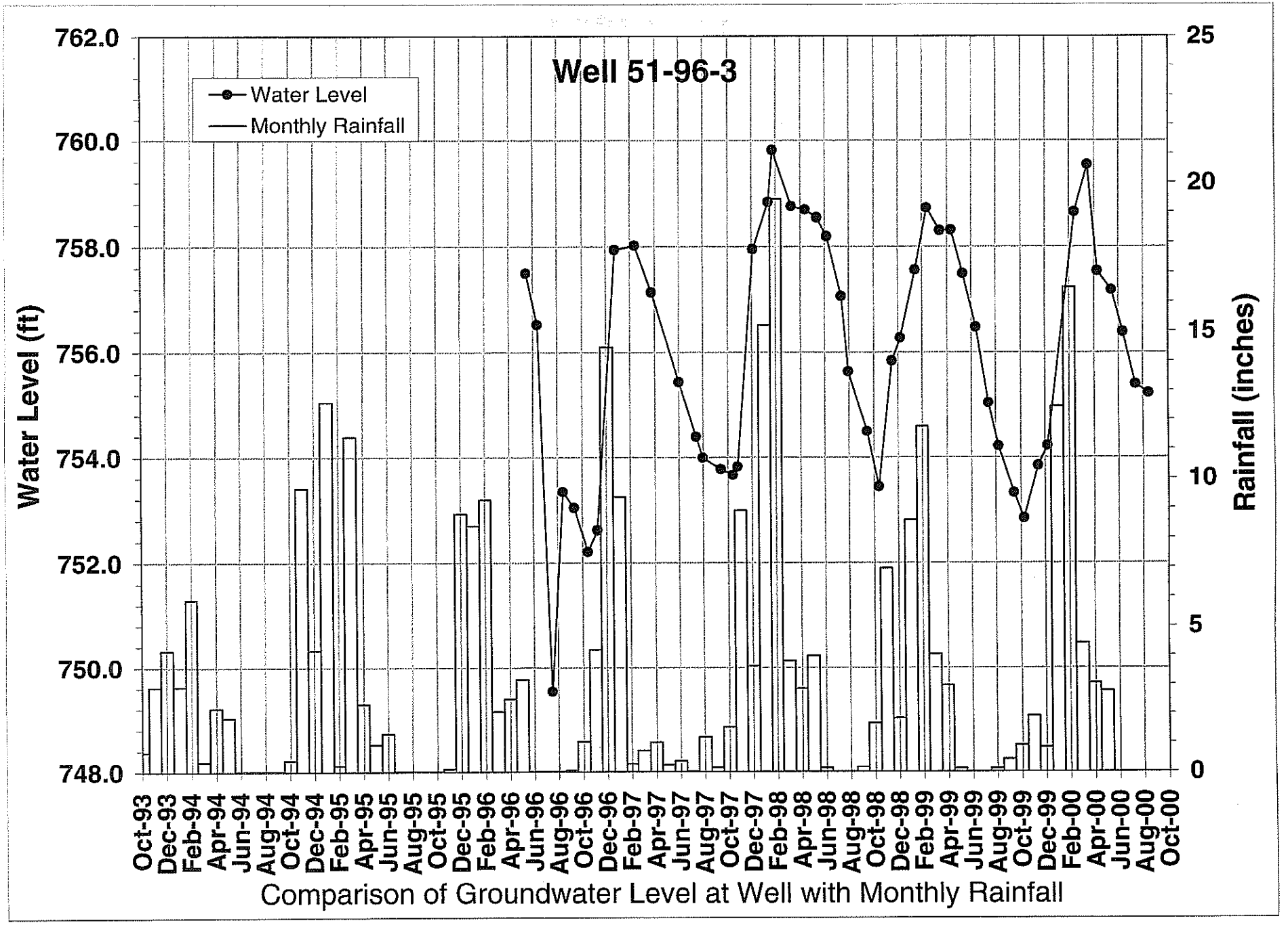

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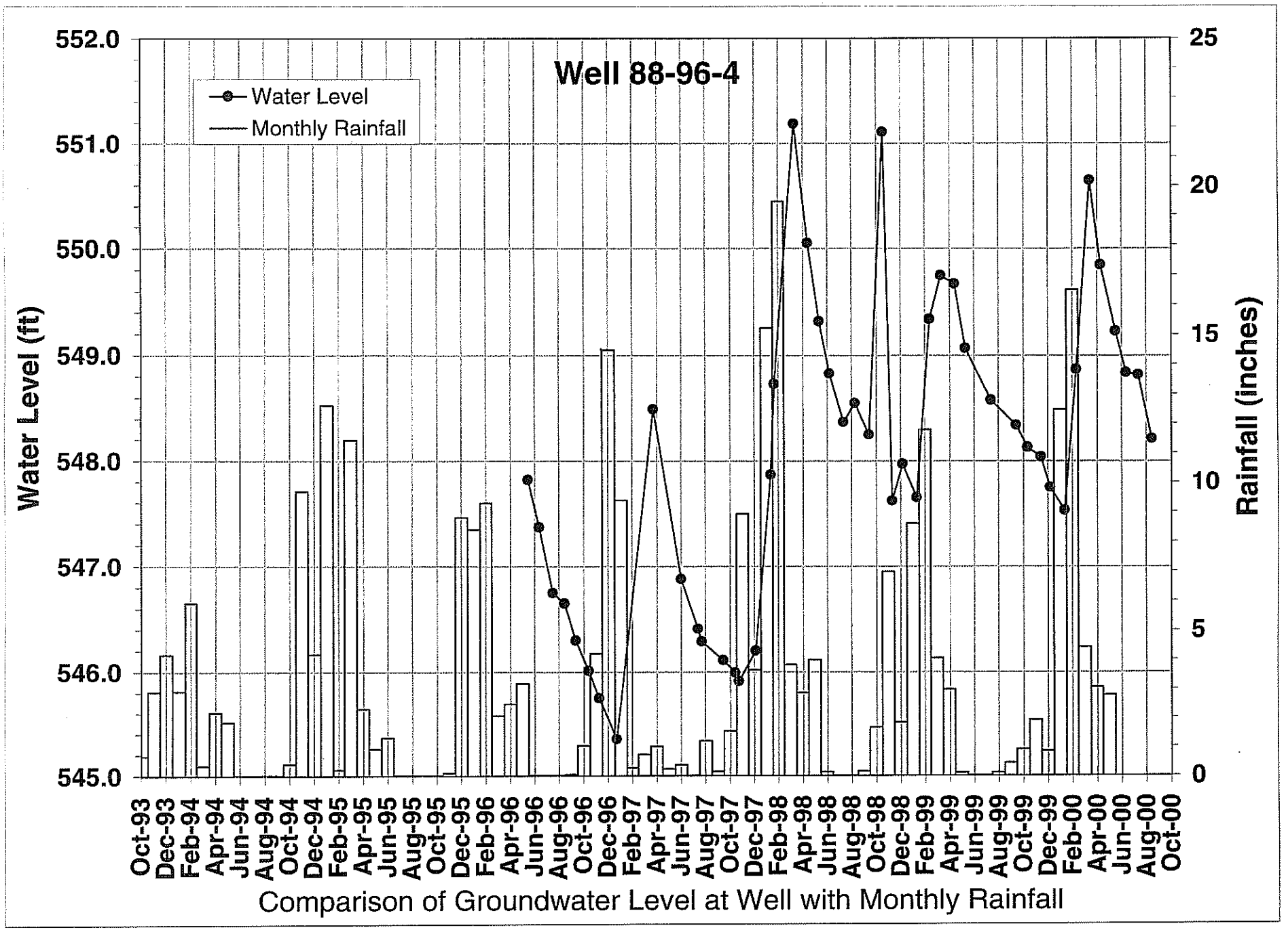

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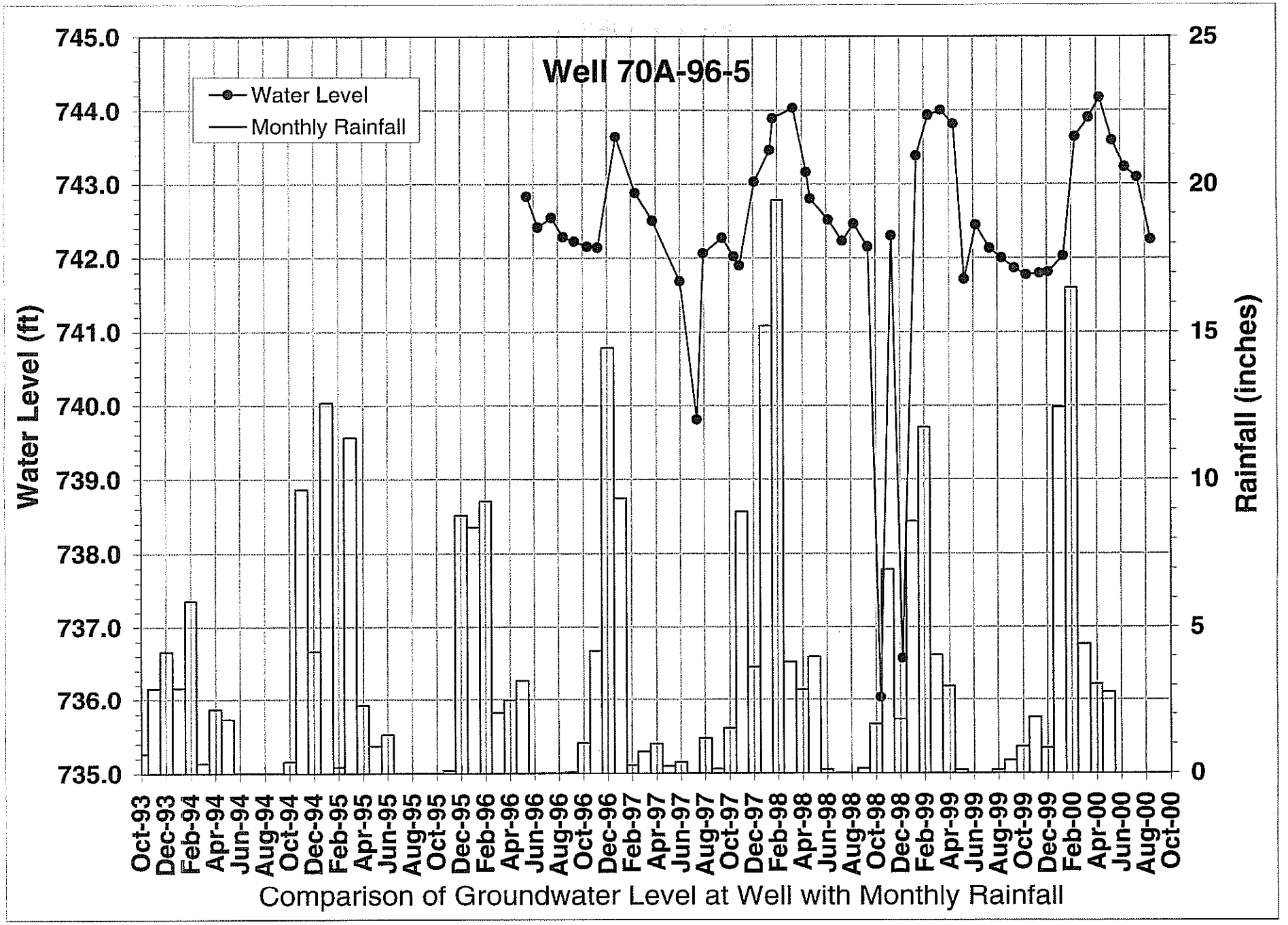

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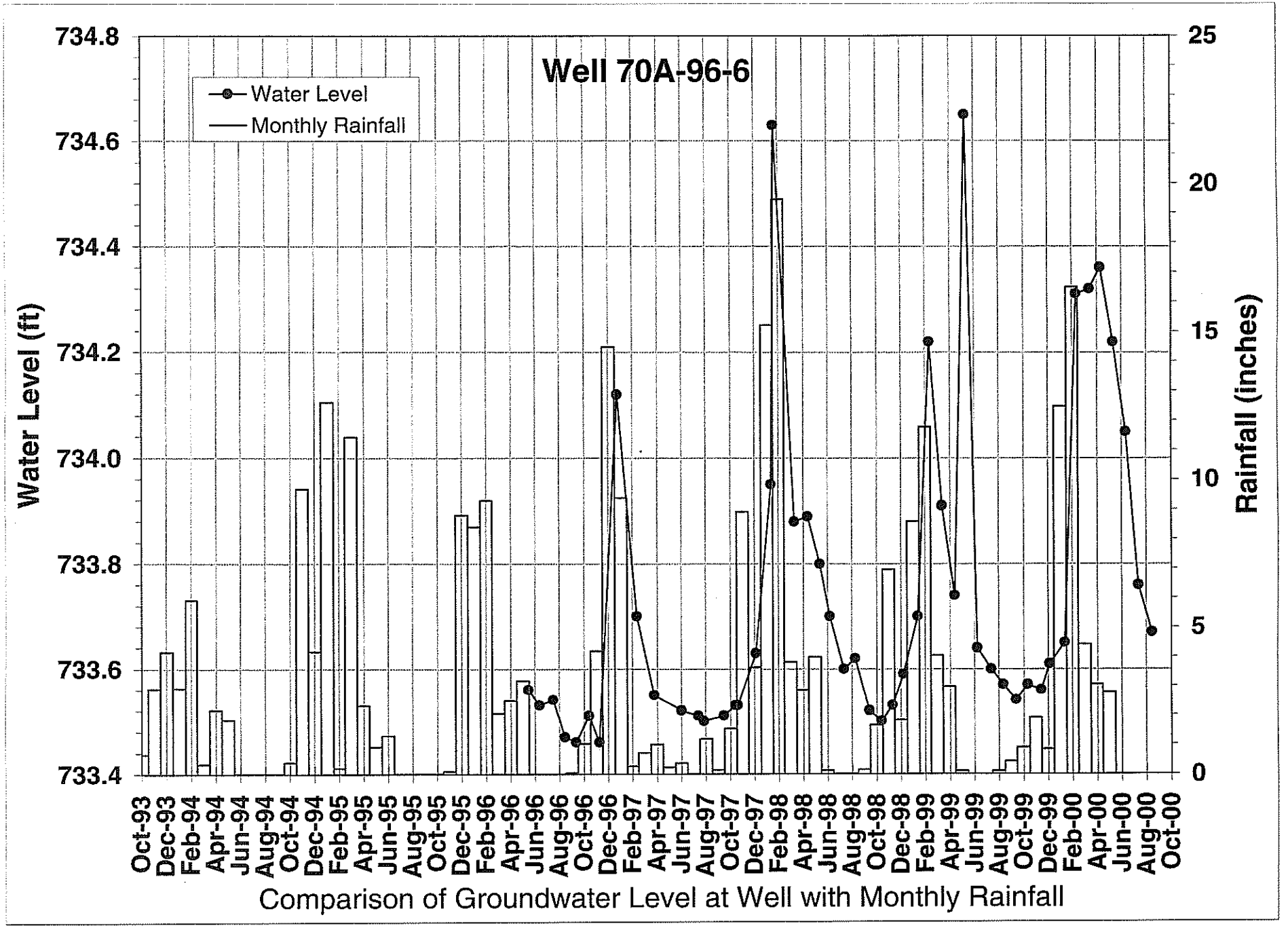

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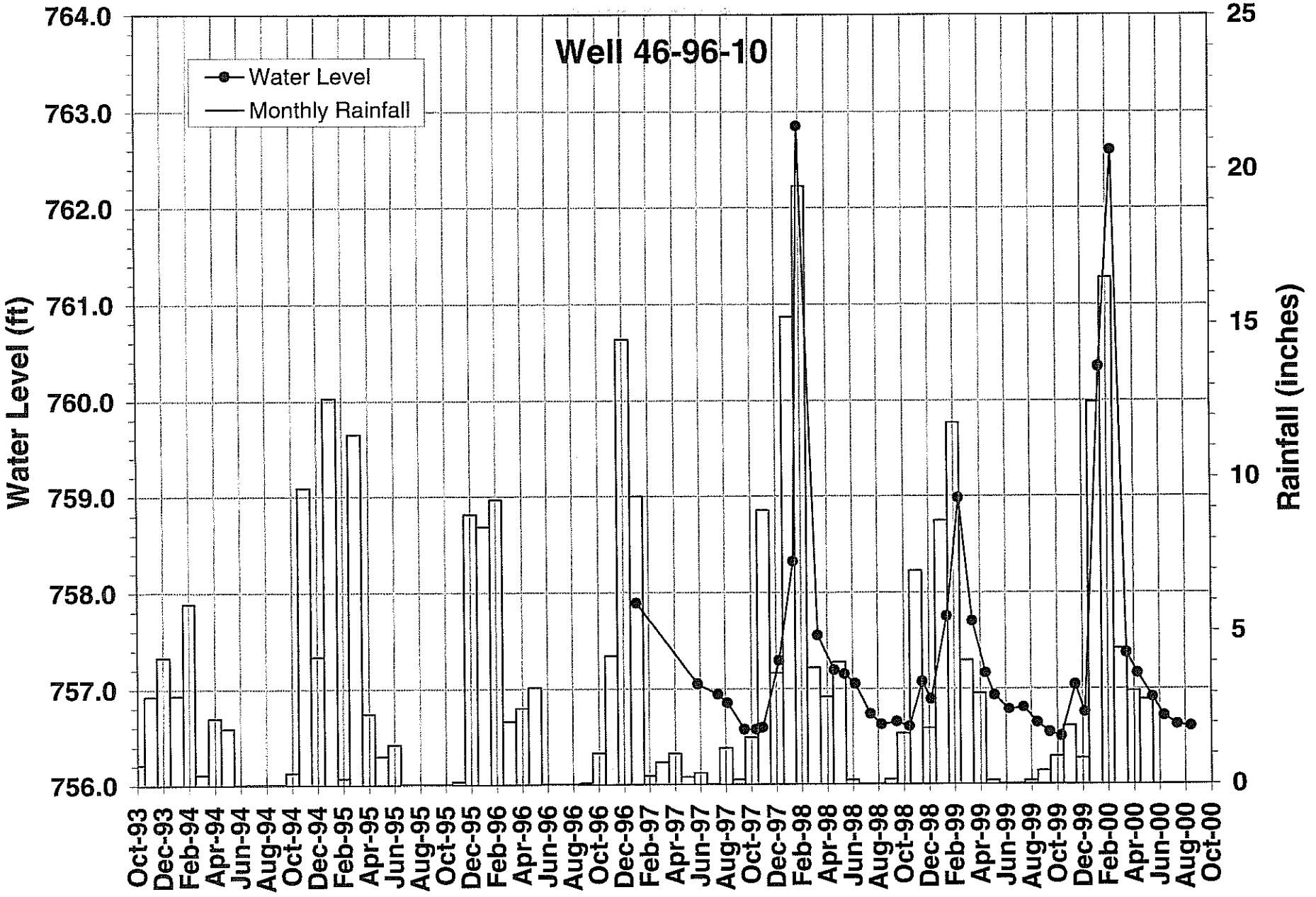

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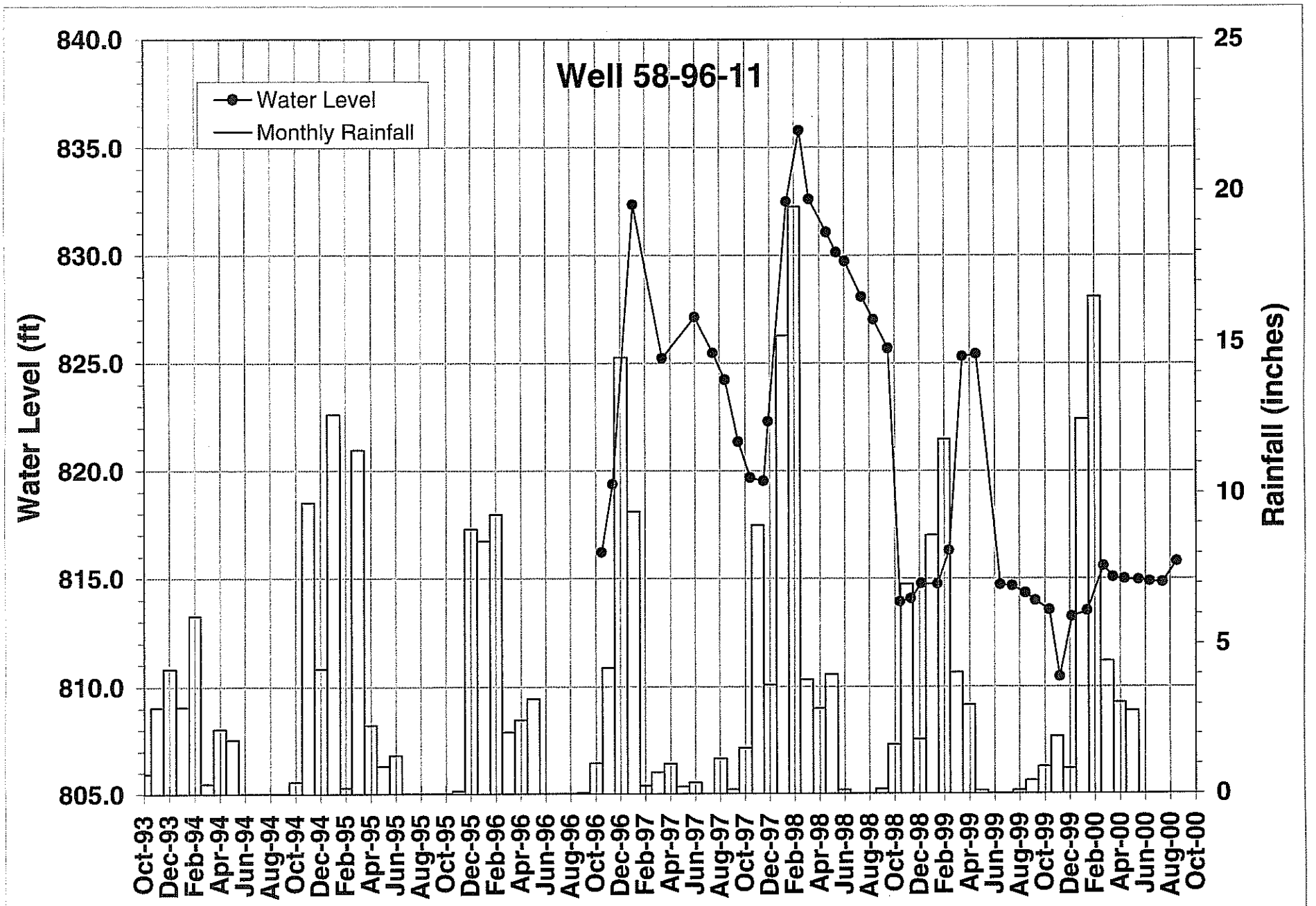

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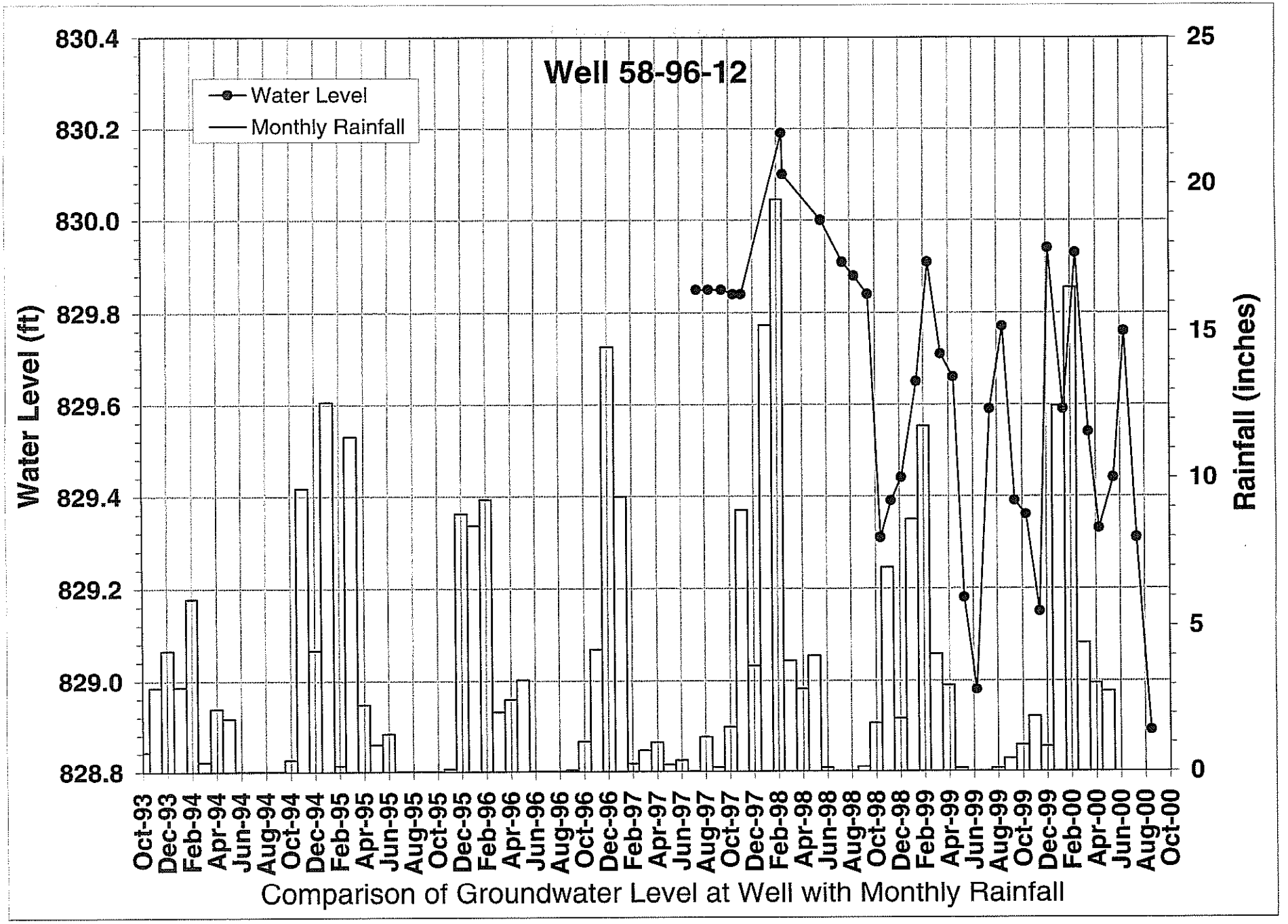

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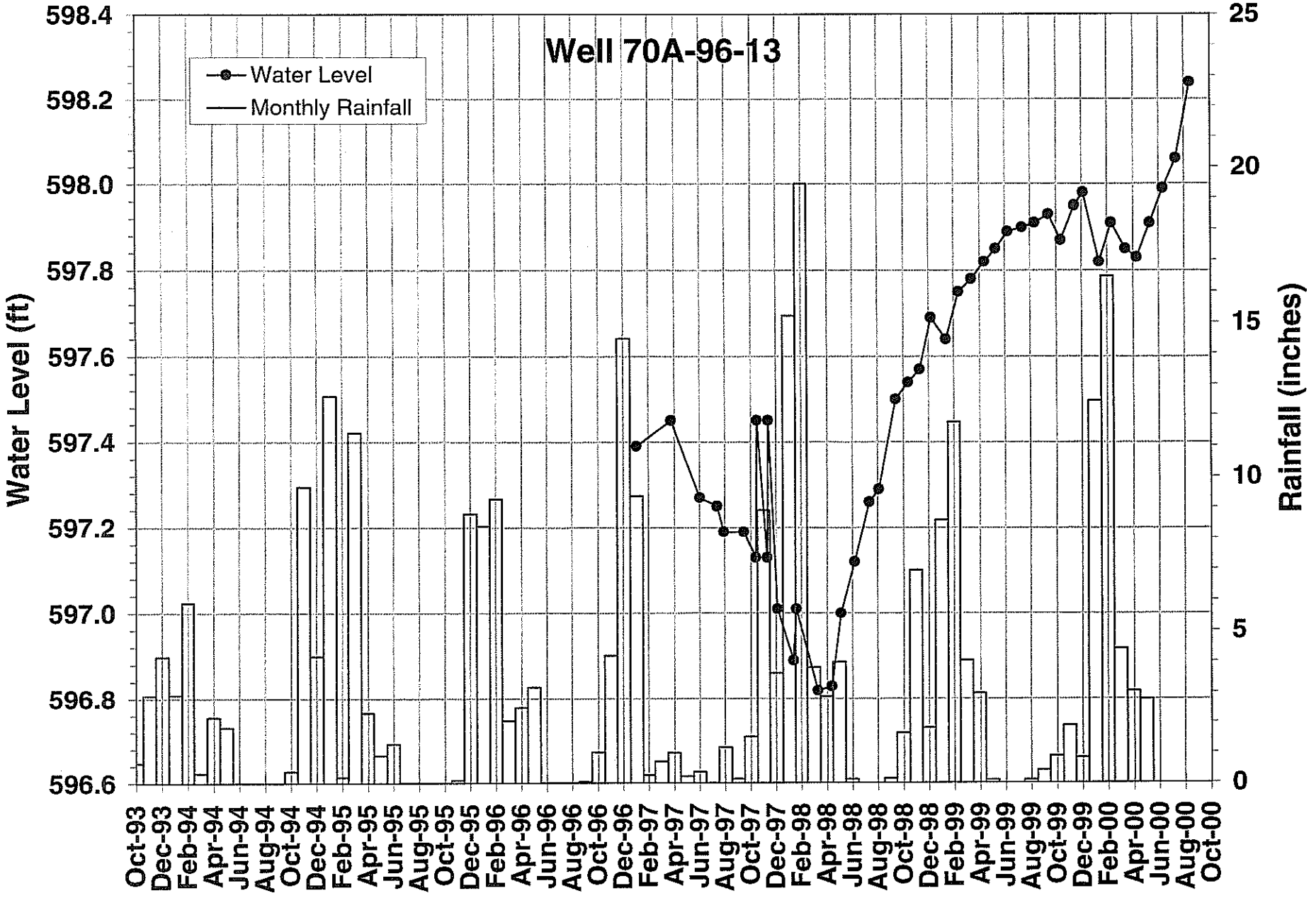

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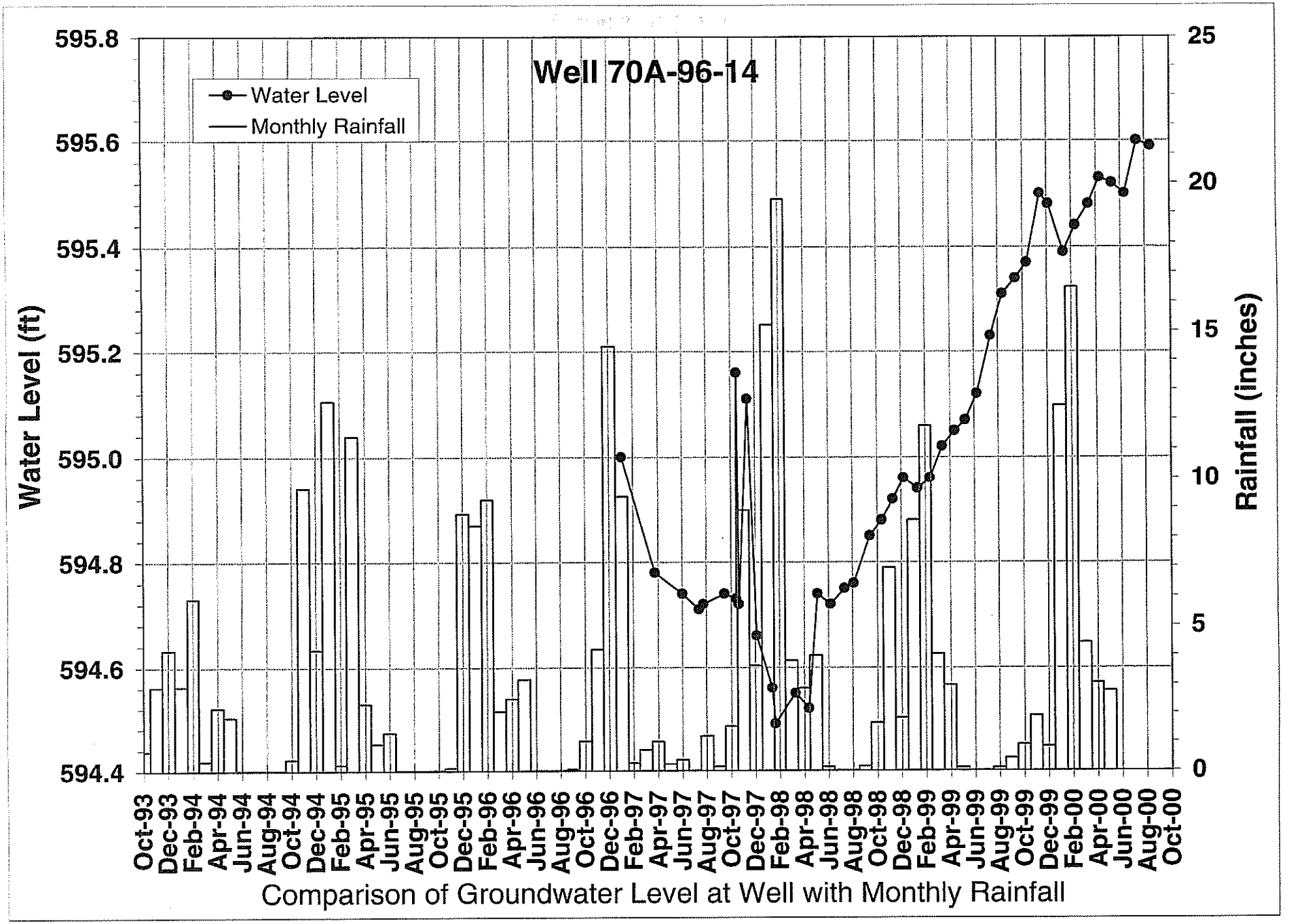

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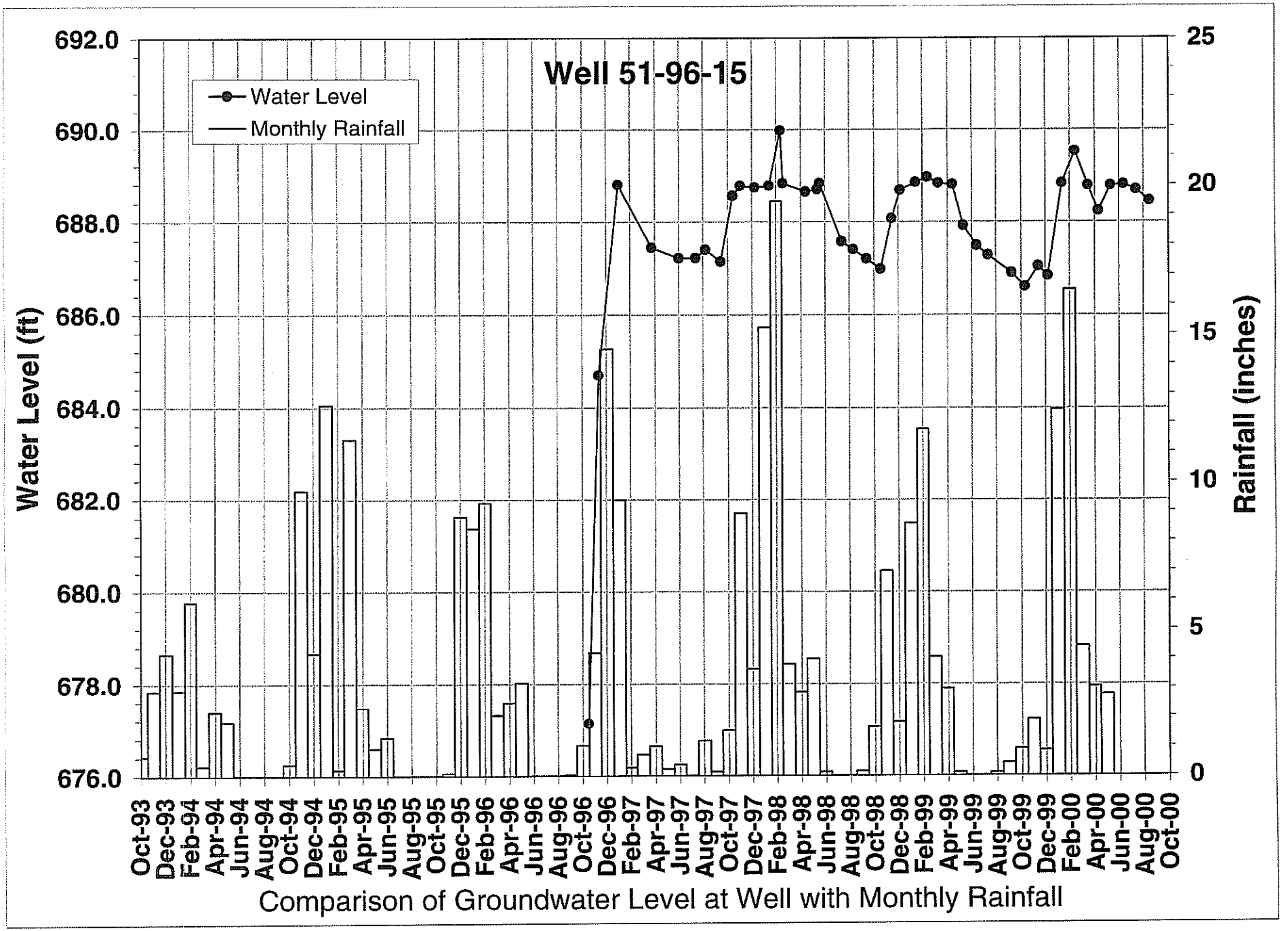

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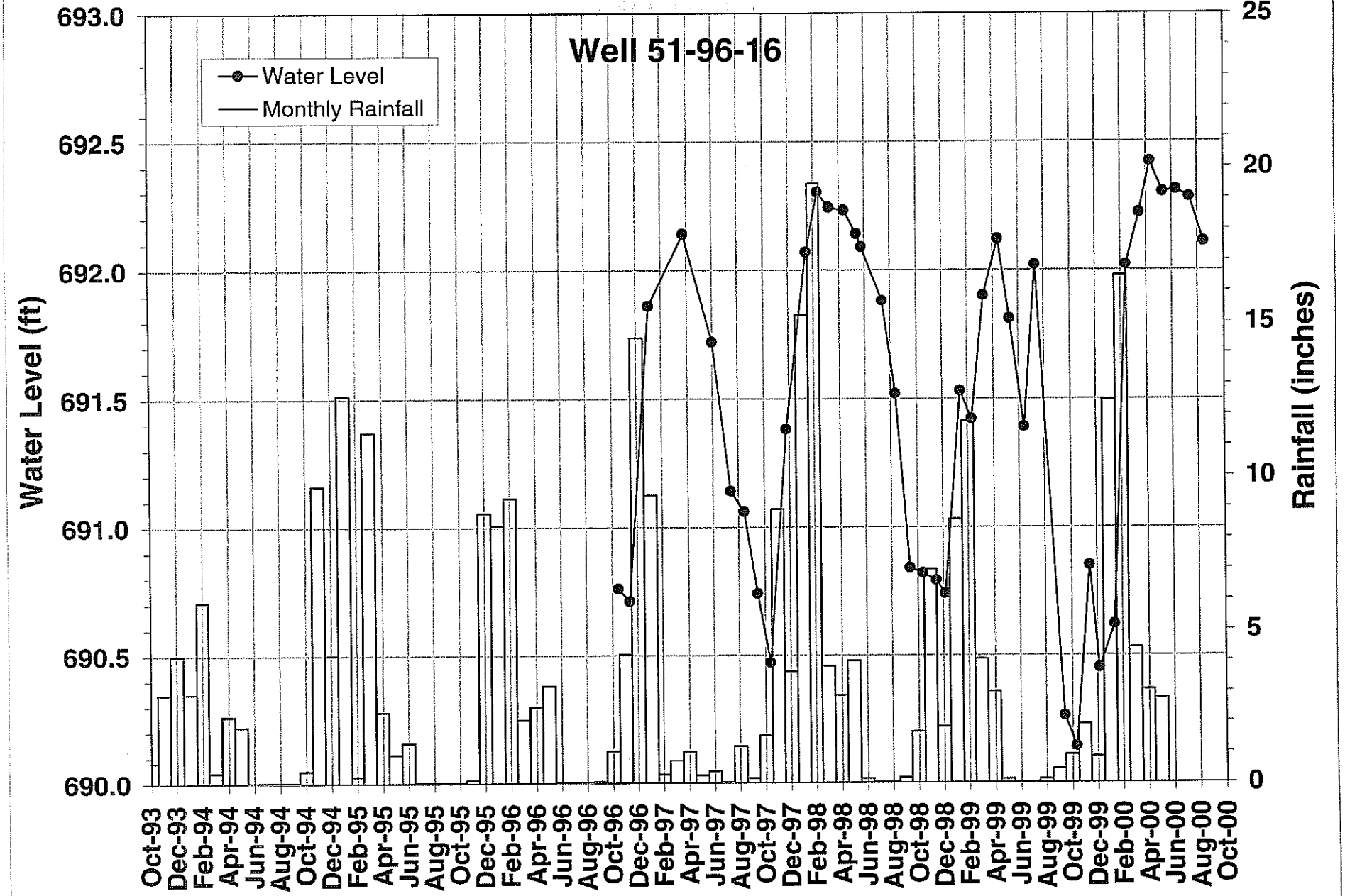

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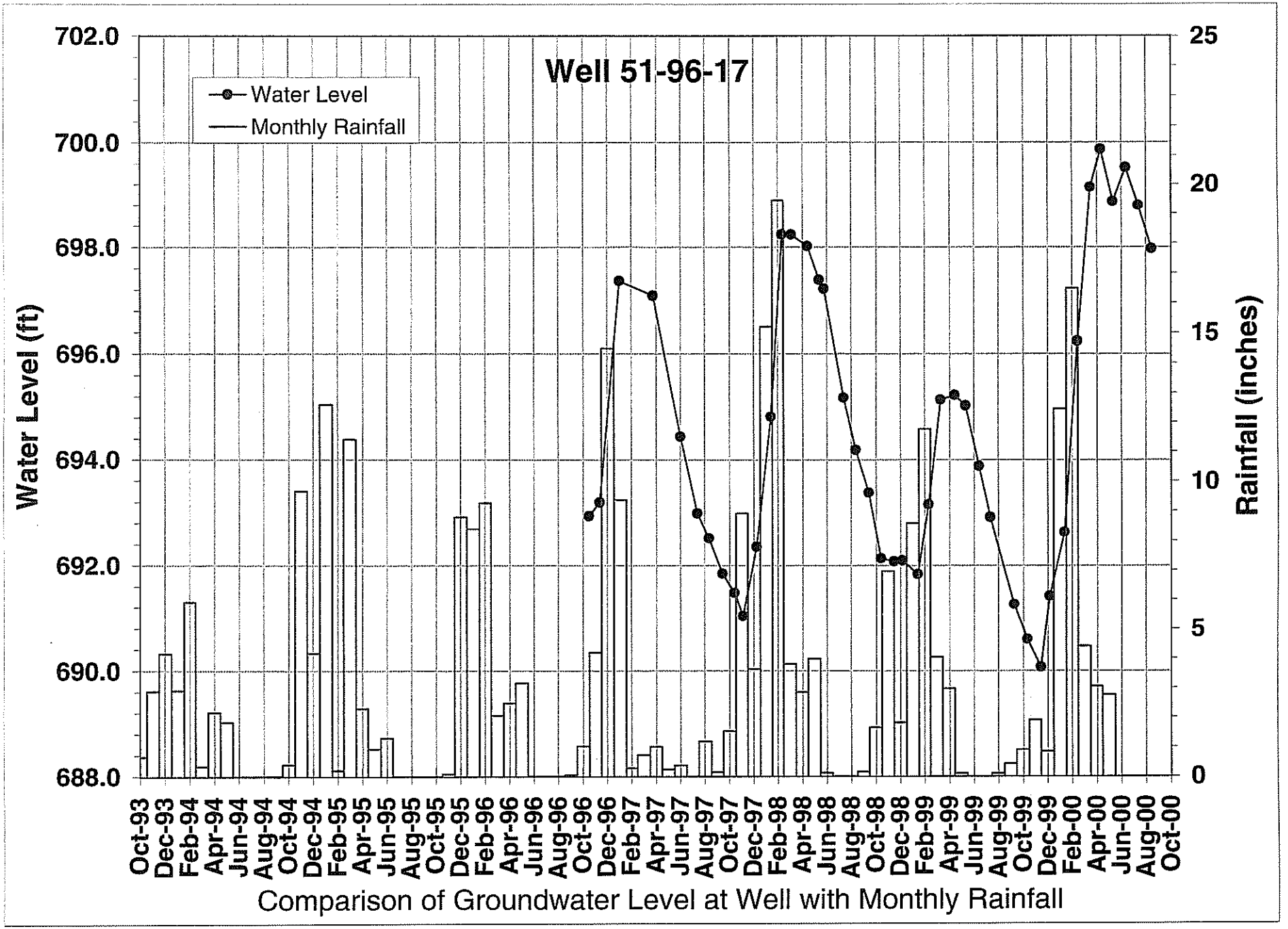

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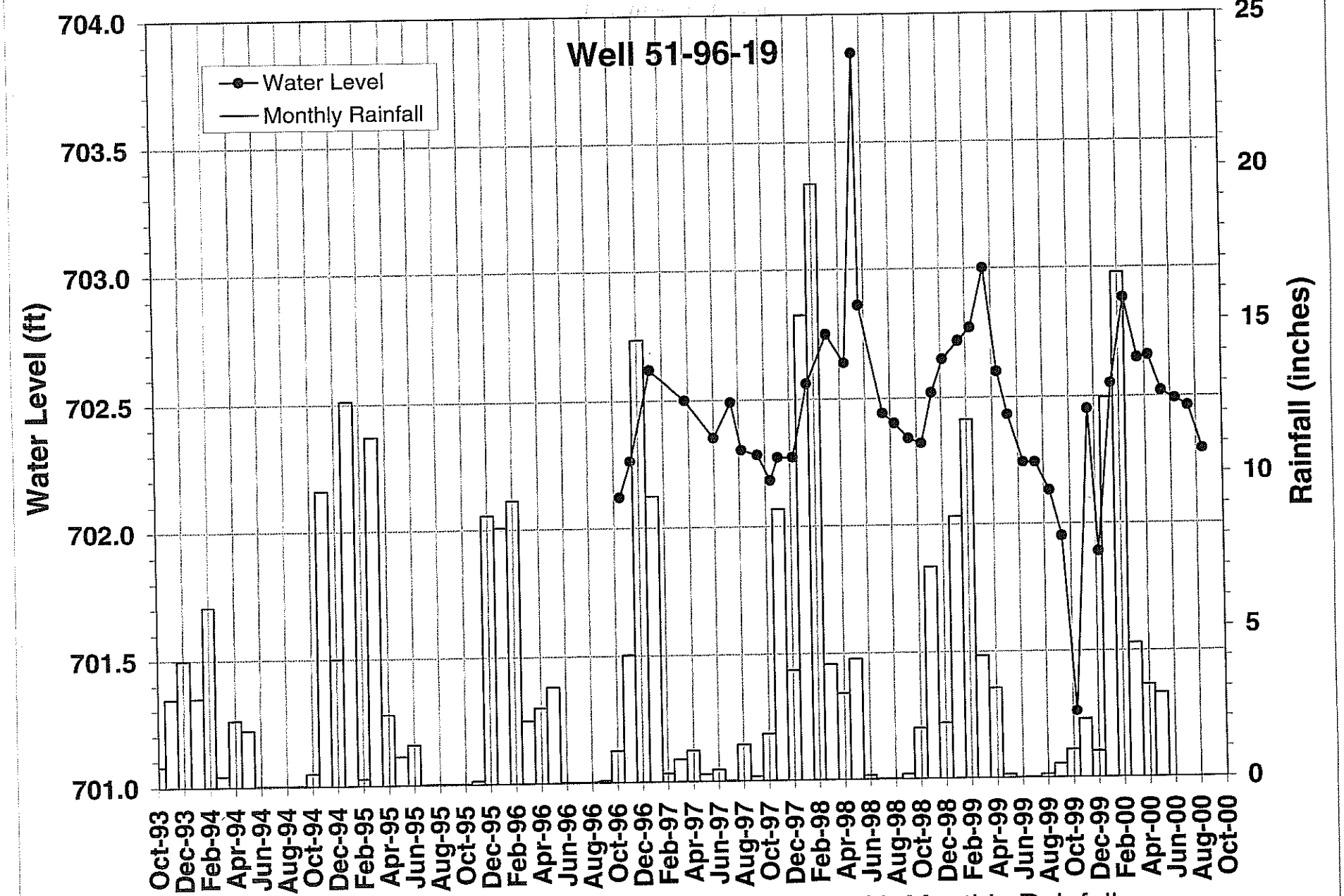

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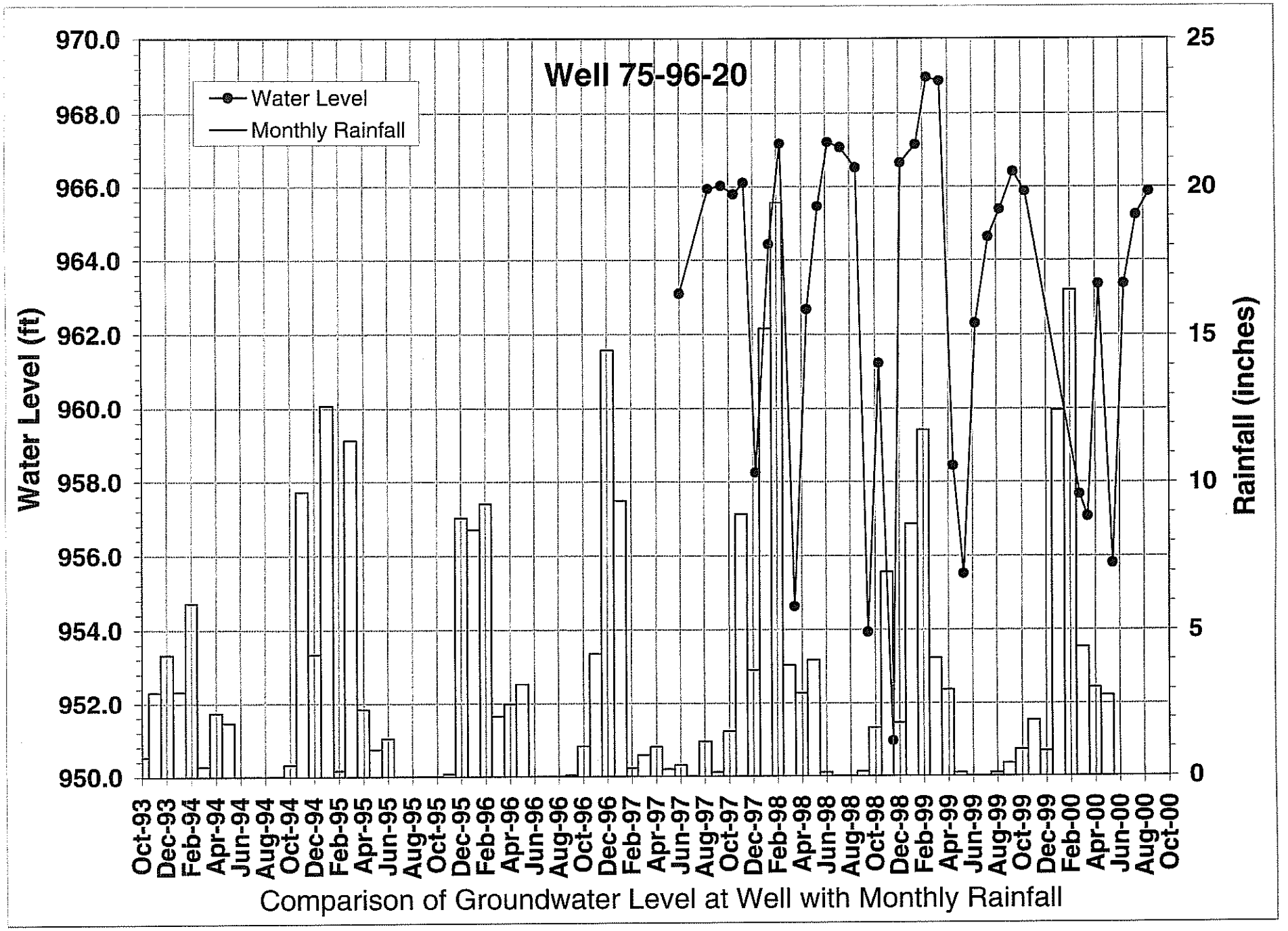

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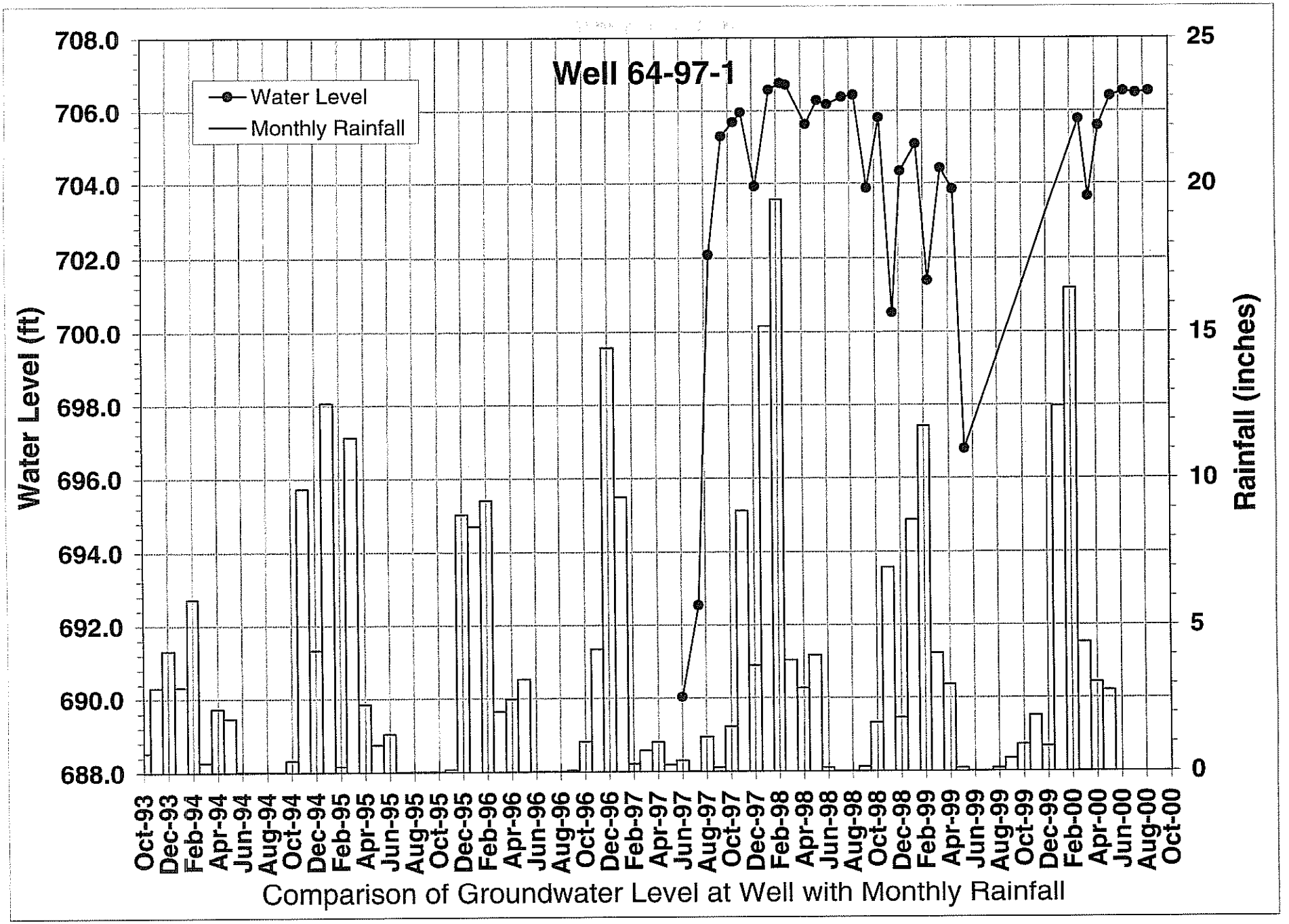

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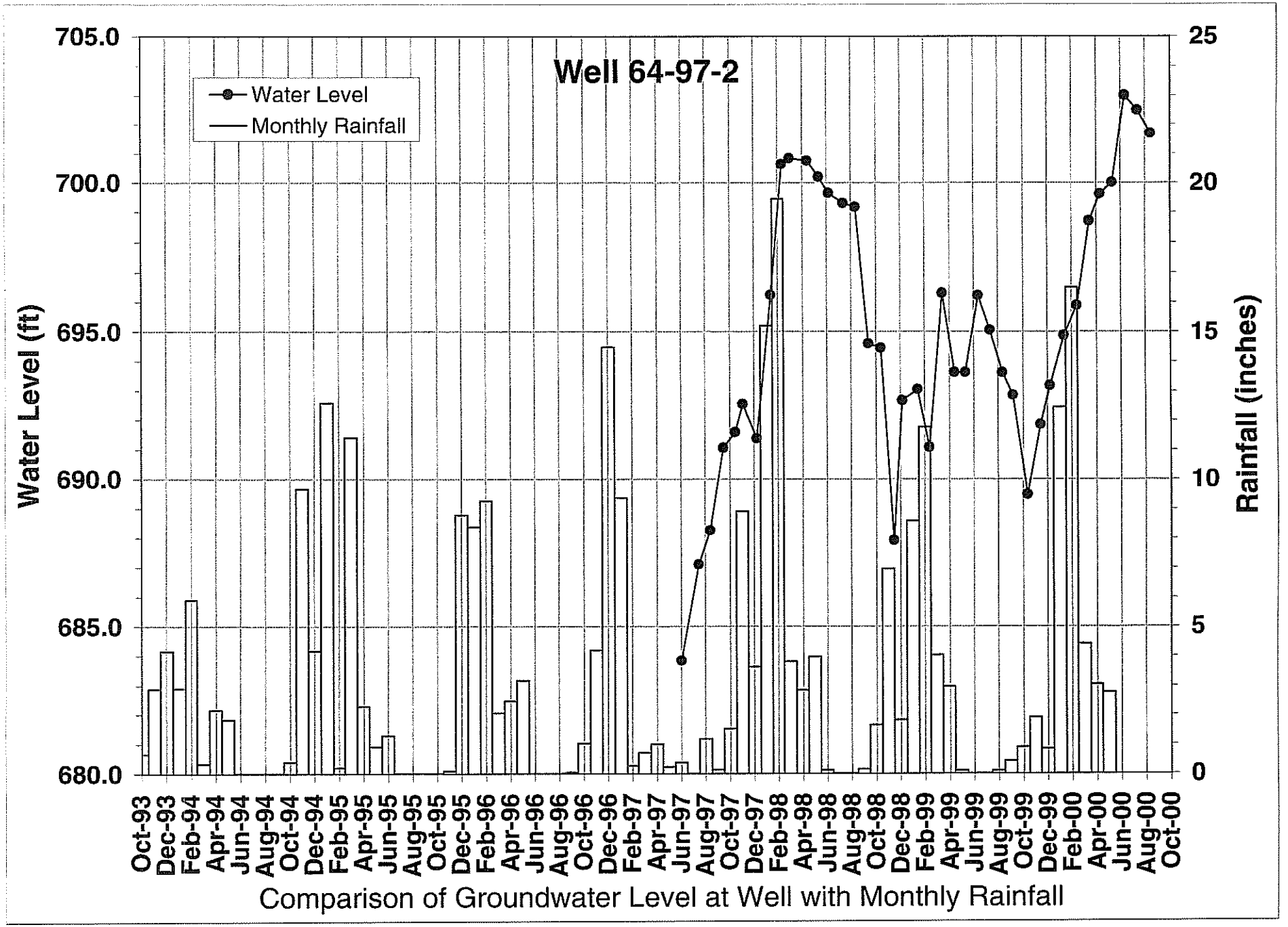

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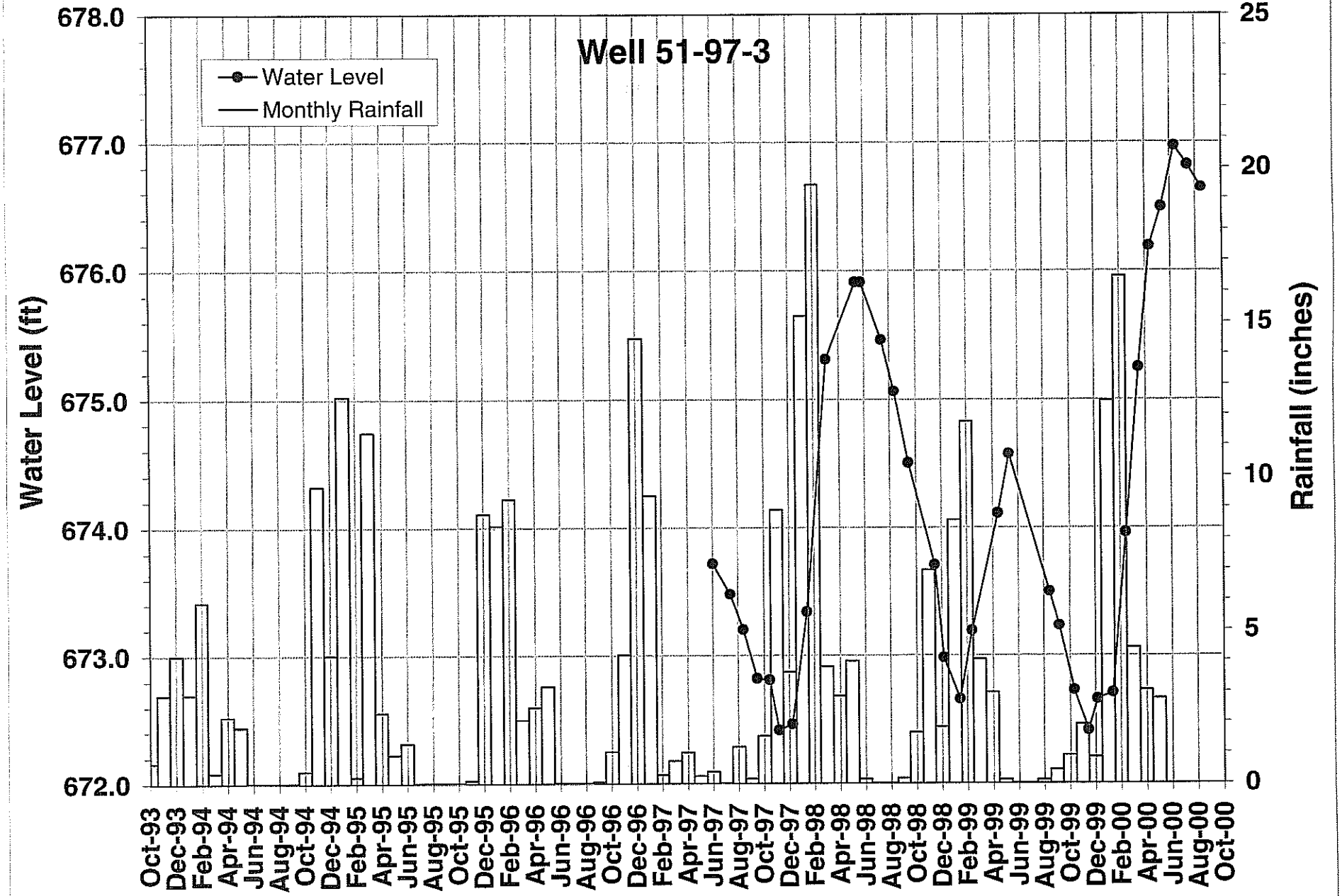

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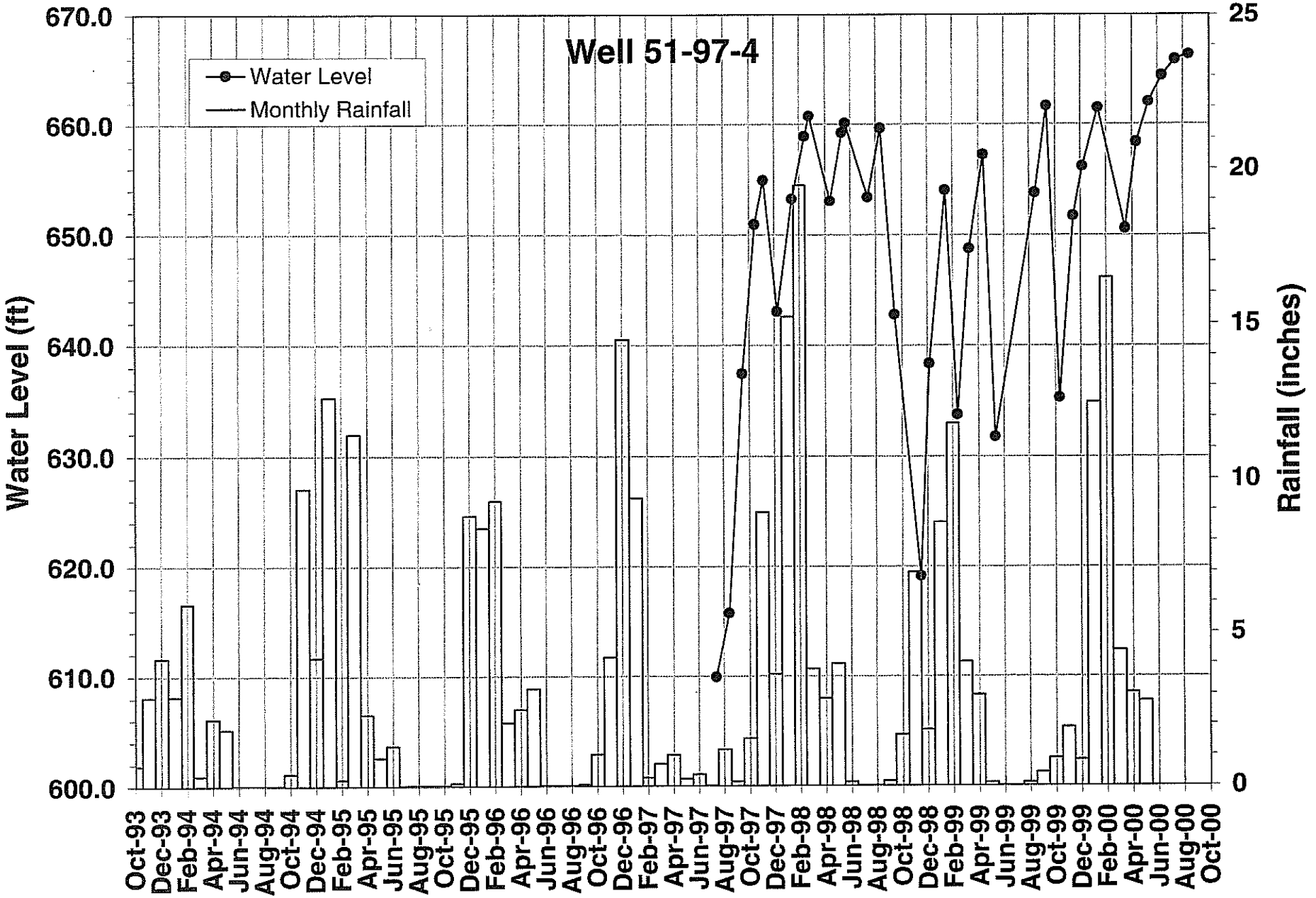

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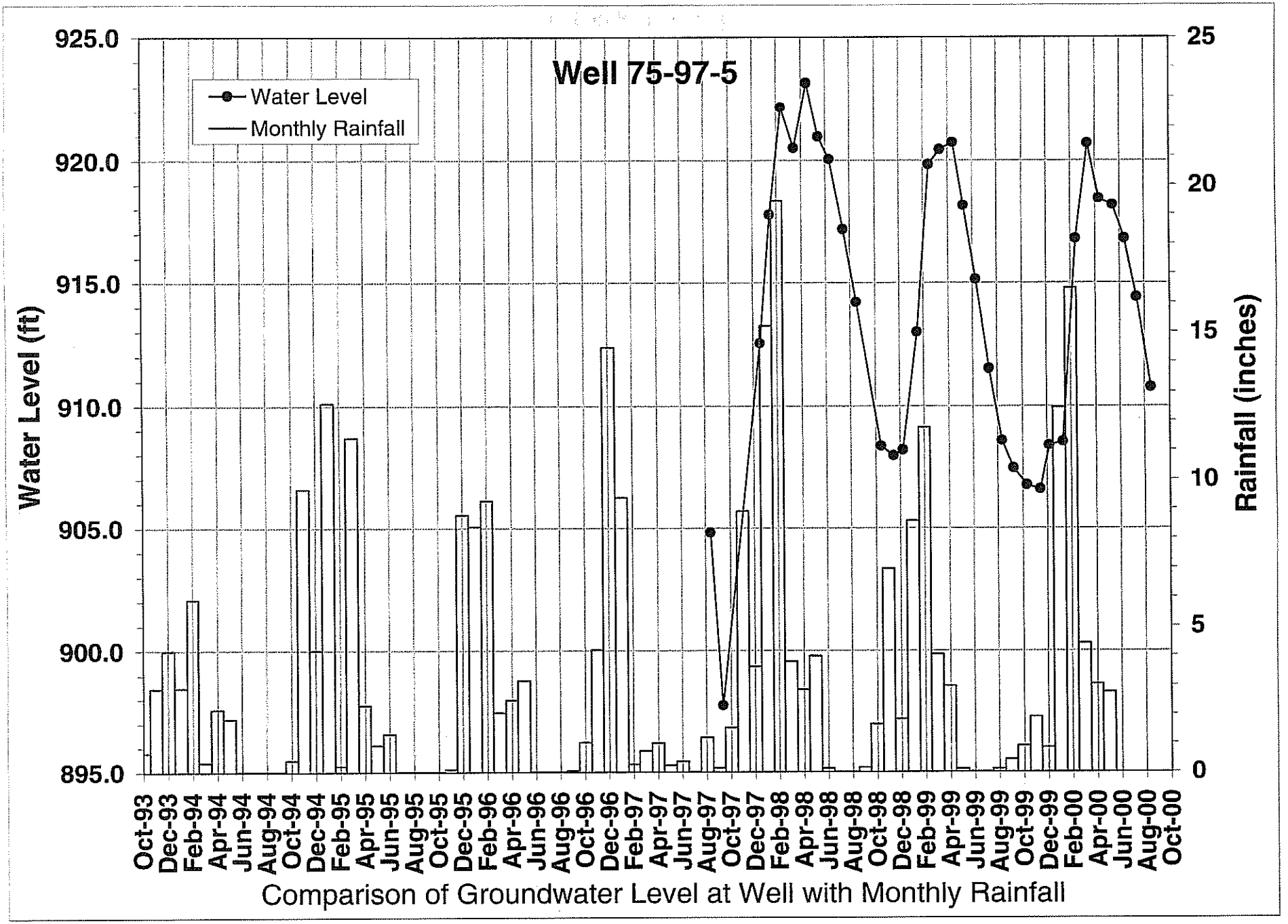

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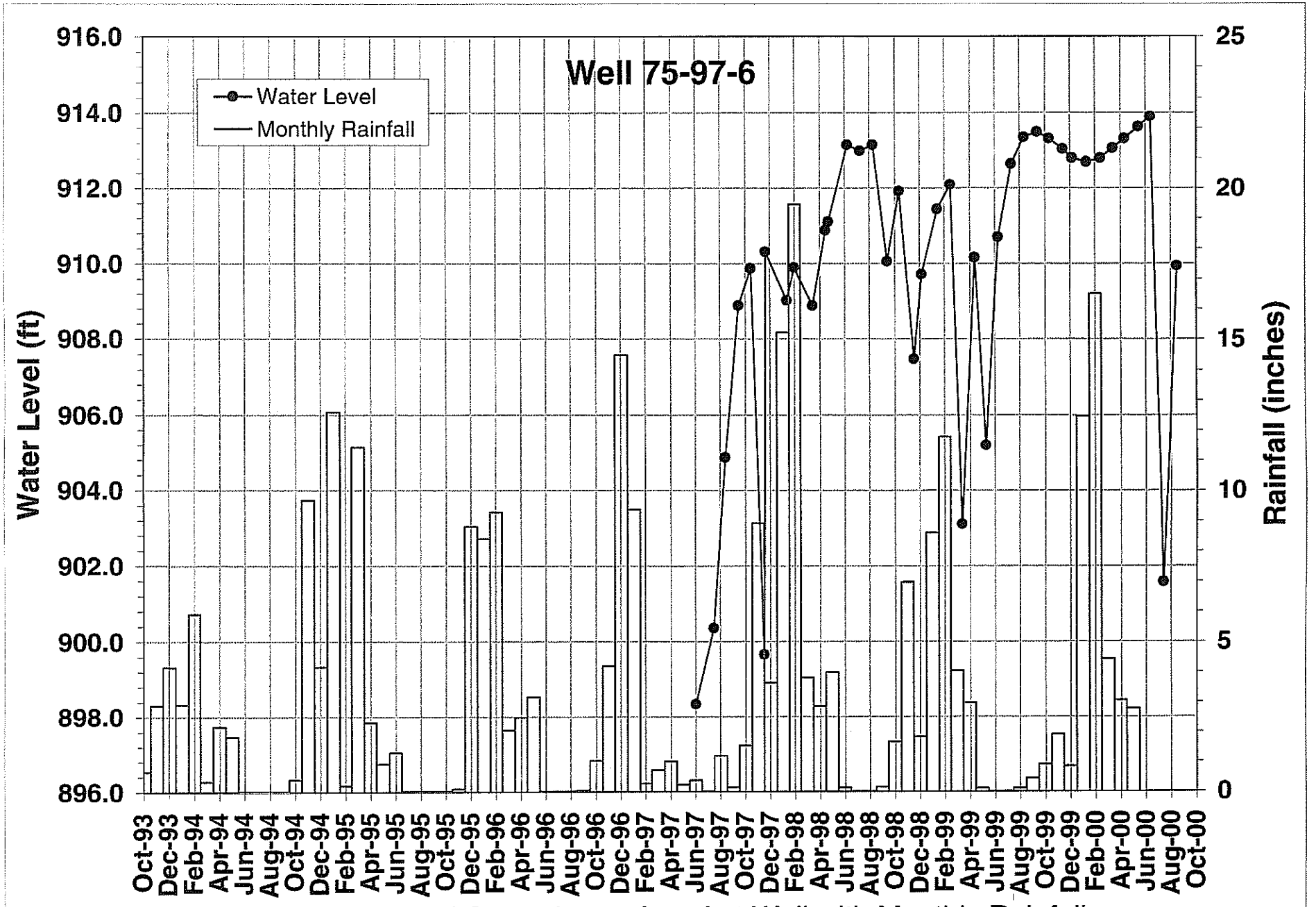

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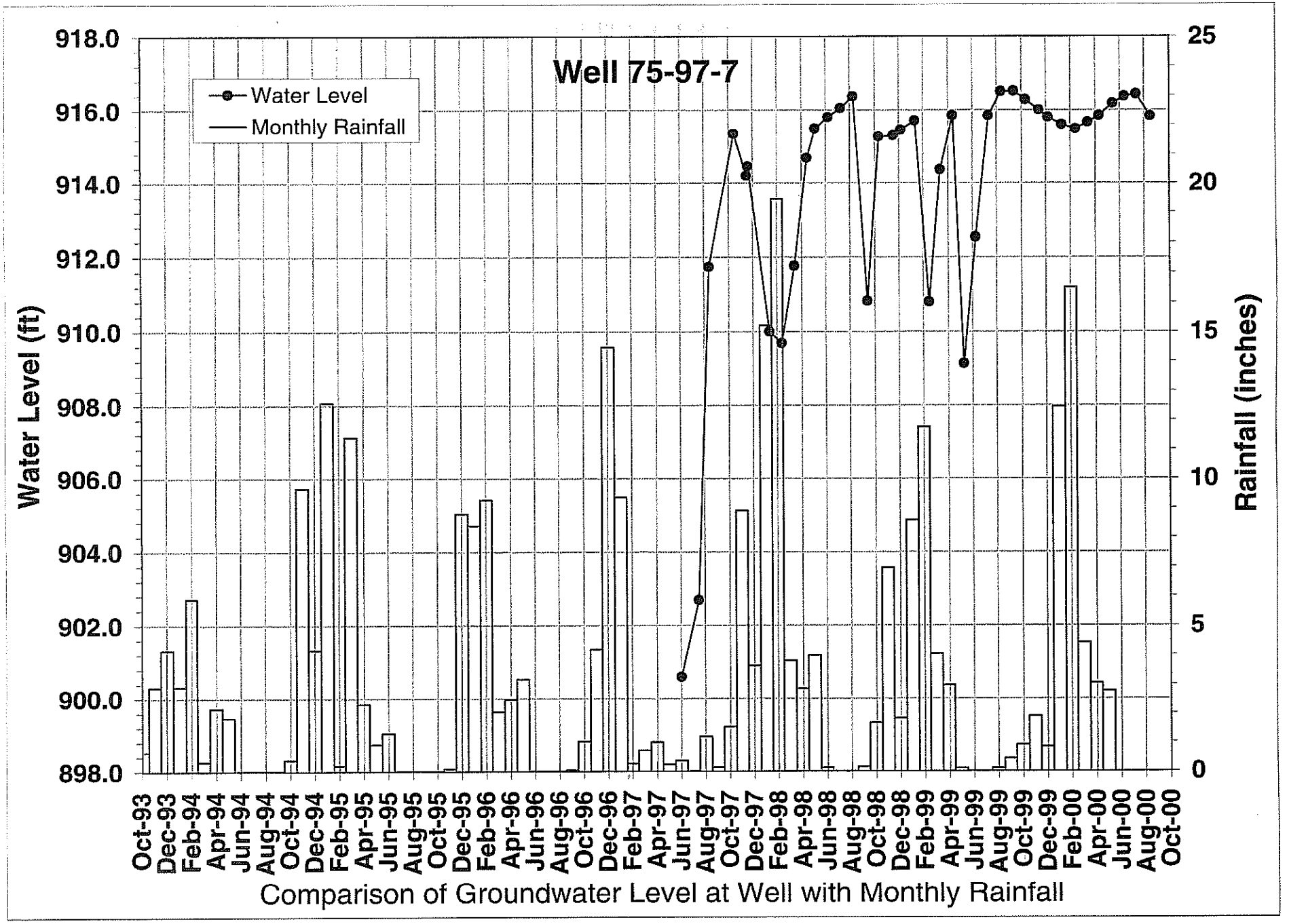

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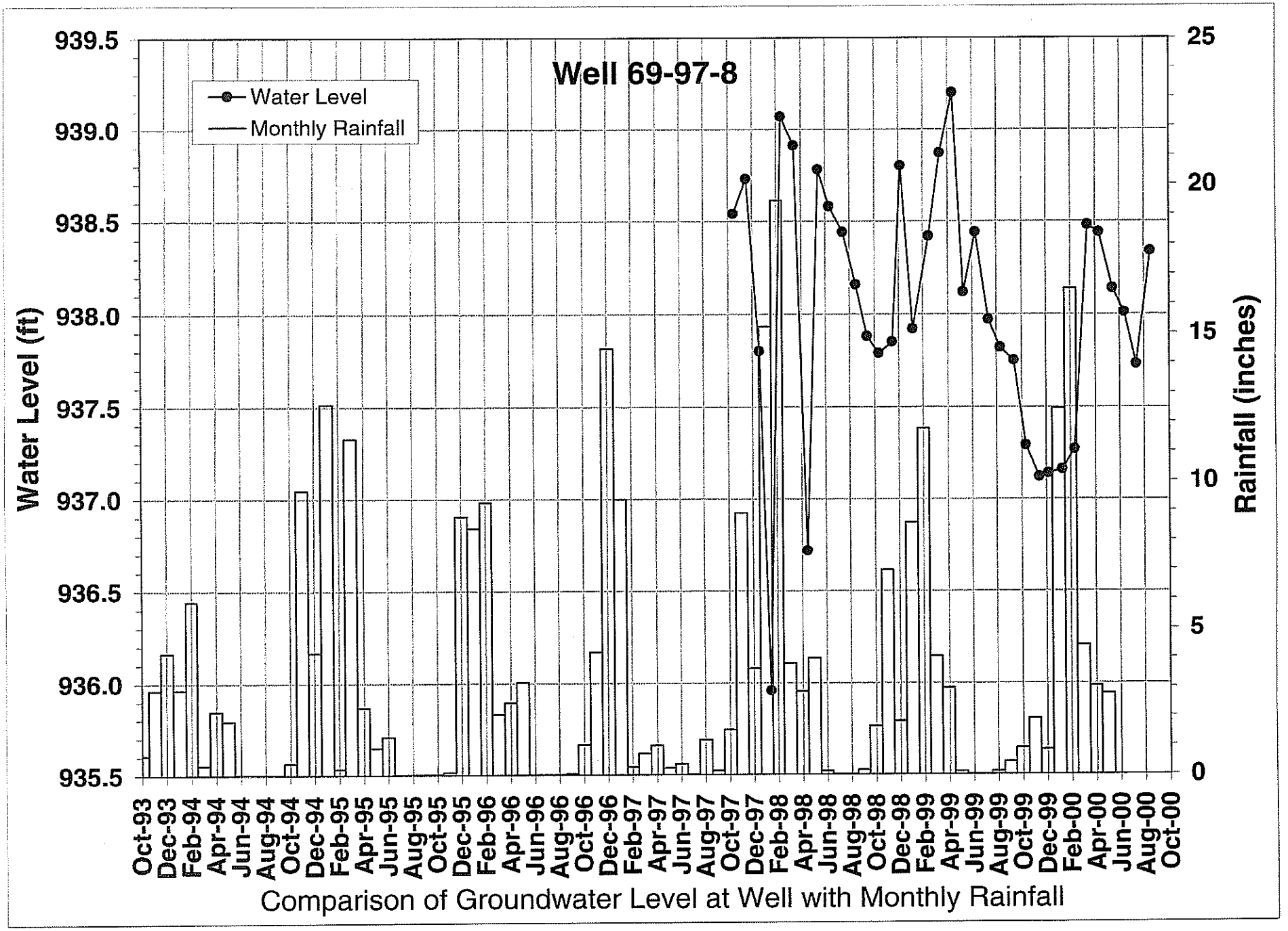

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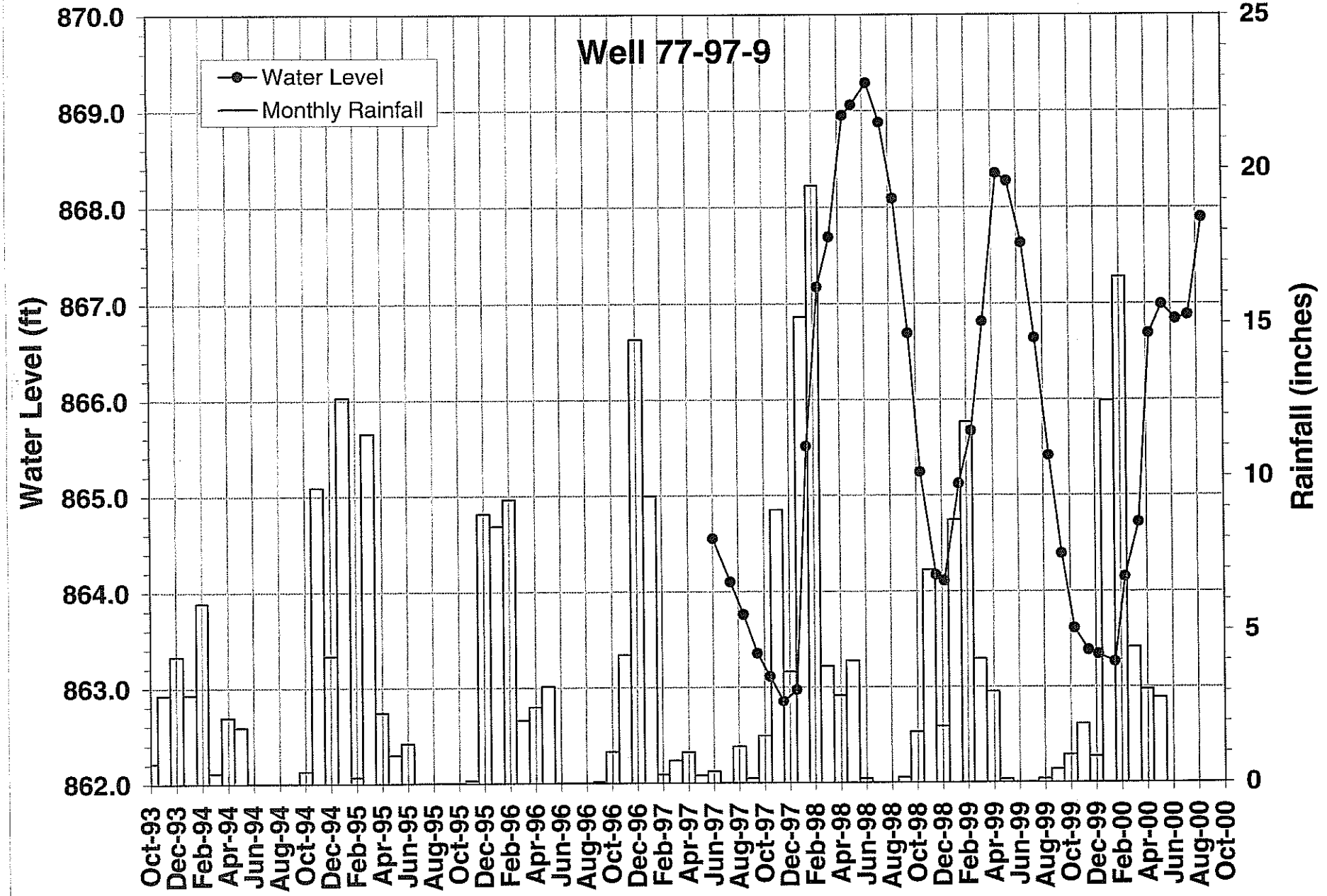

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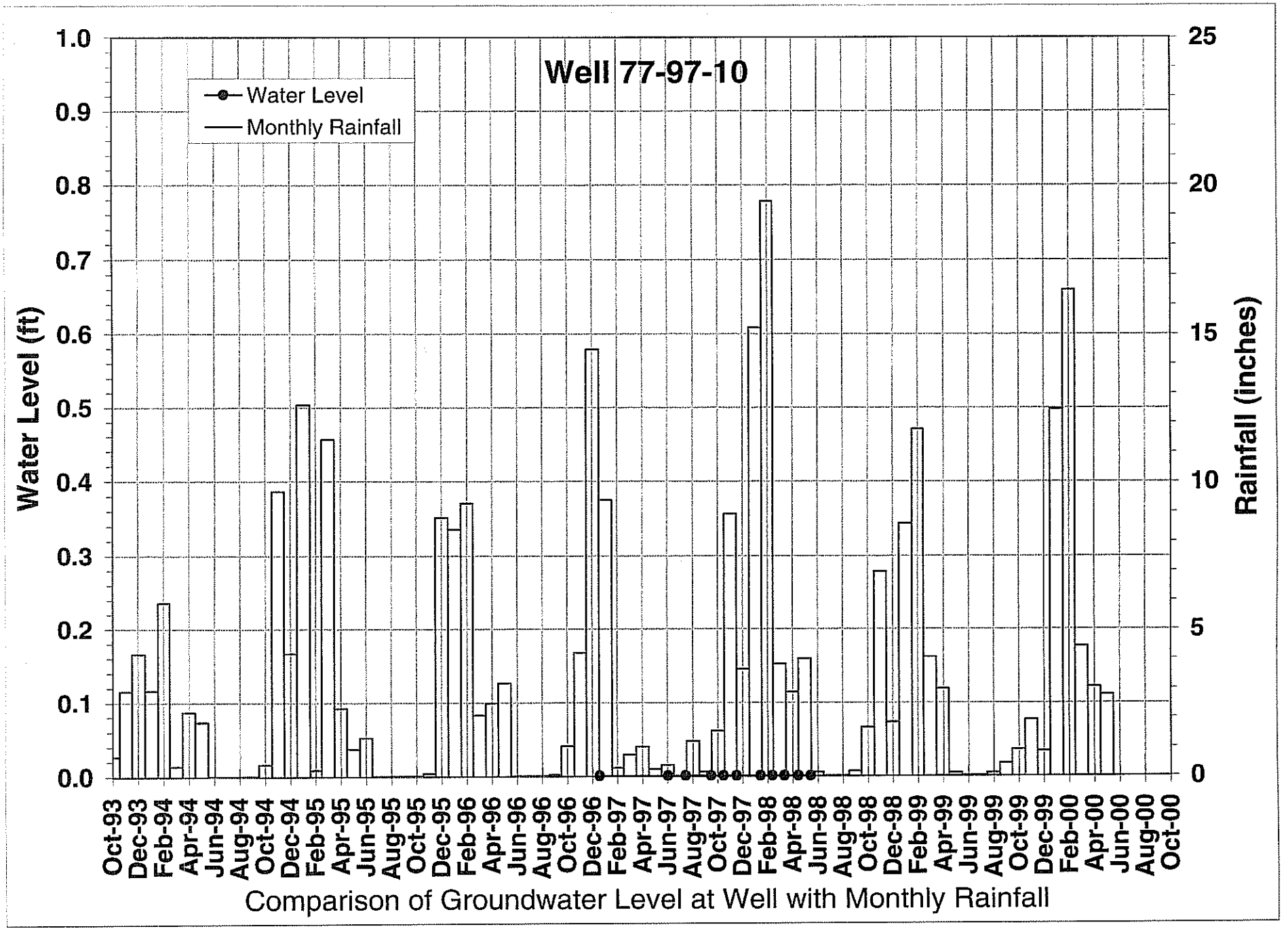

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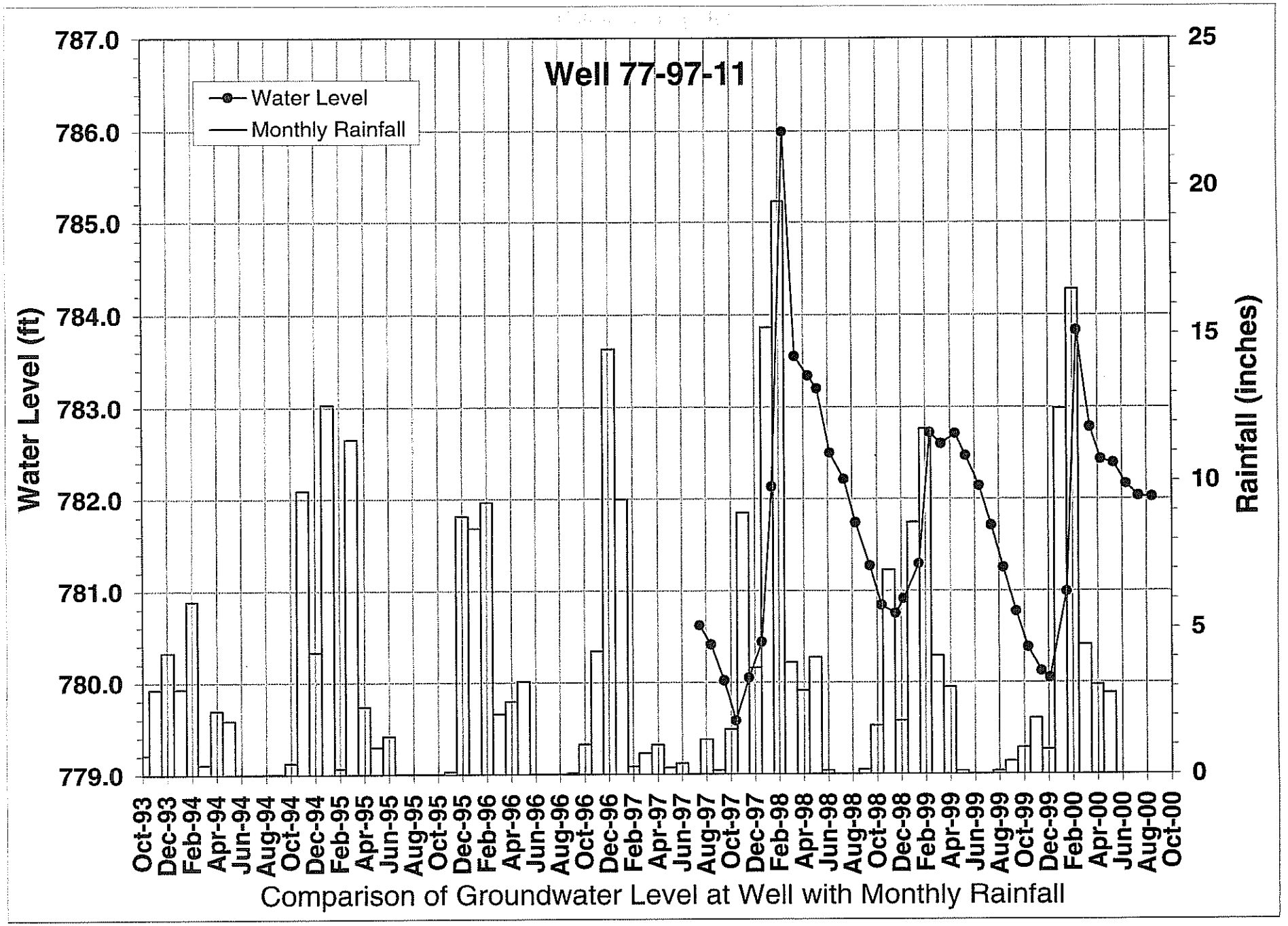

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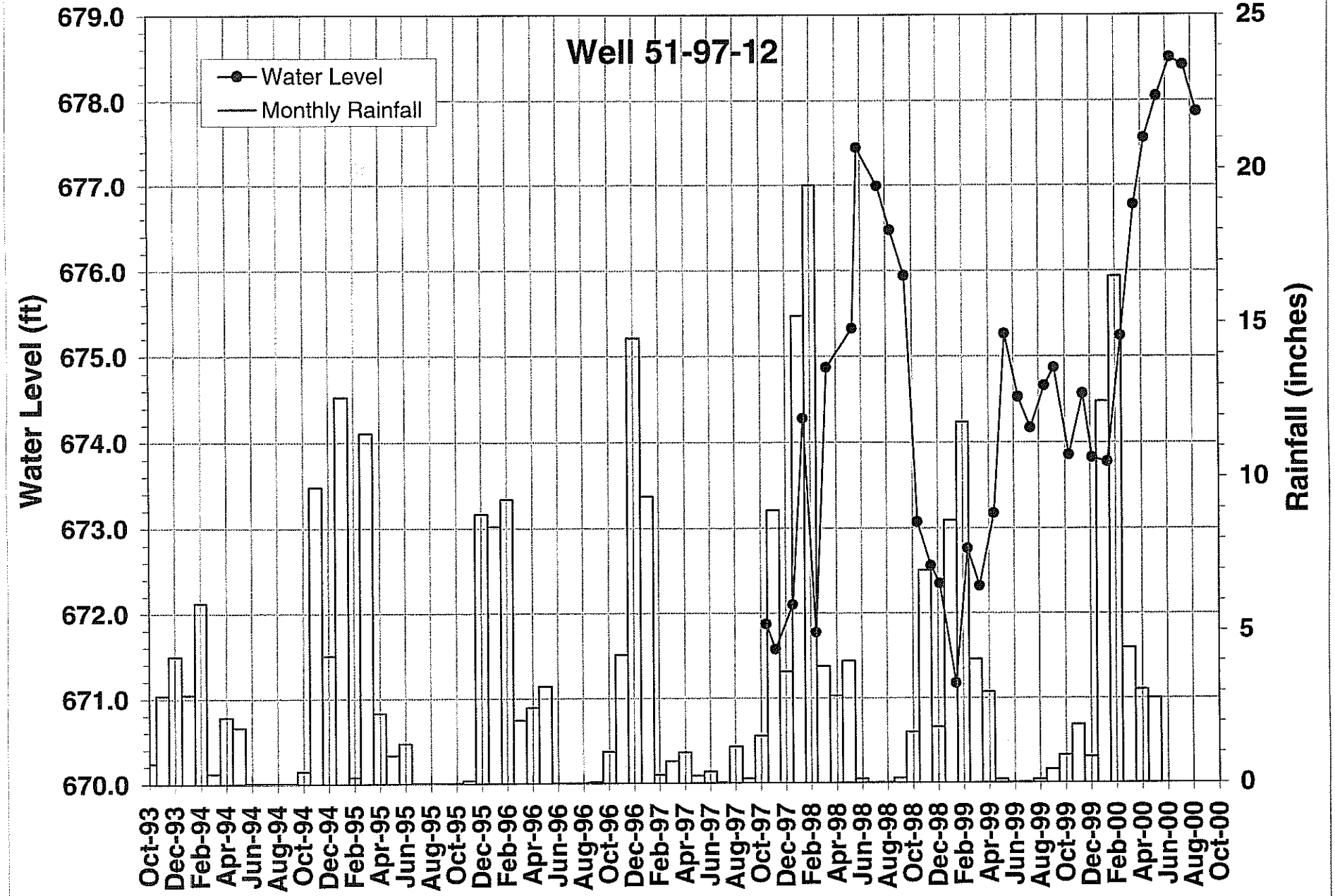

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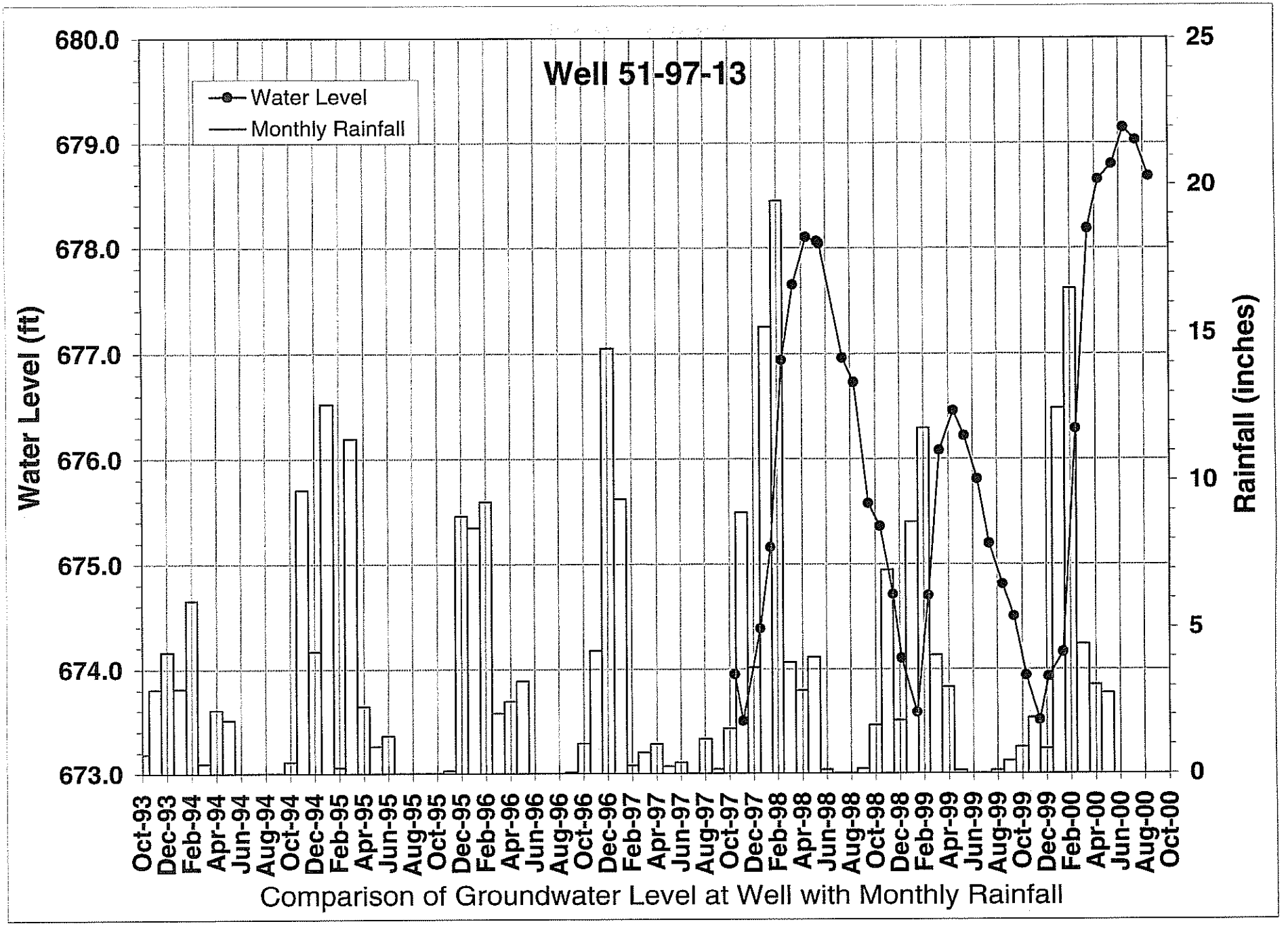

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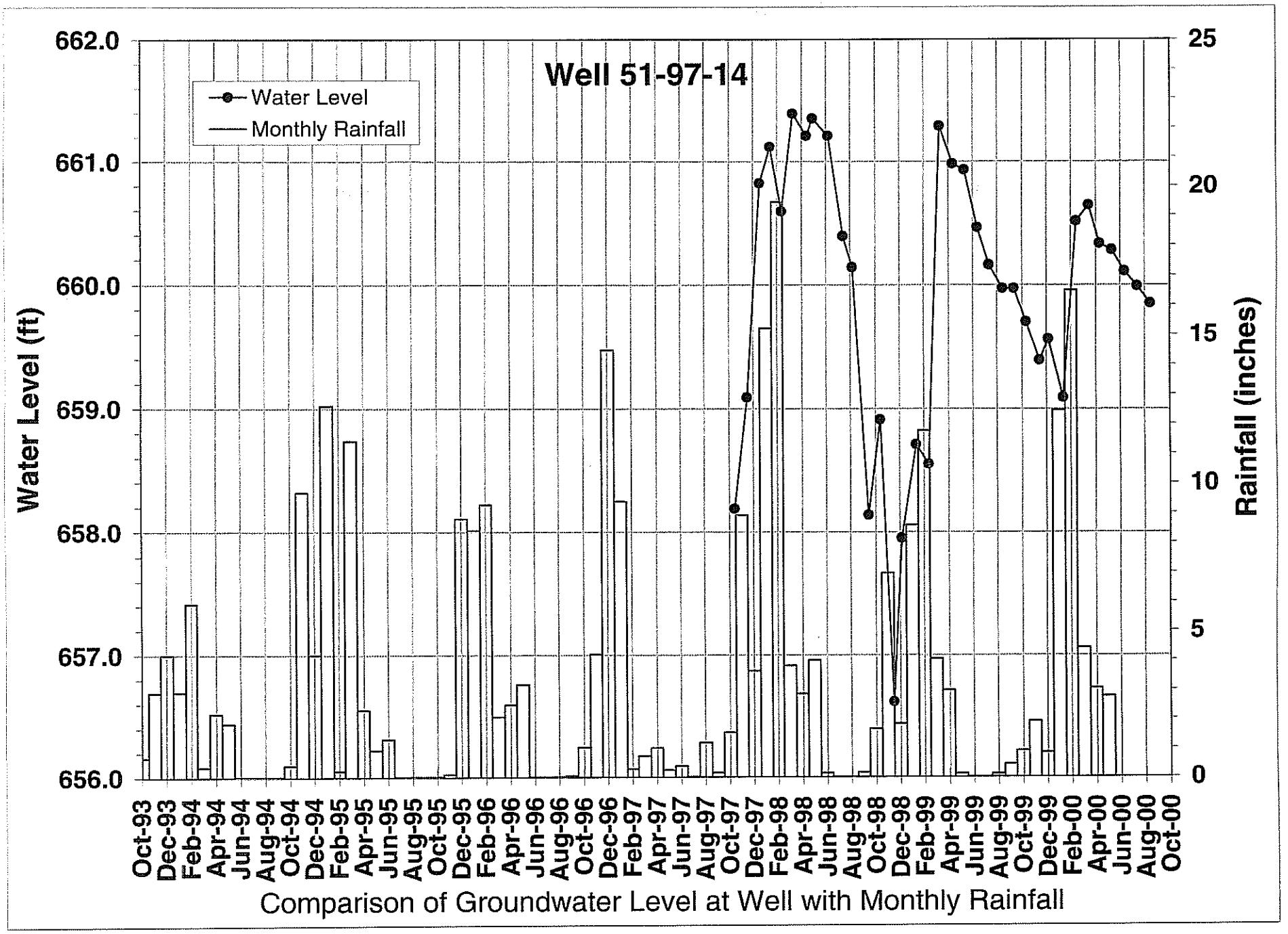

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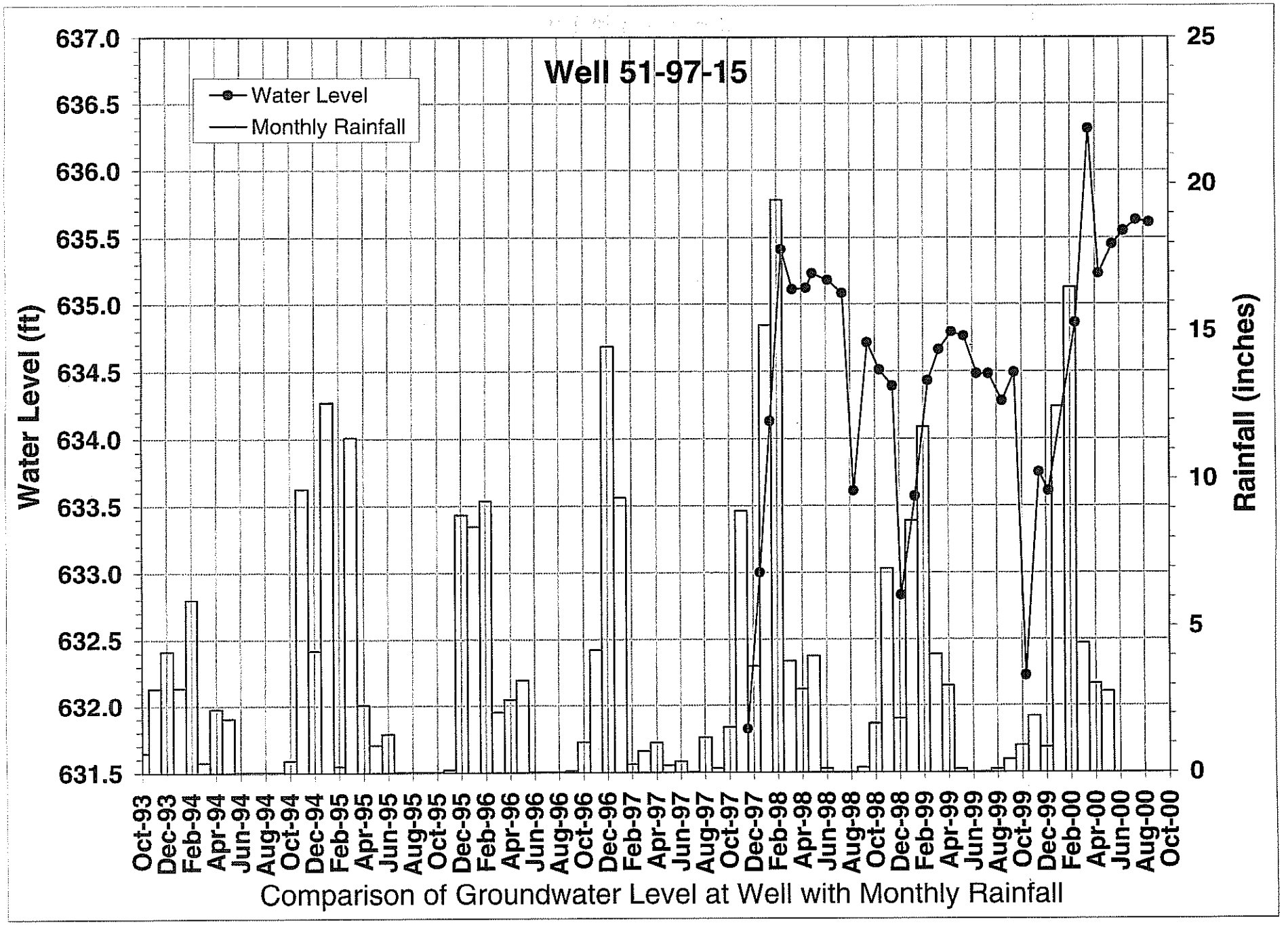

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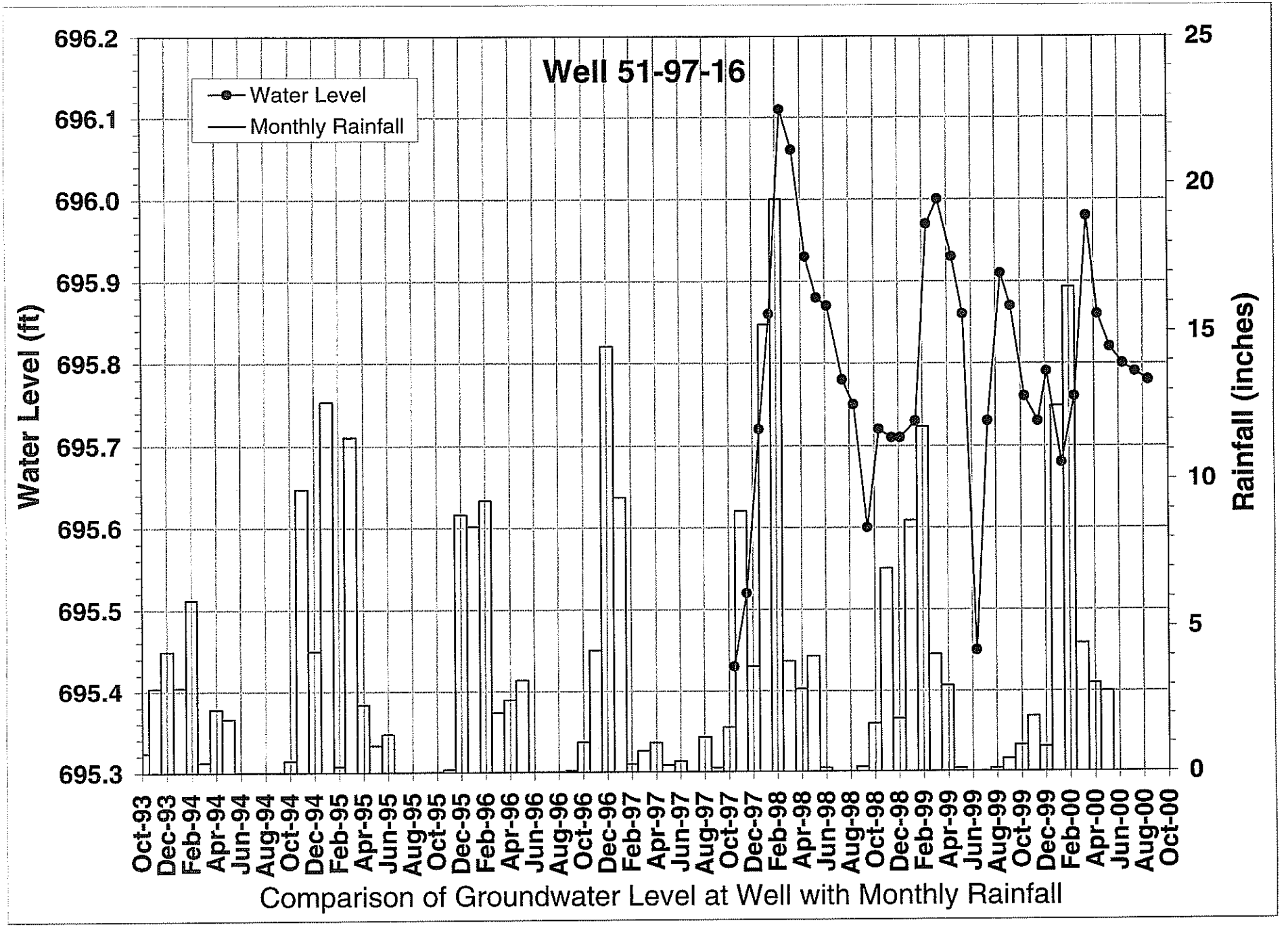

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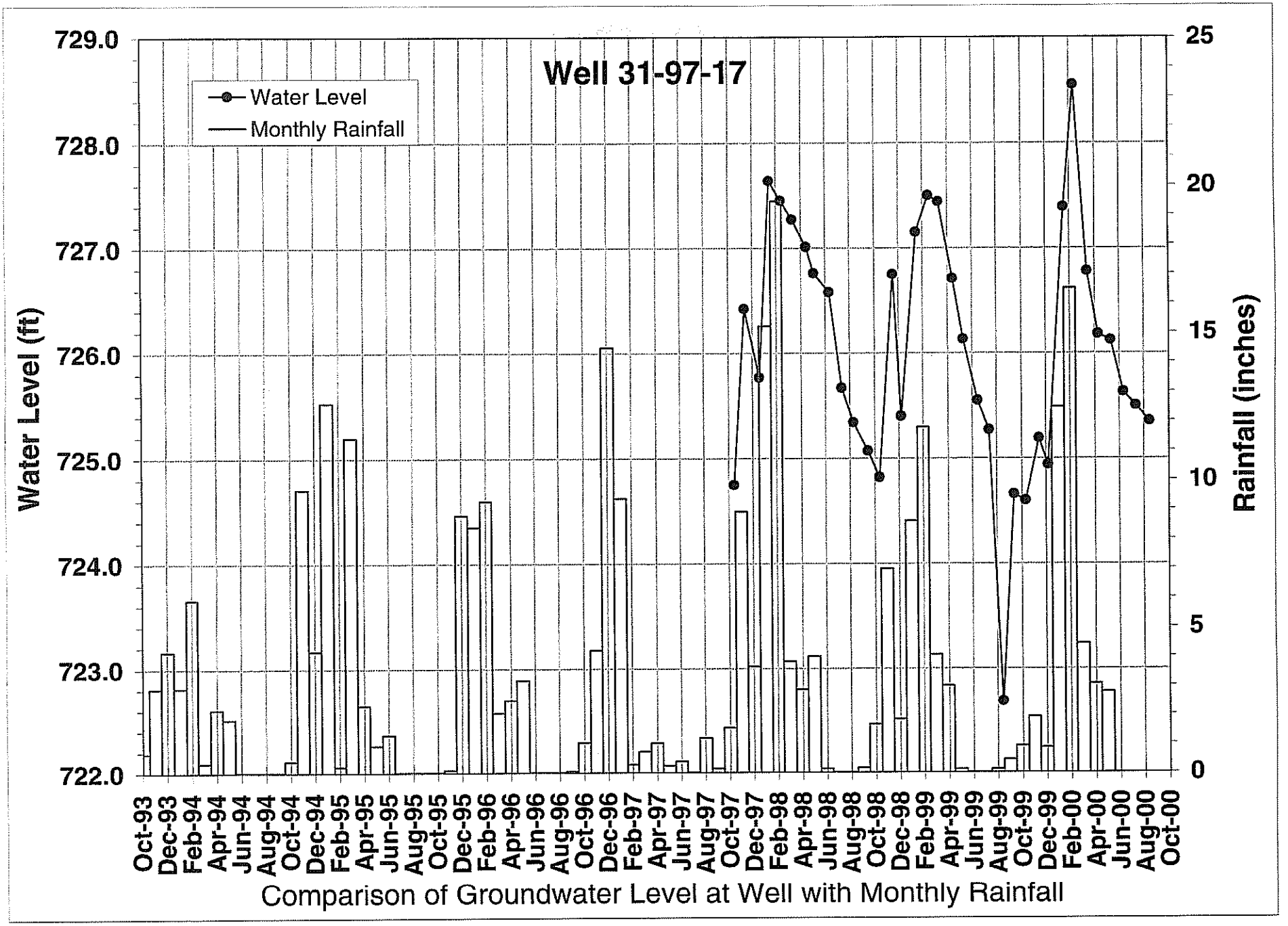

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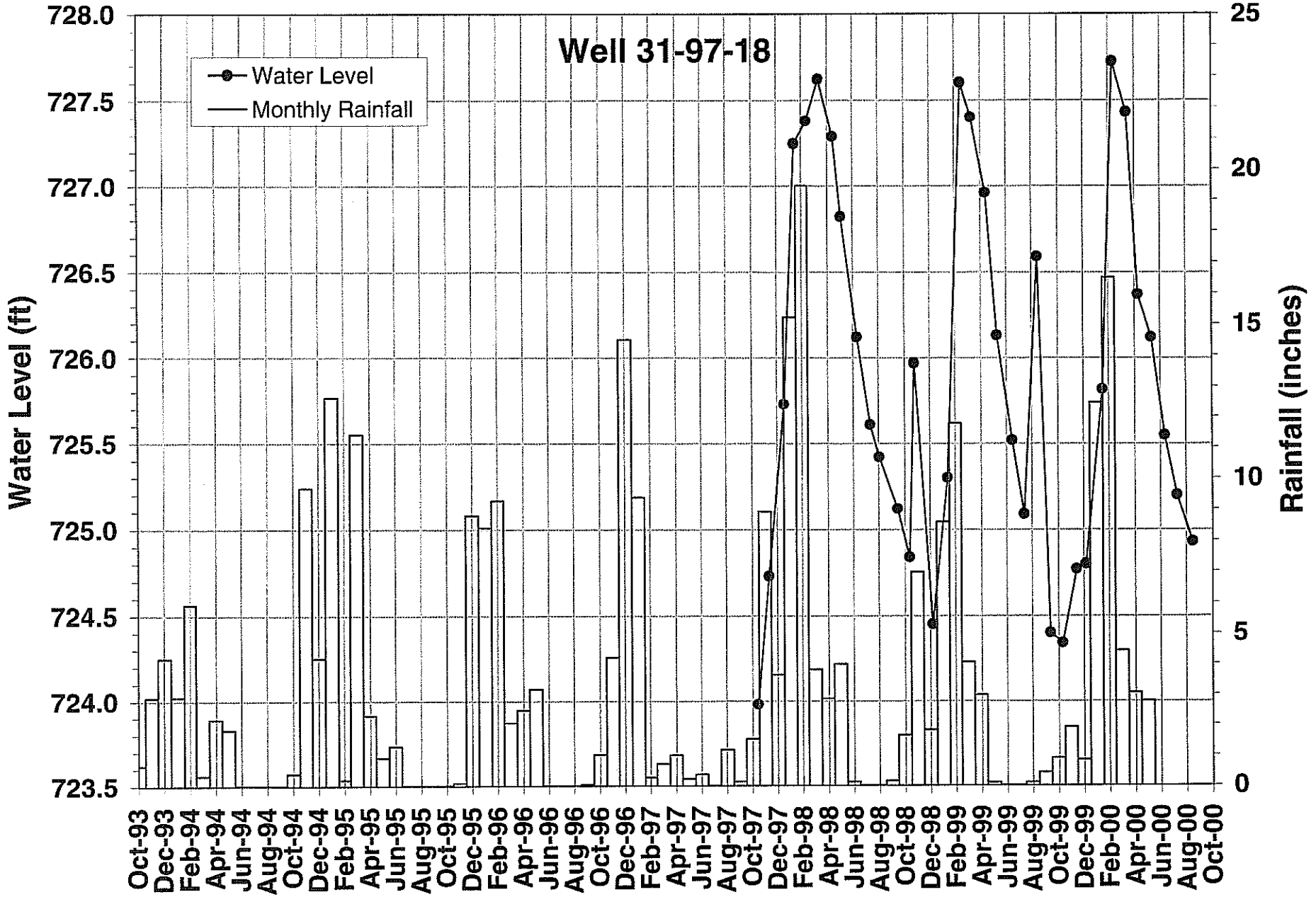

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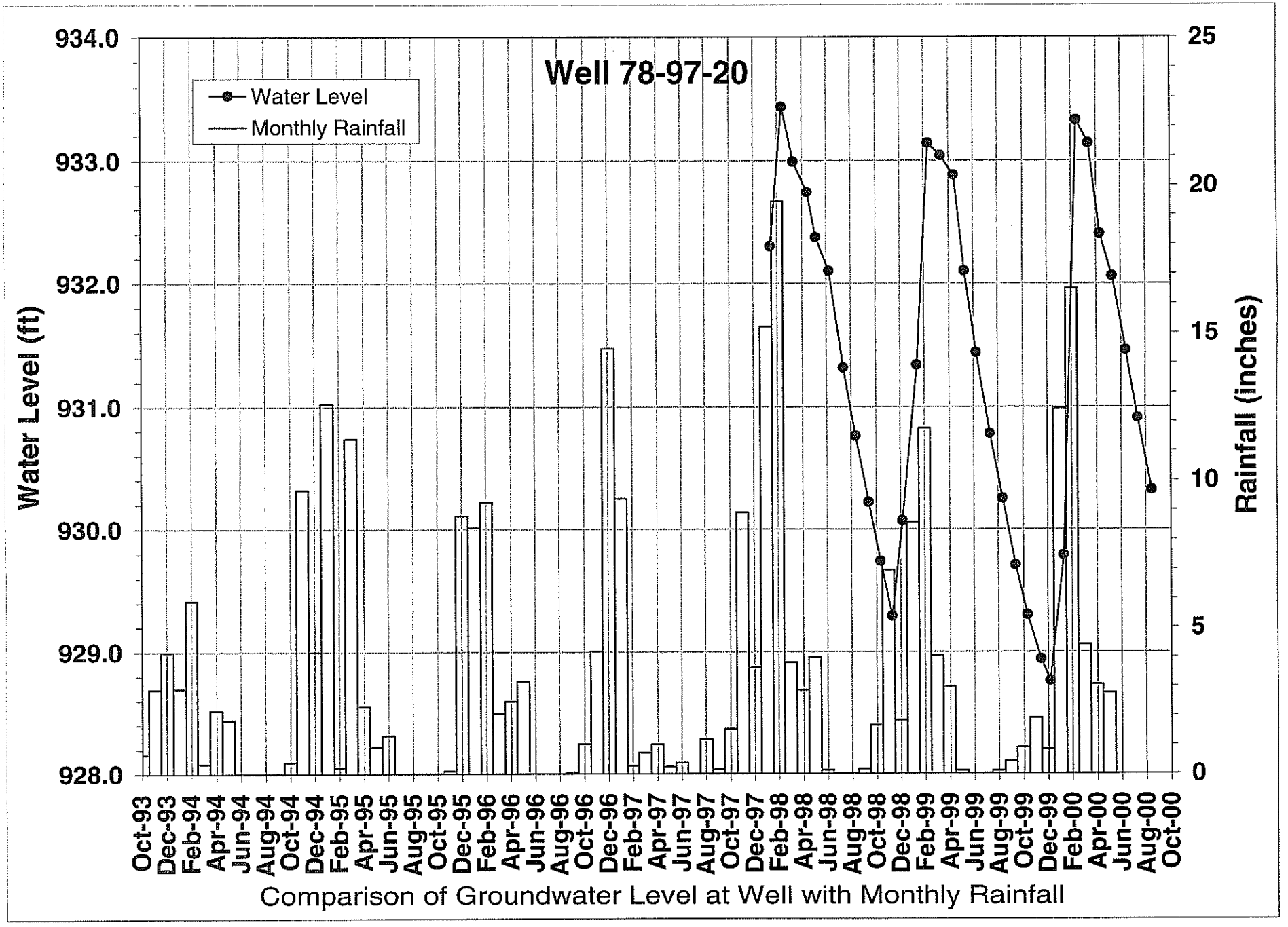

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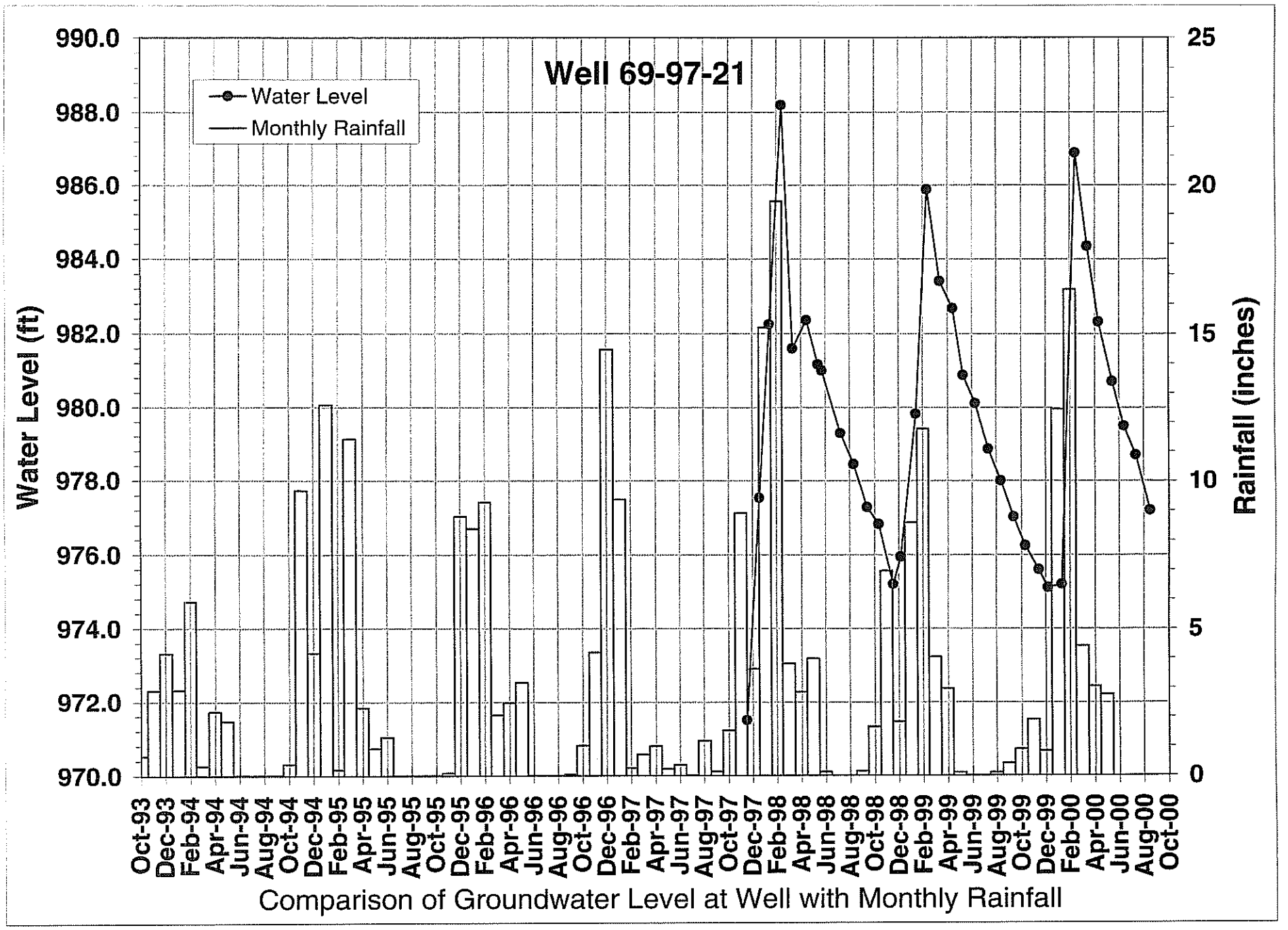

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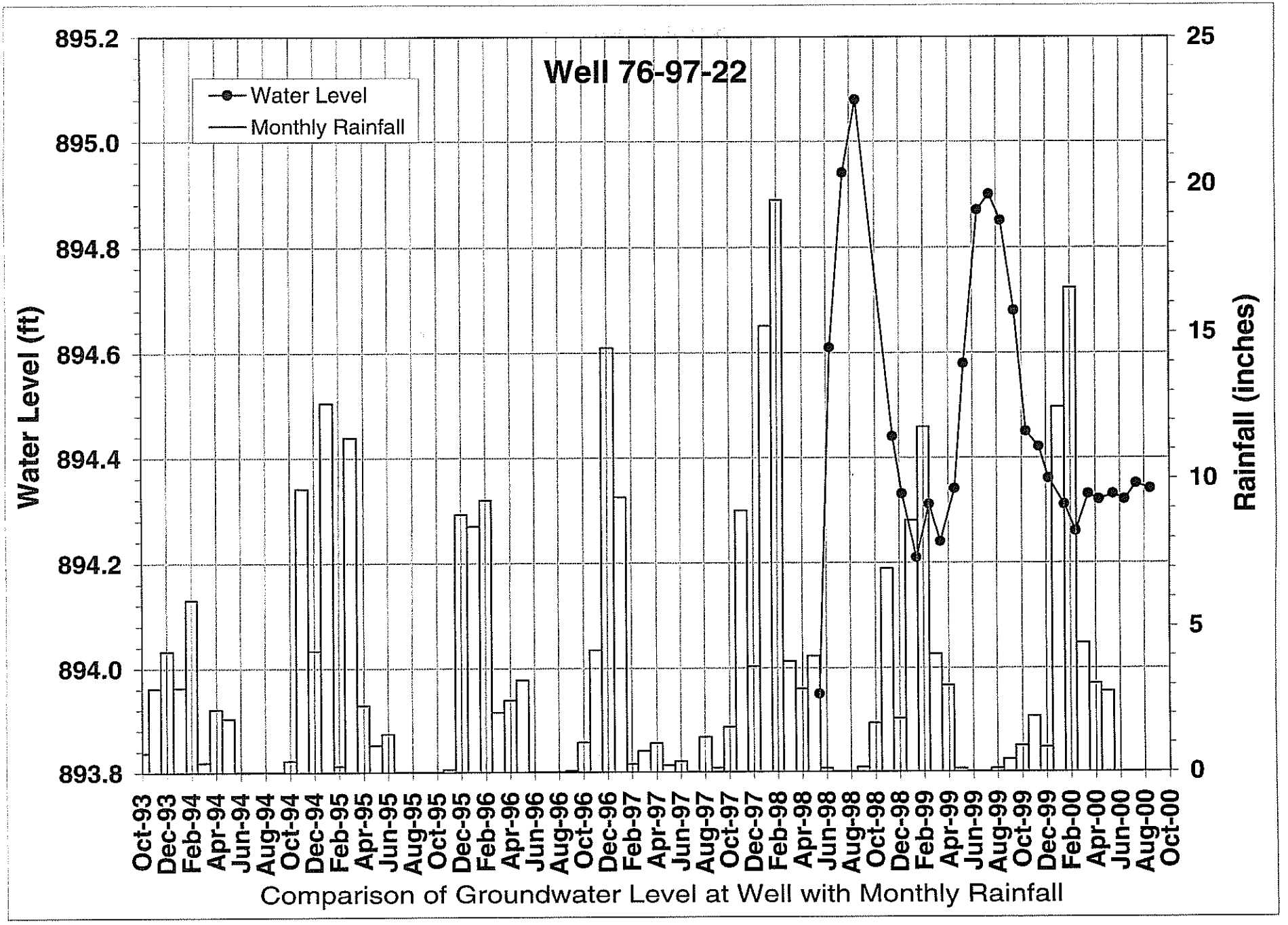

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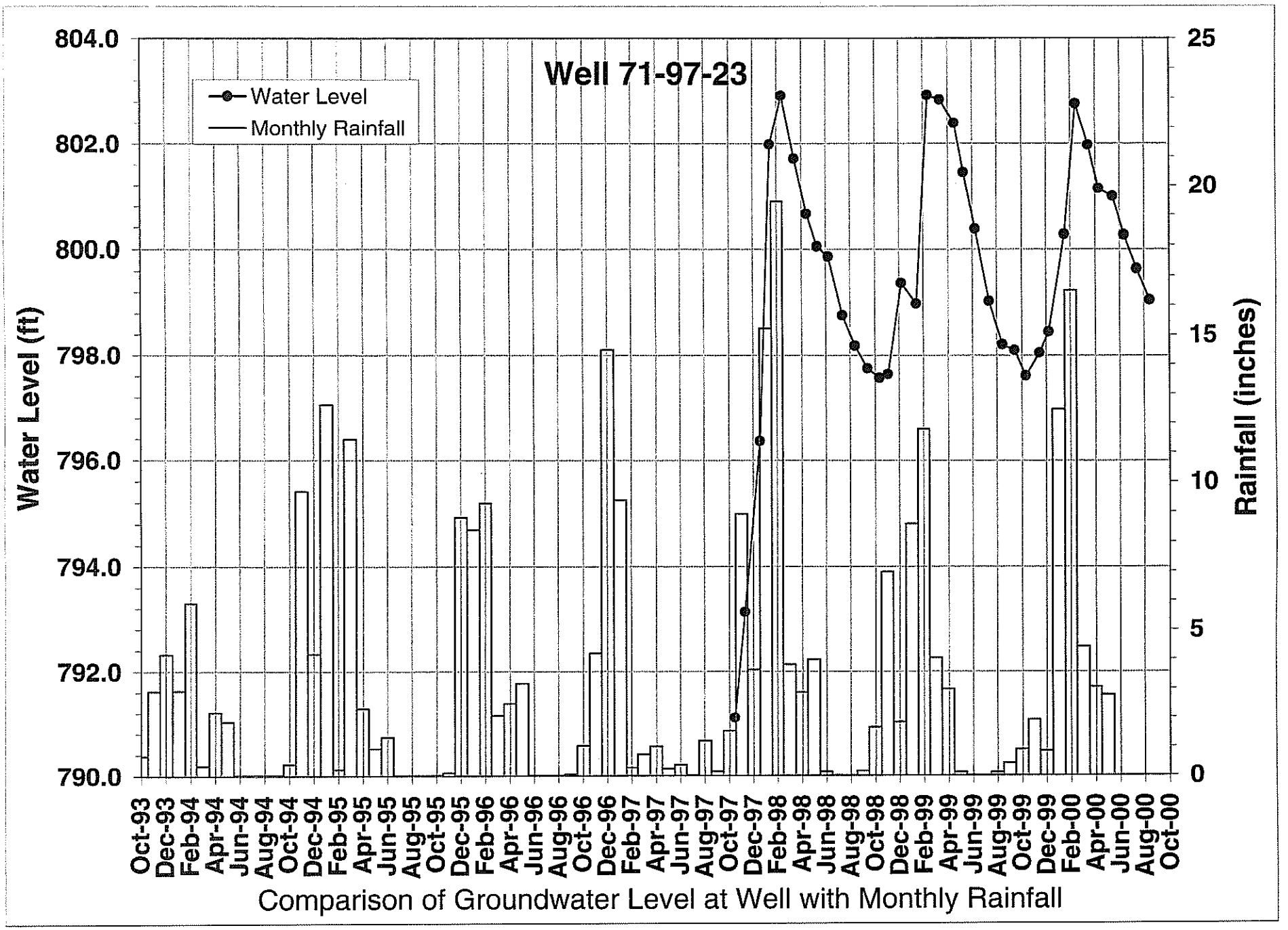

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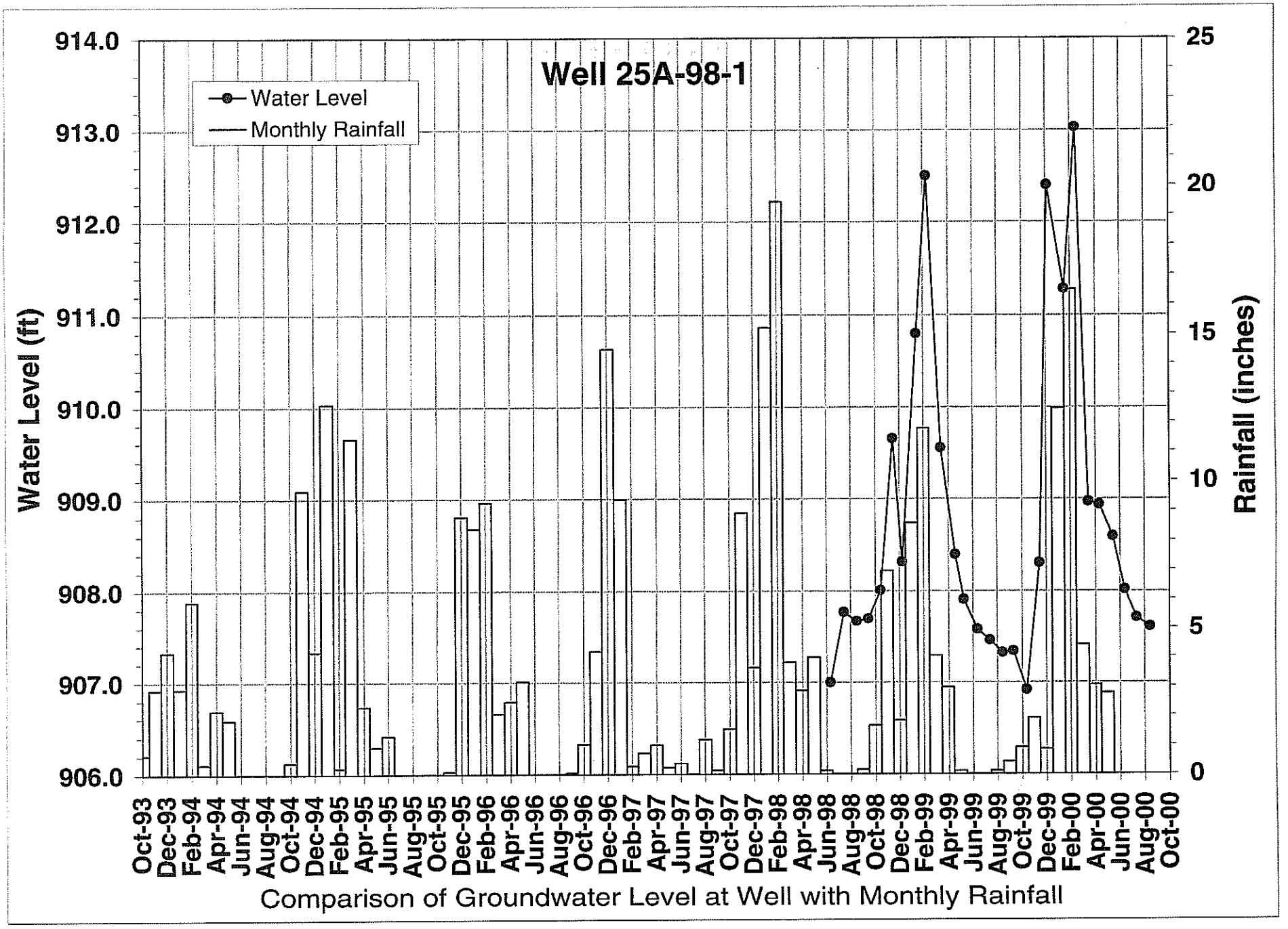

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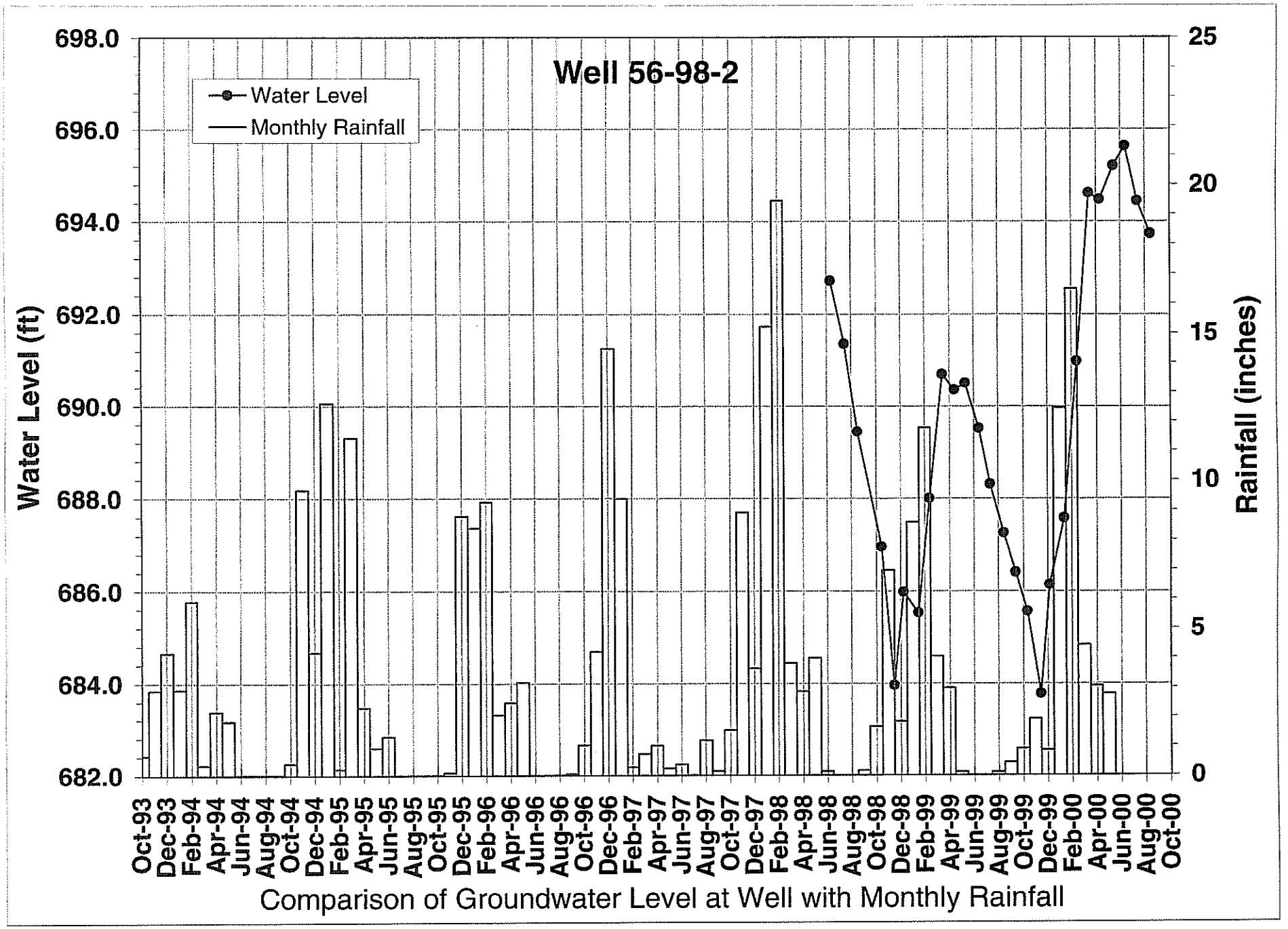

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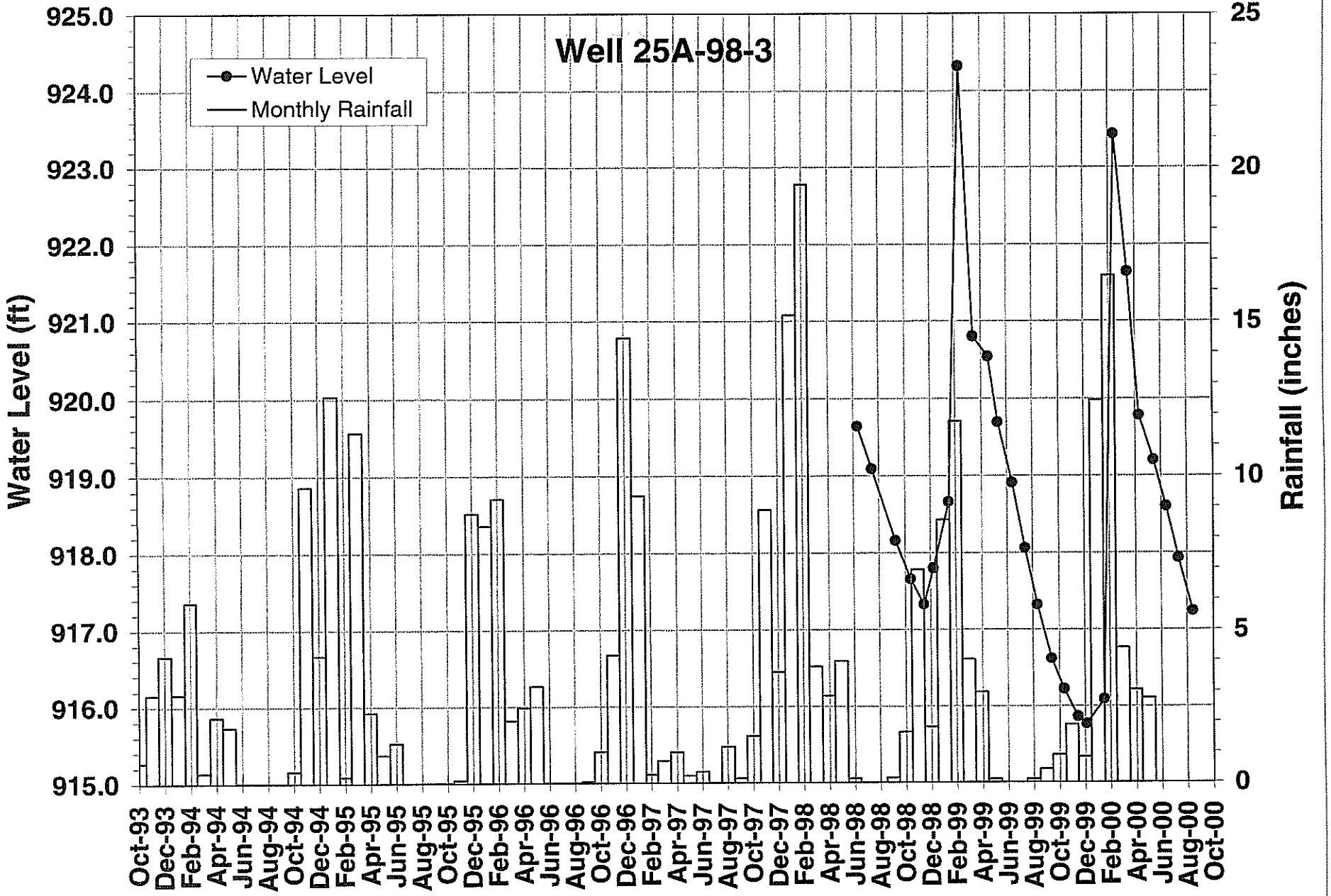

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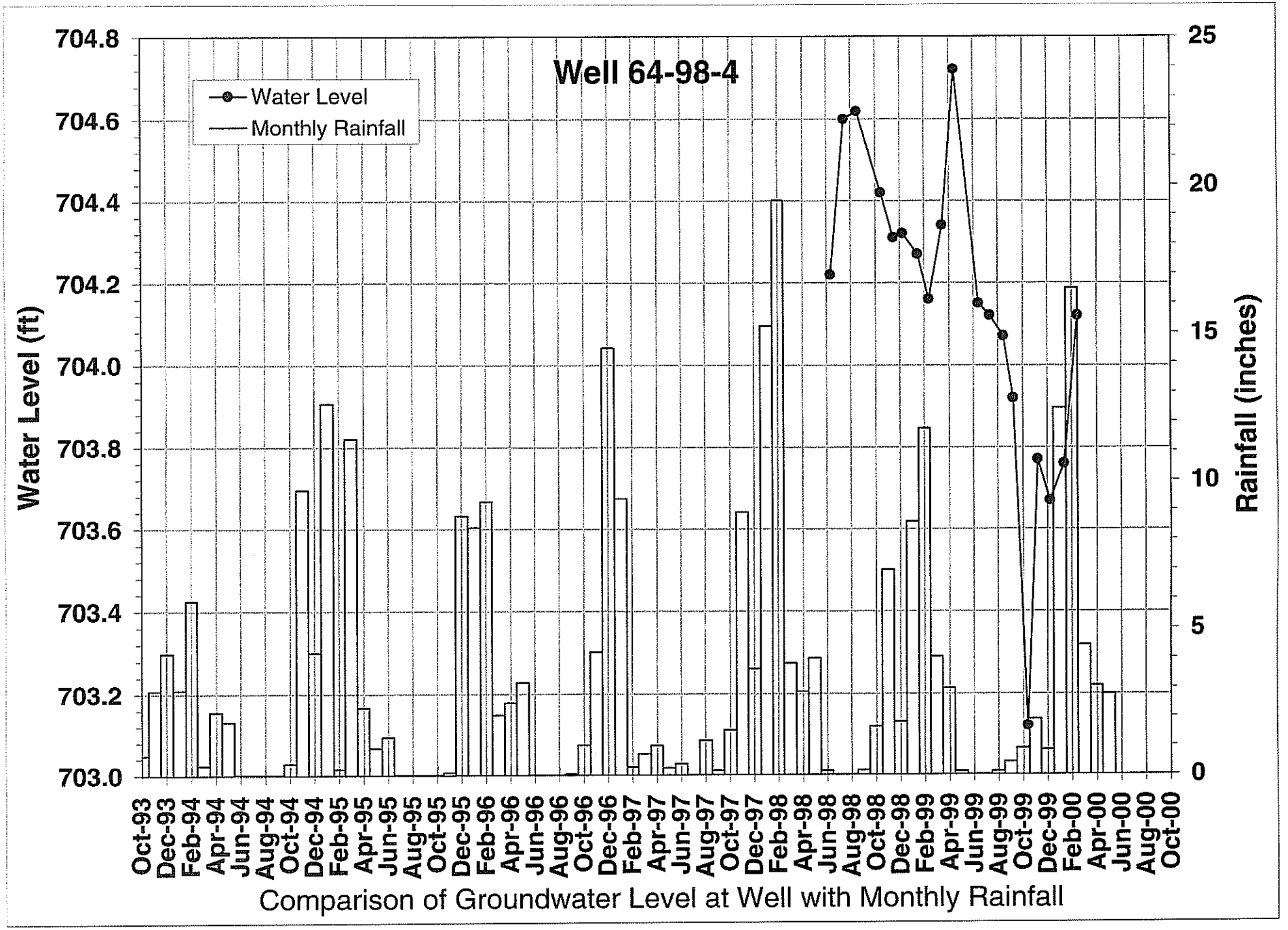

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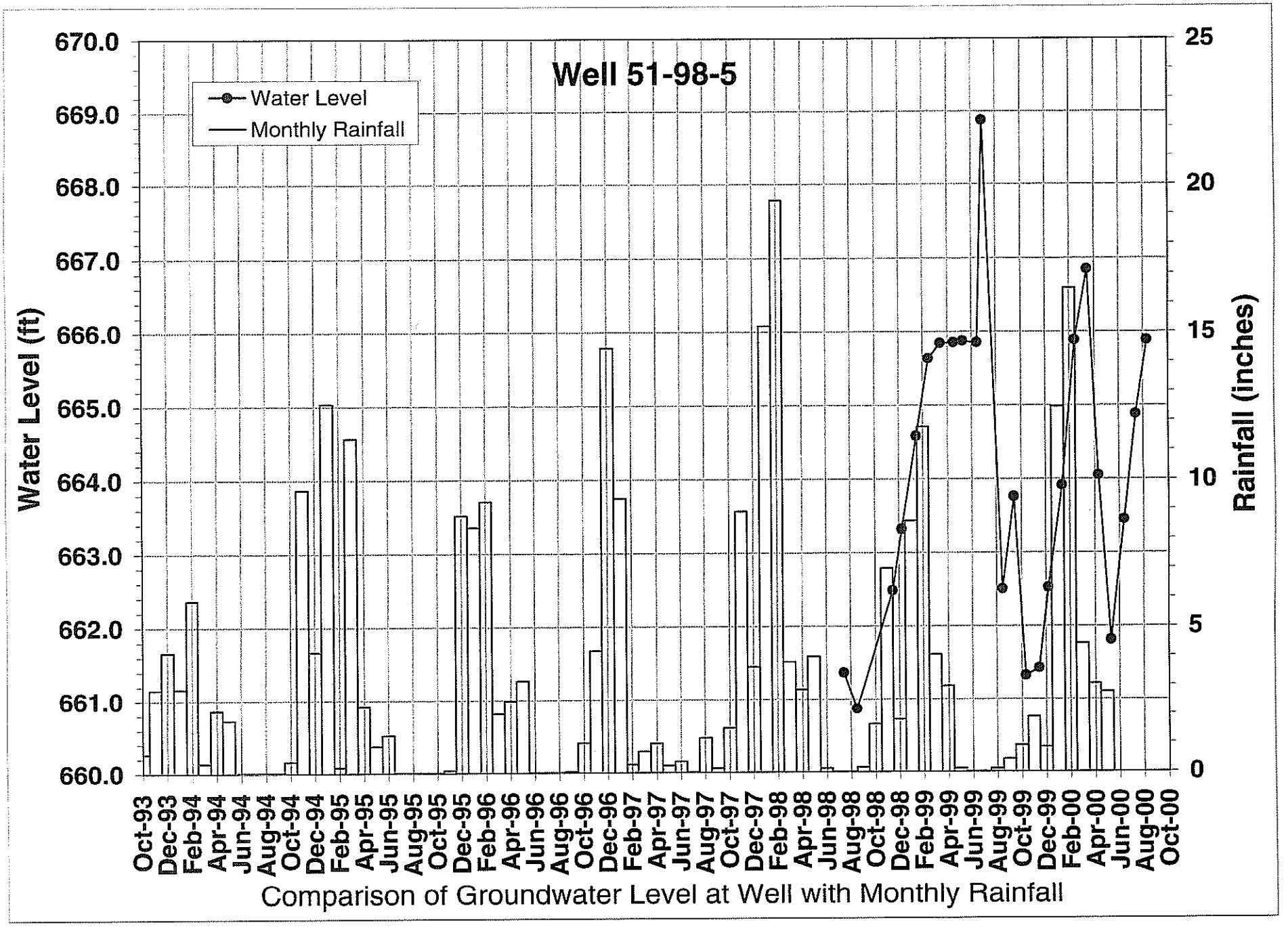

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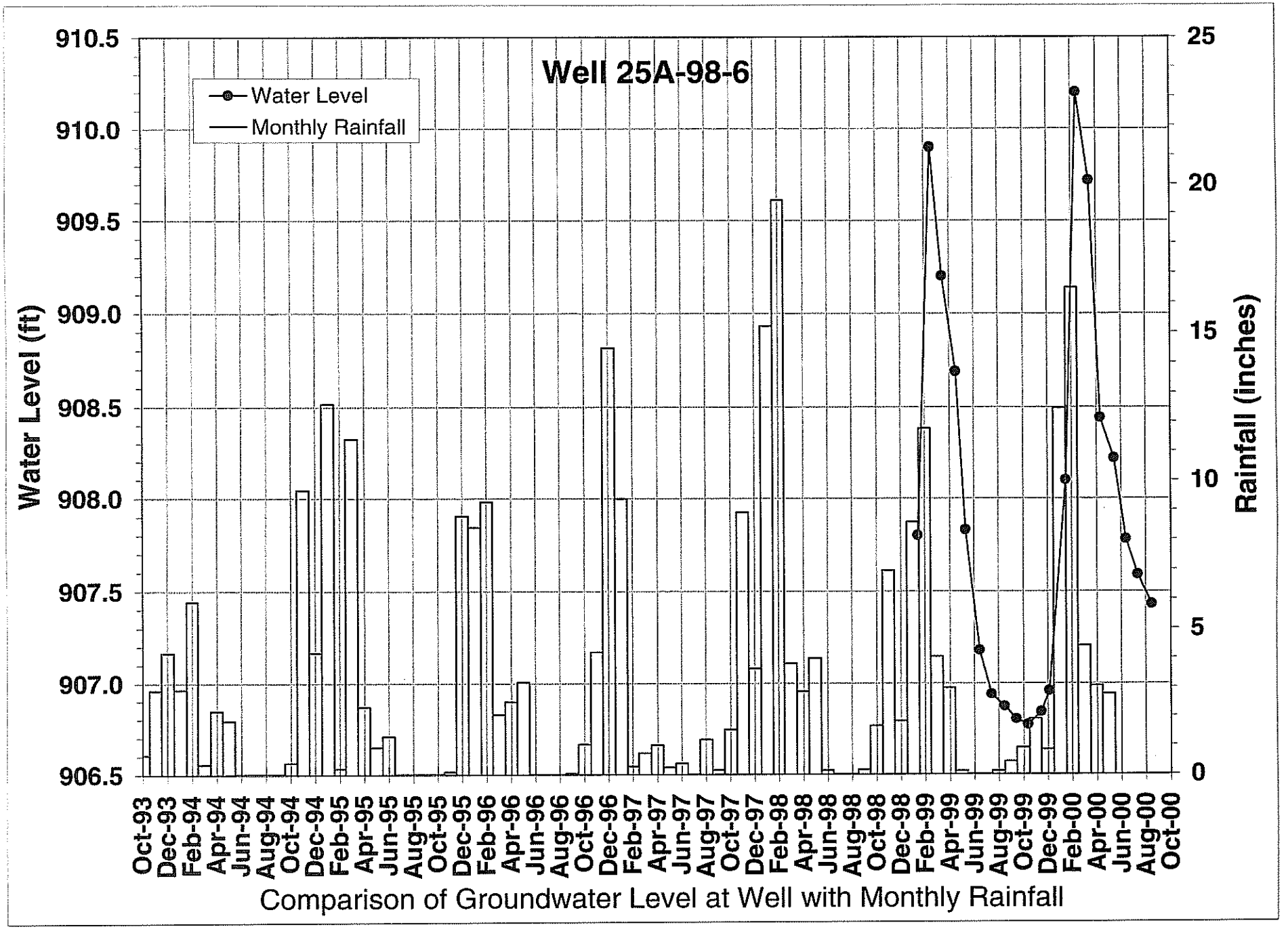

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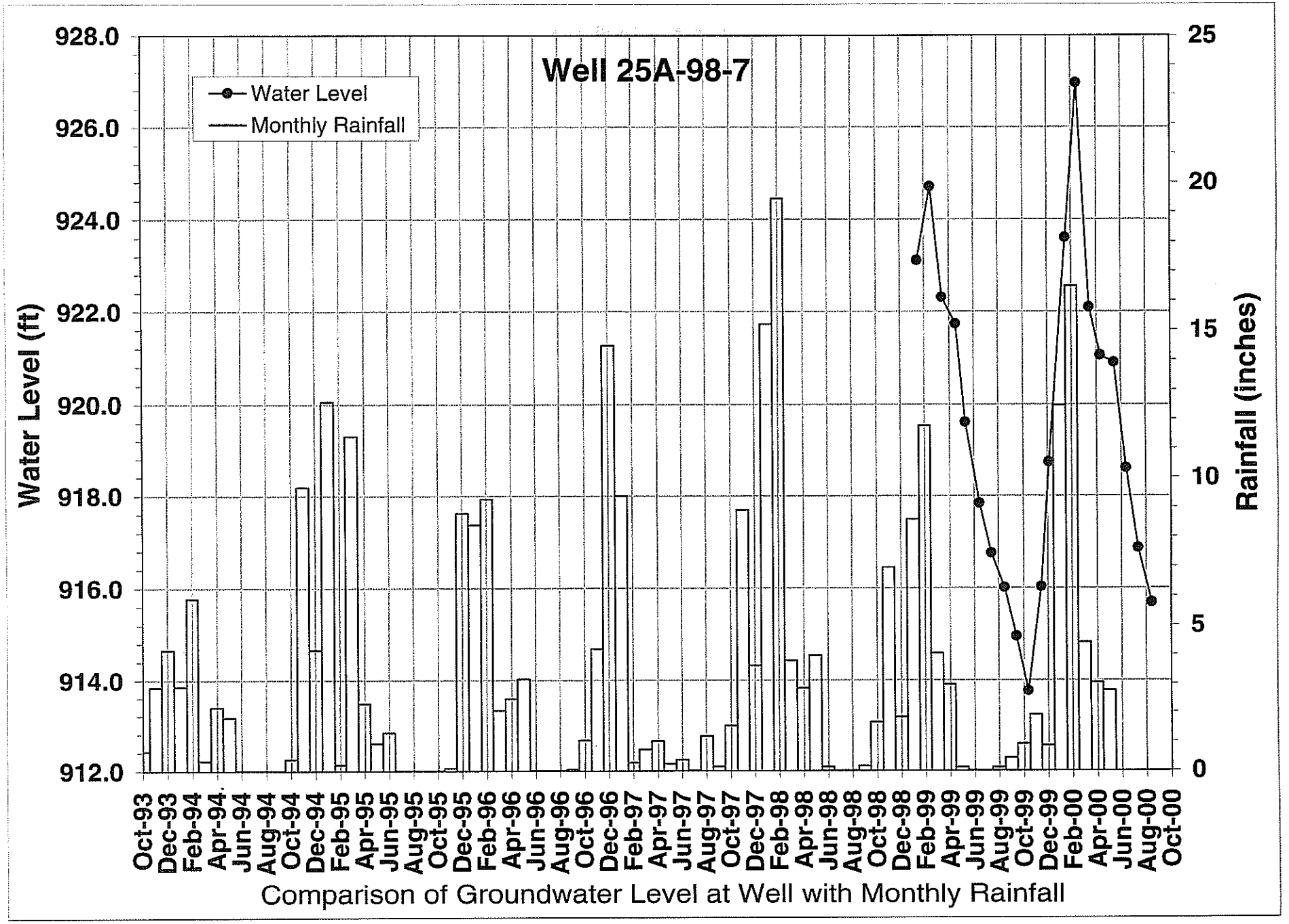

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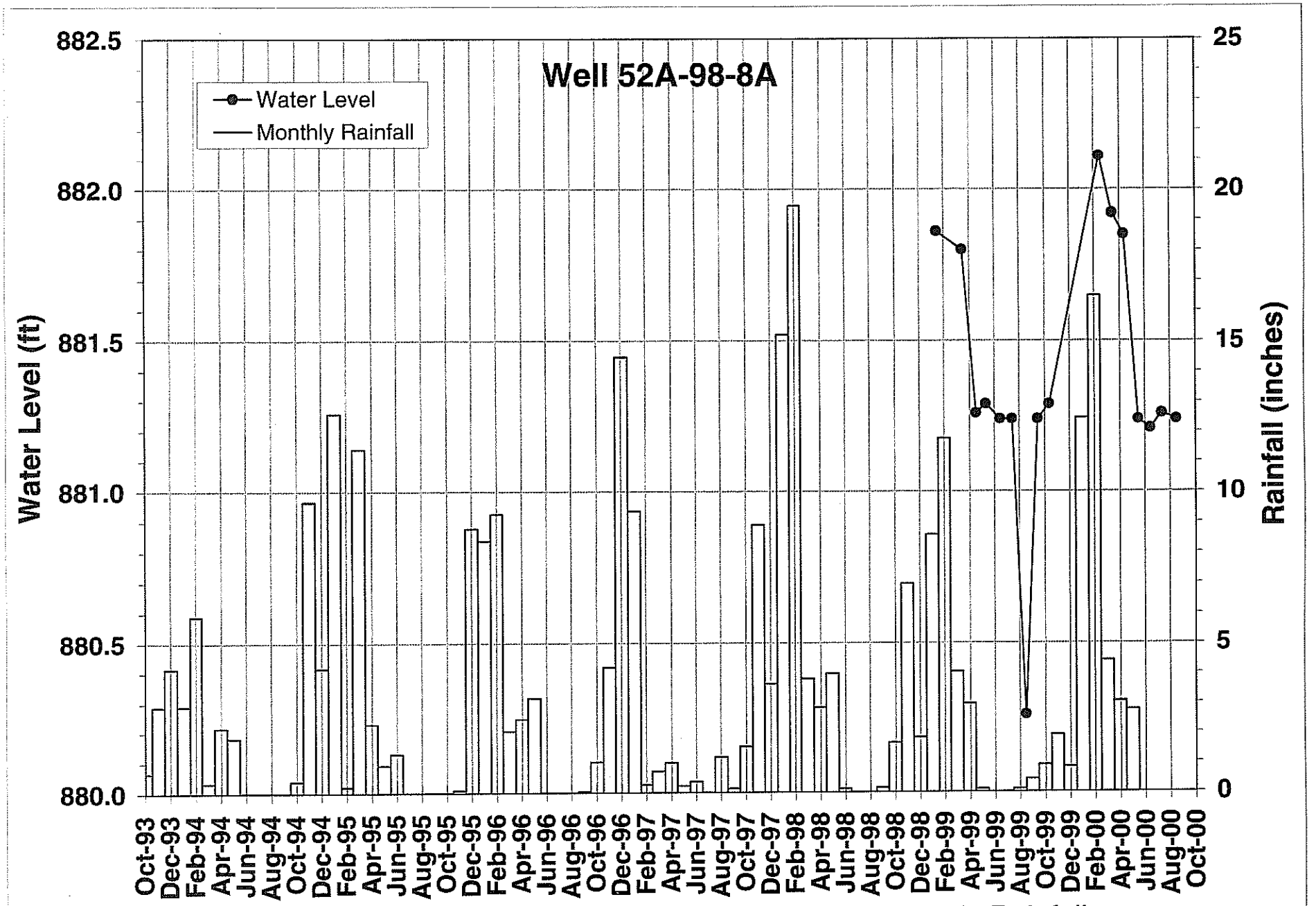

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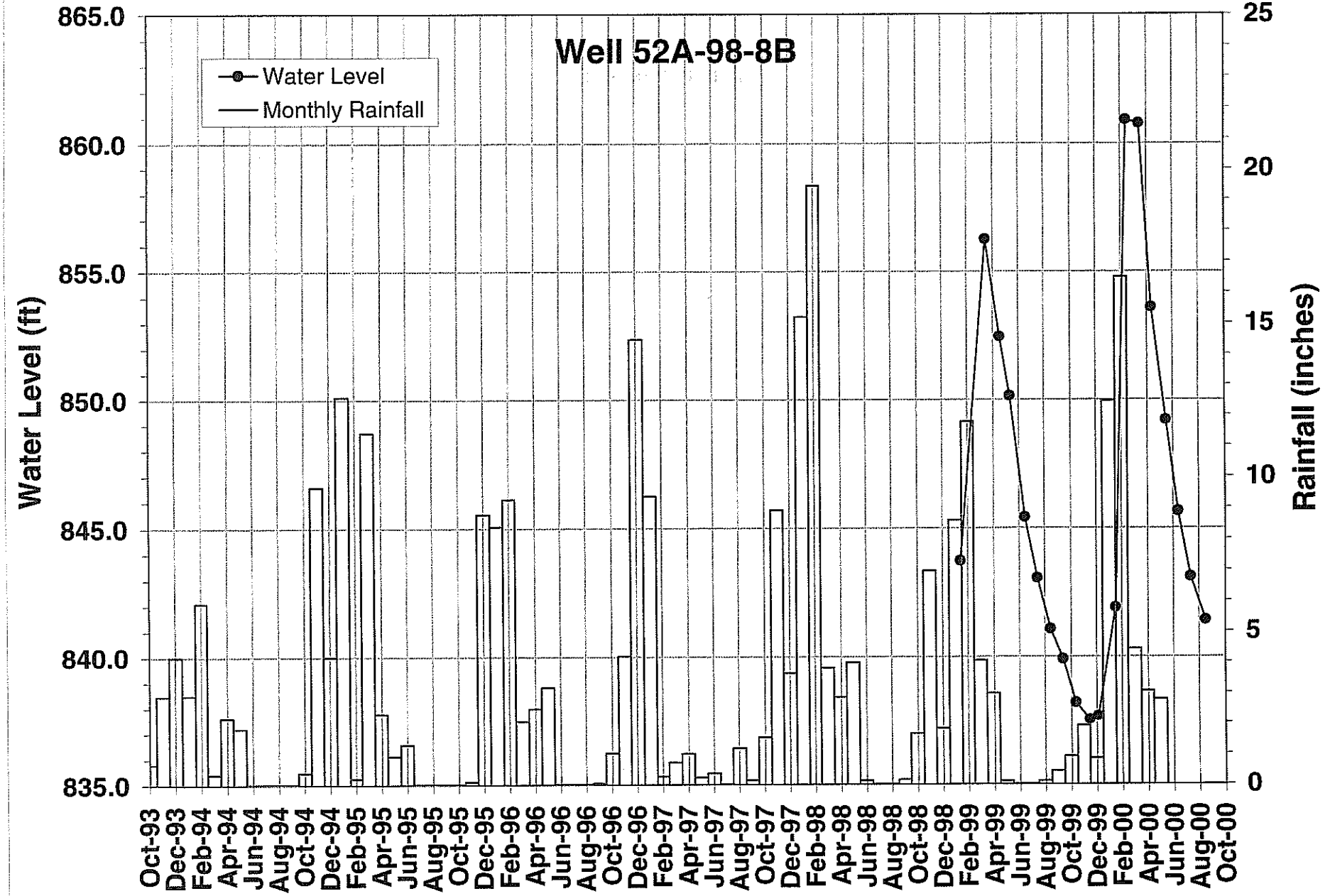

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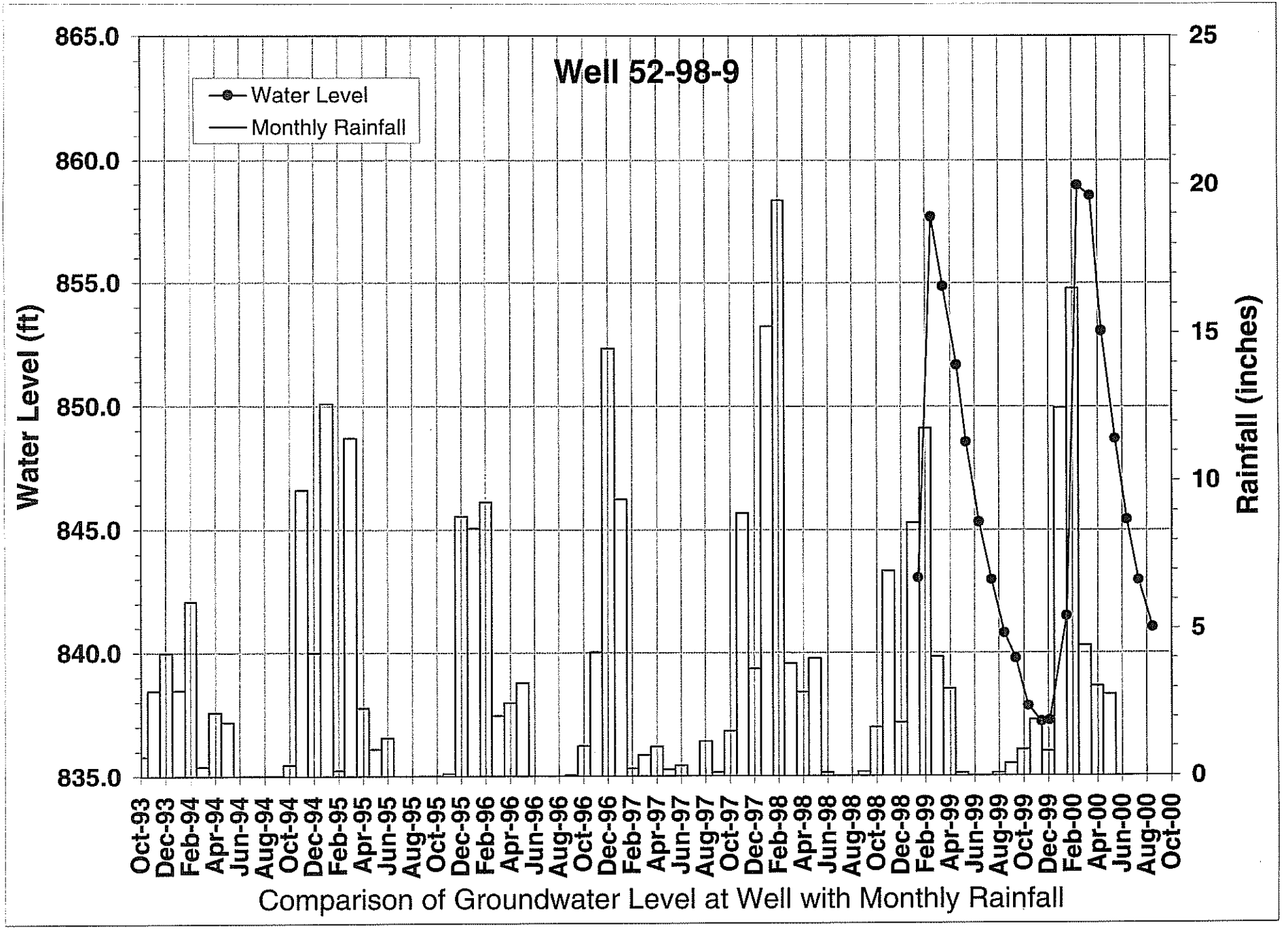

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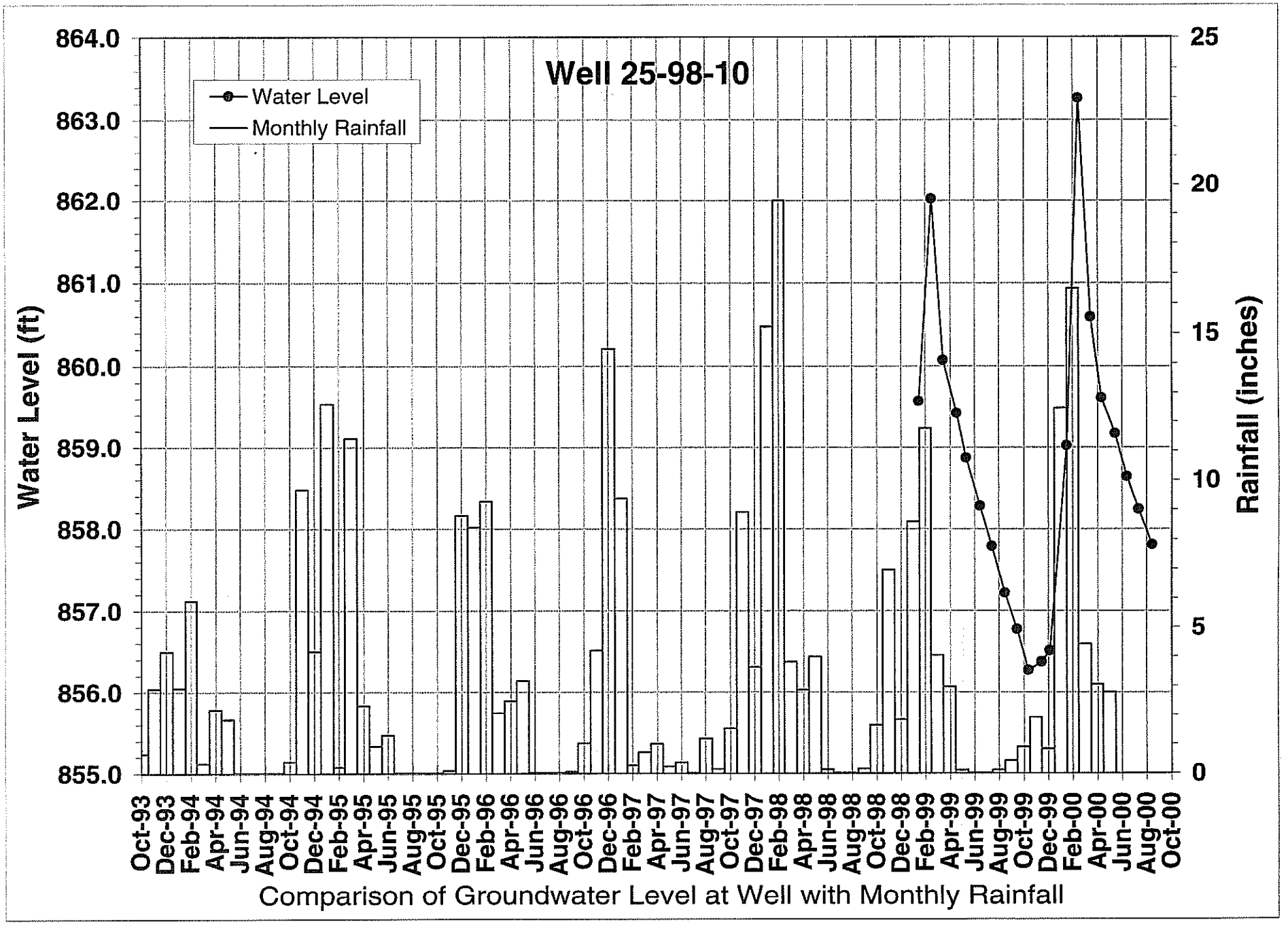

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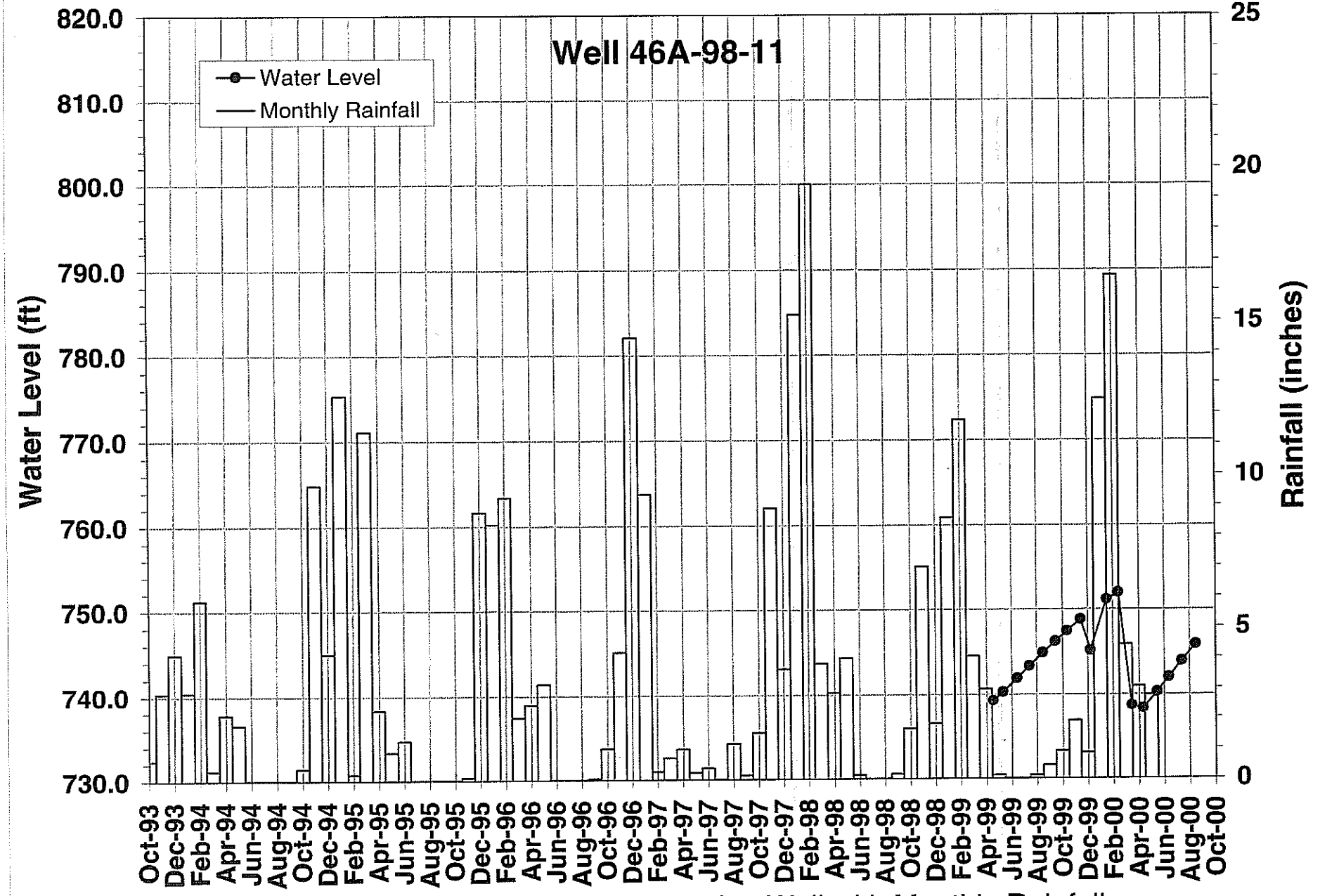

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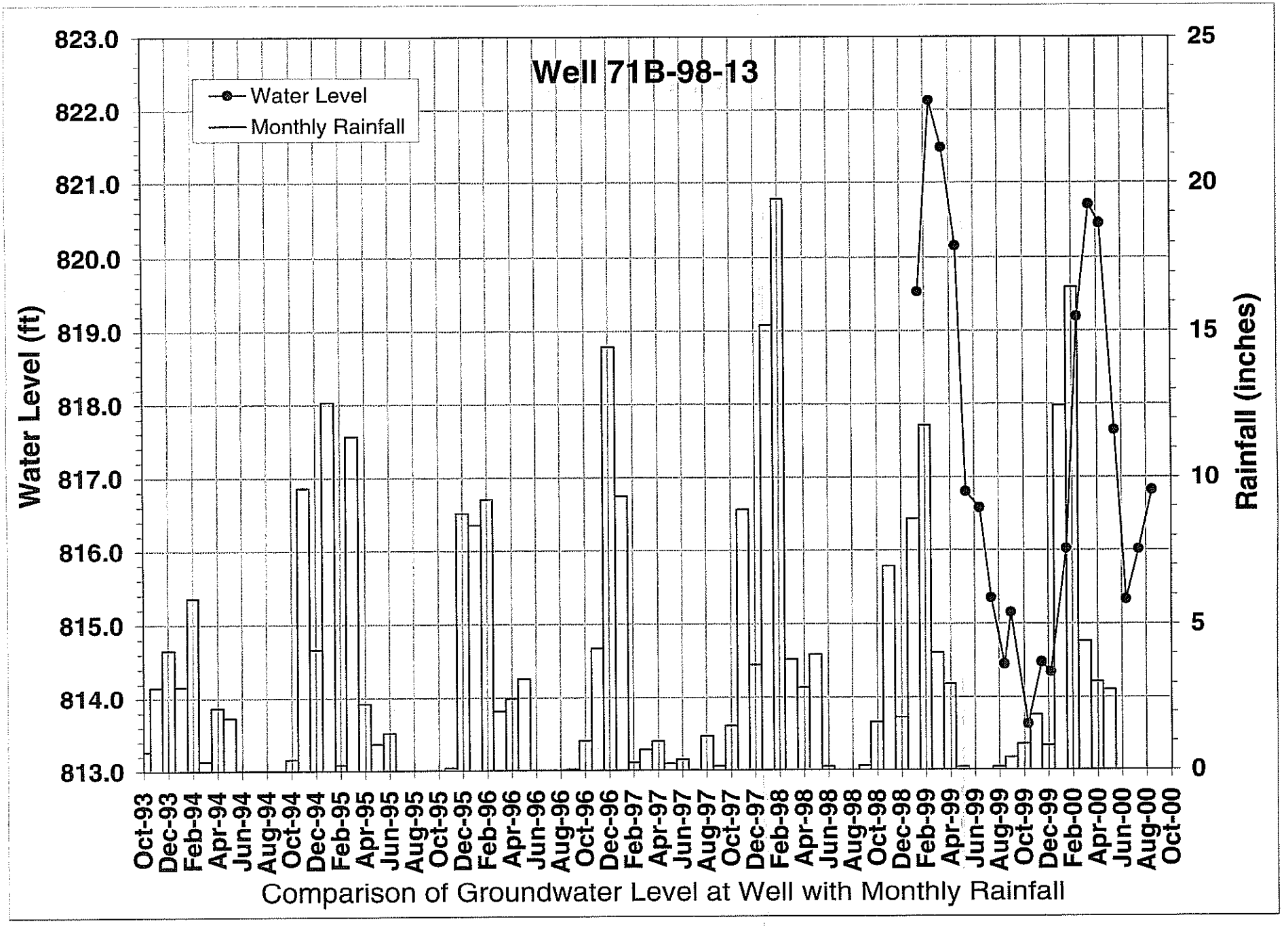

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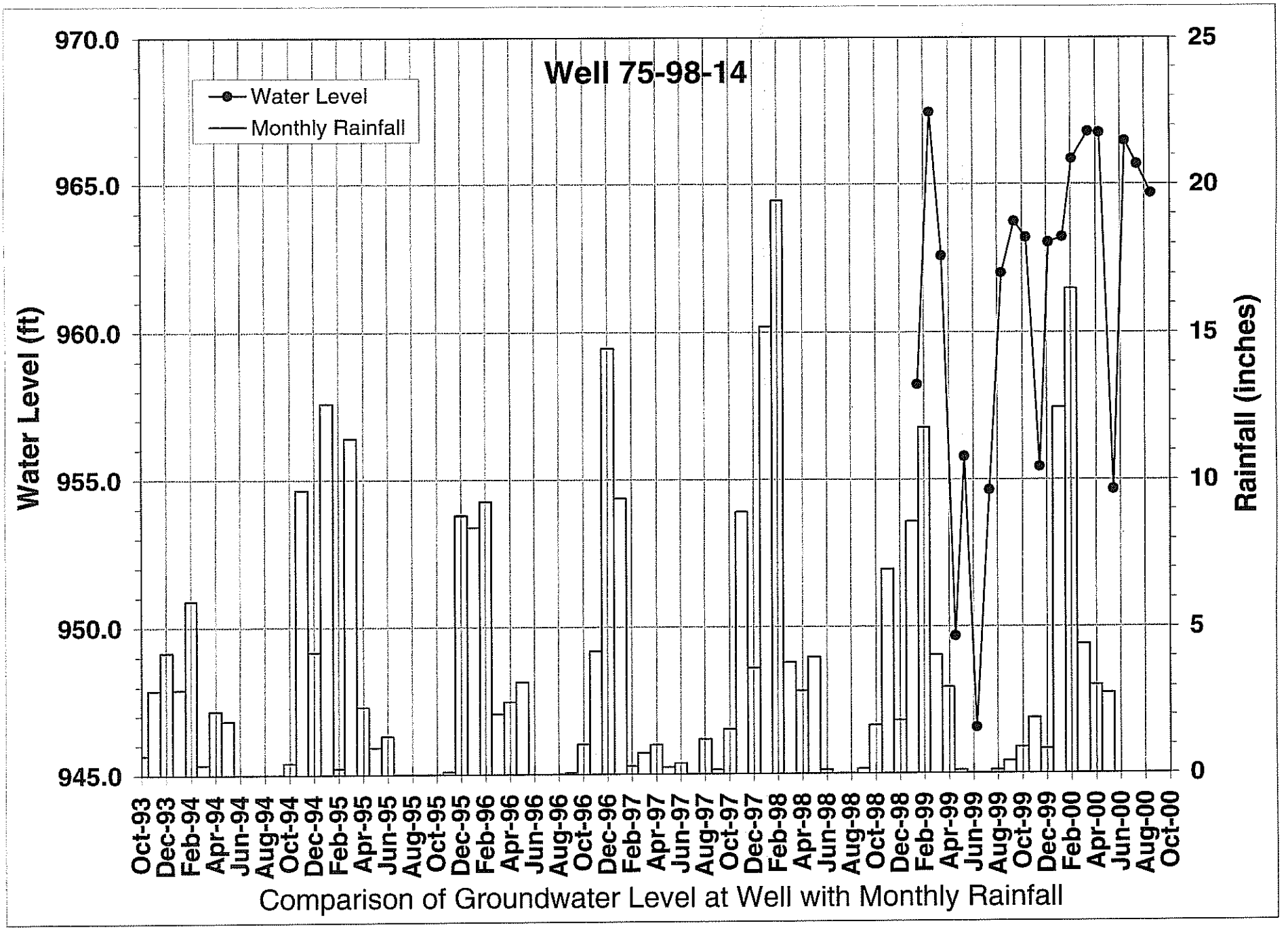

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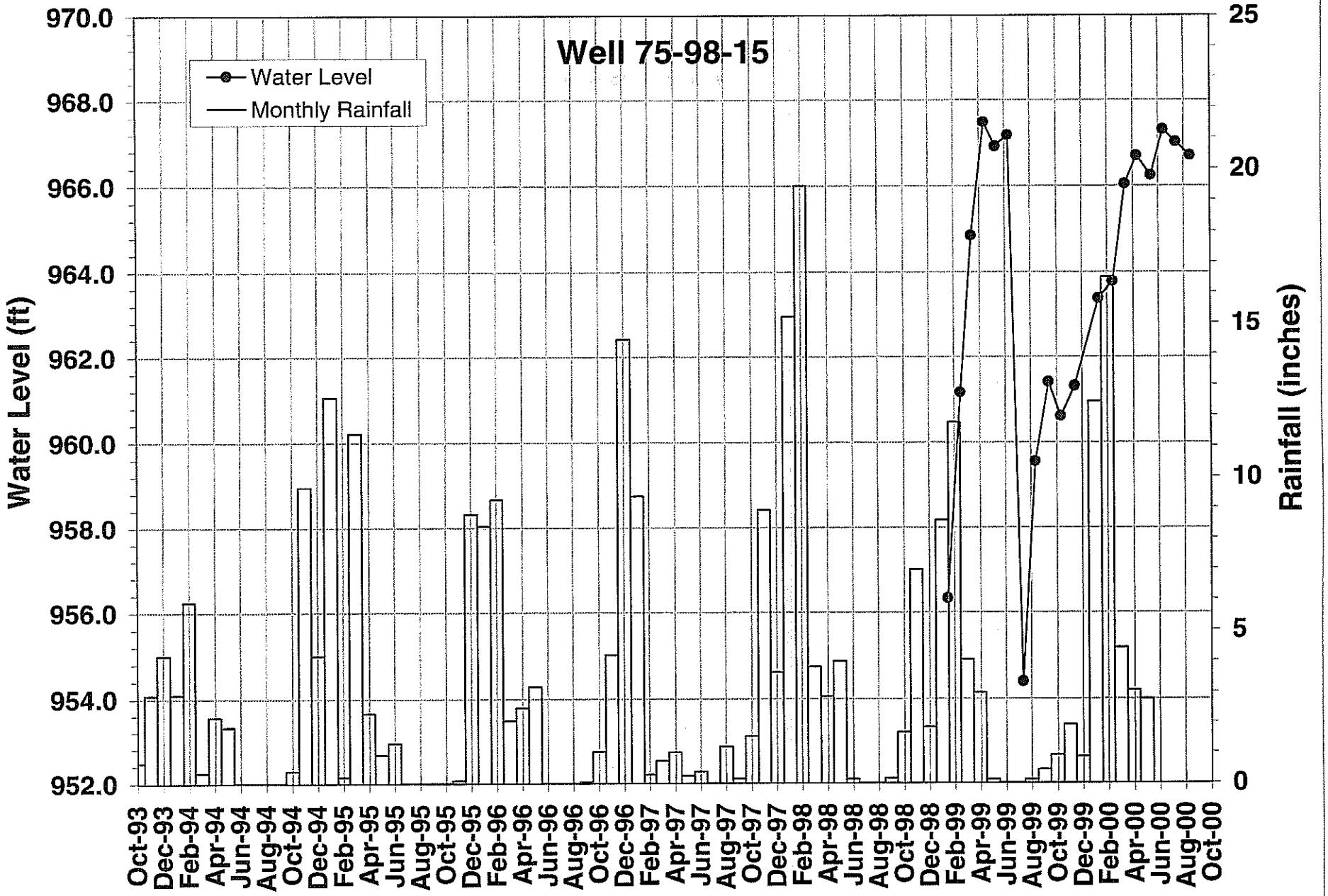
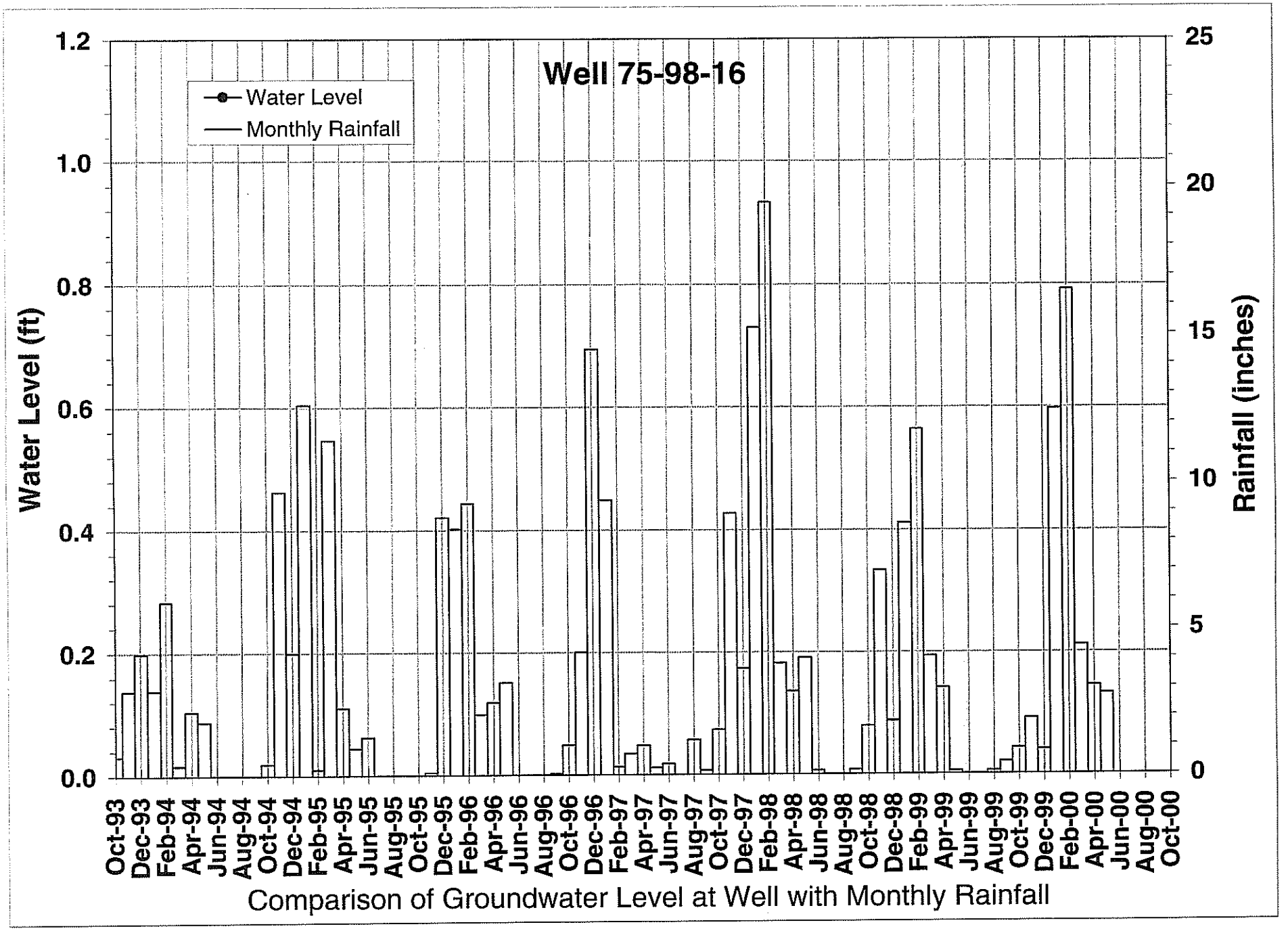


Comparison of Groundwater Level at Well with Monthly Rainfall



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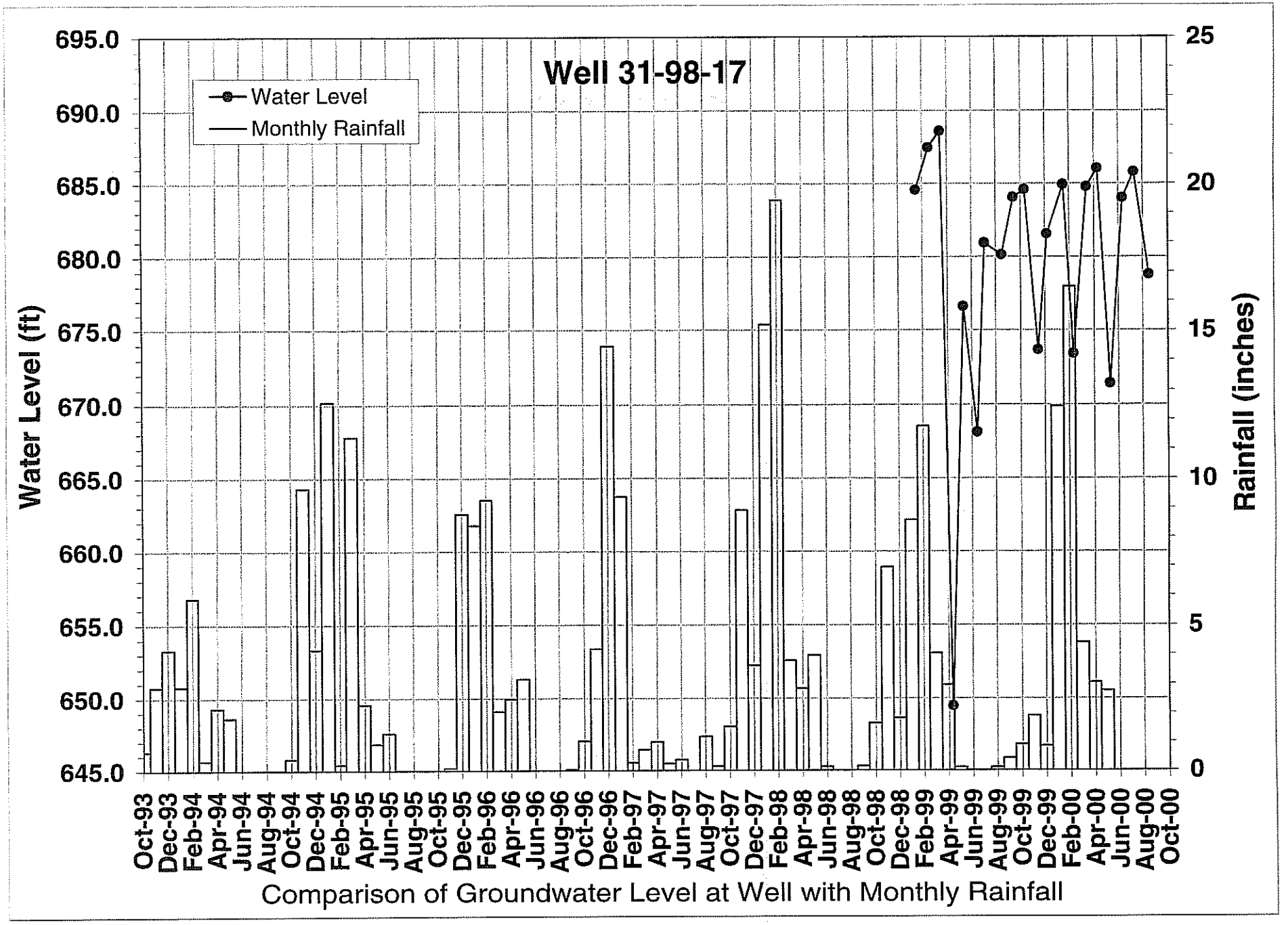

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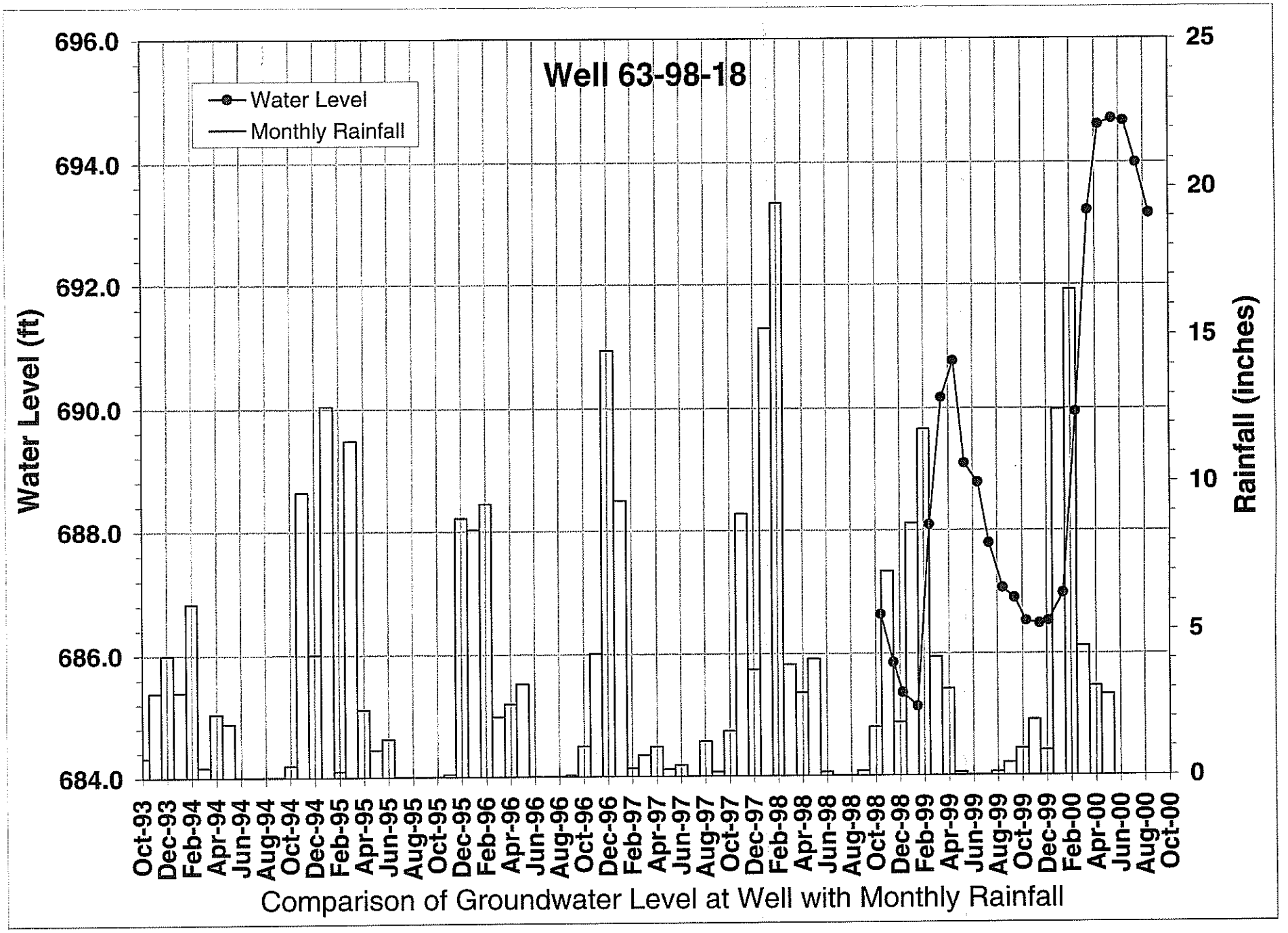

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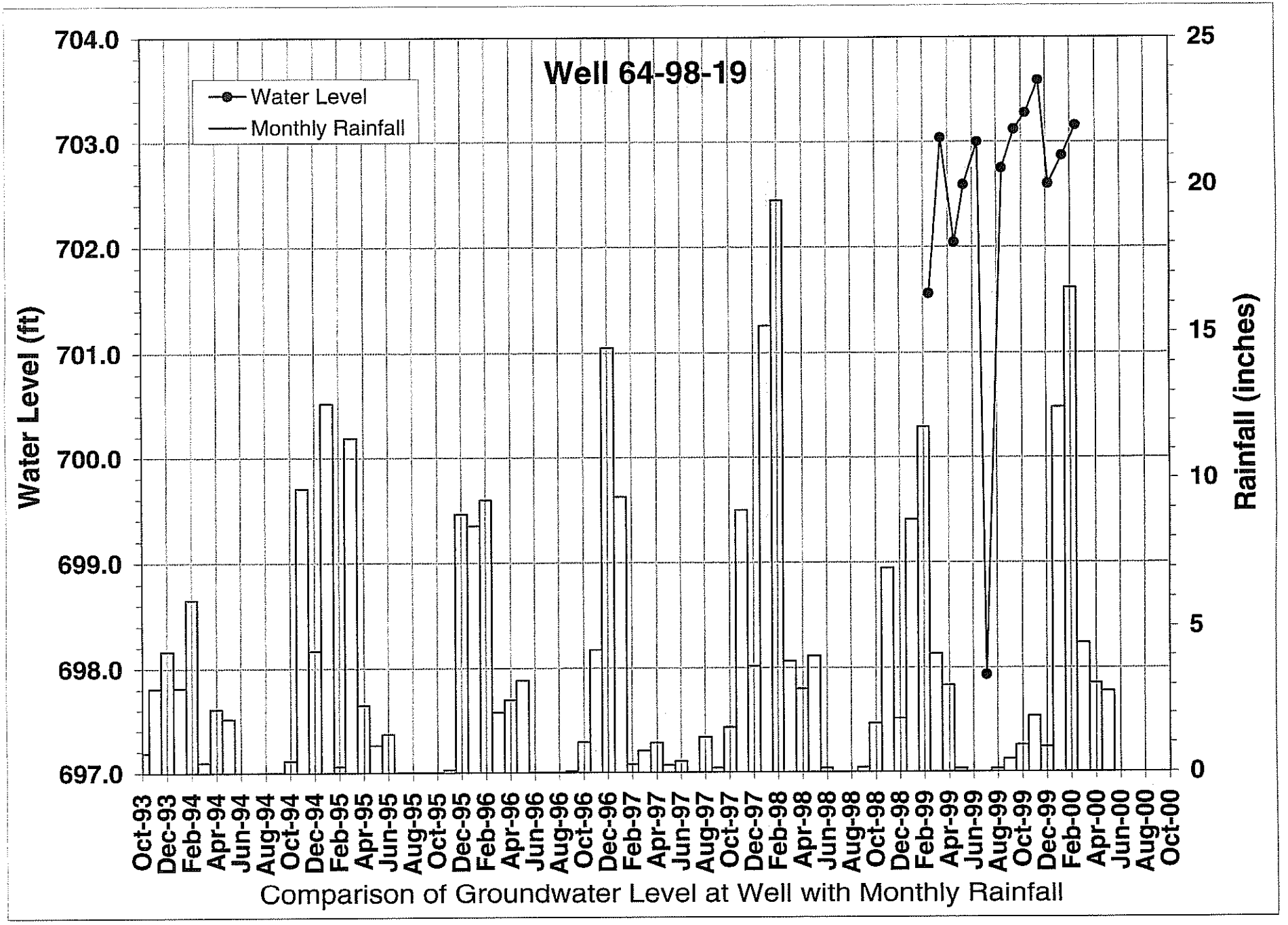

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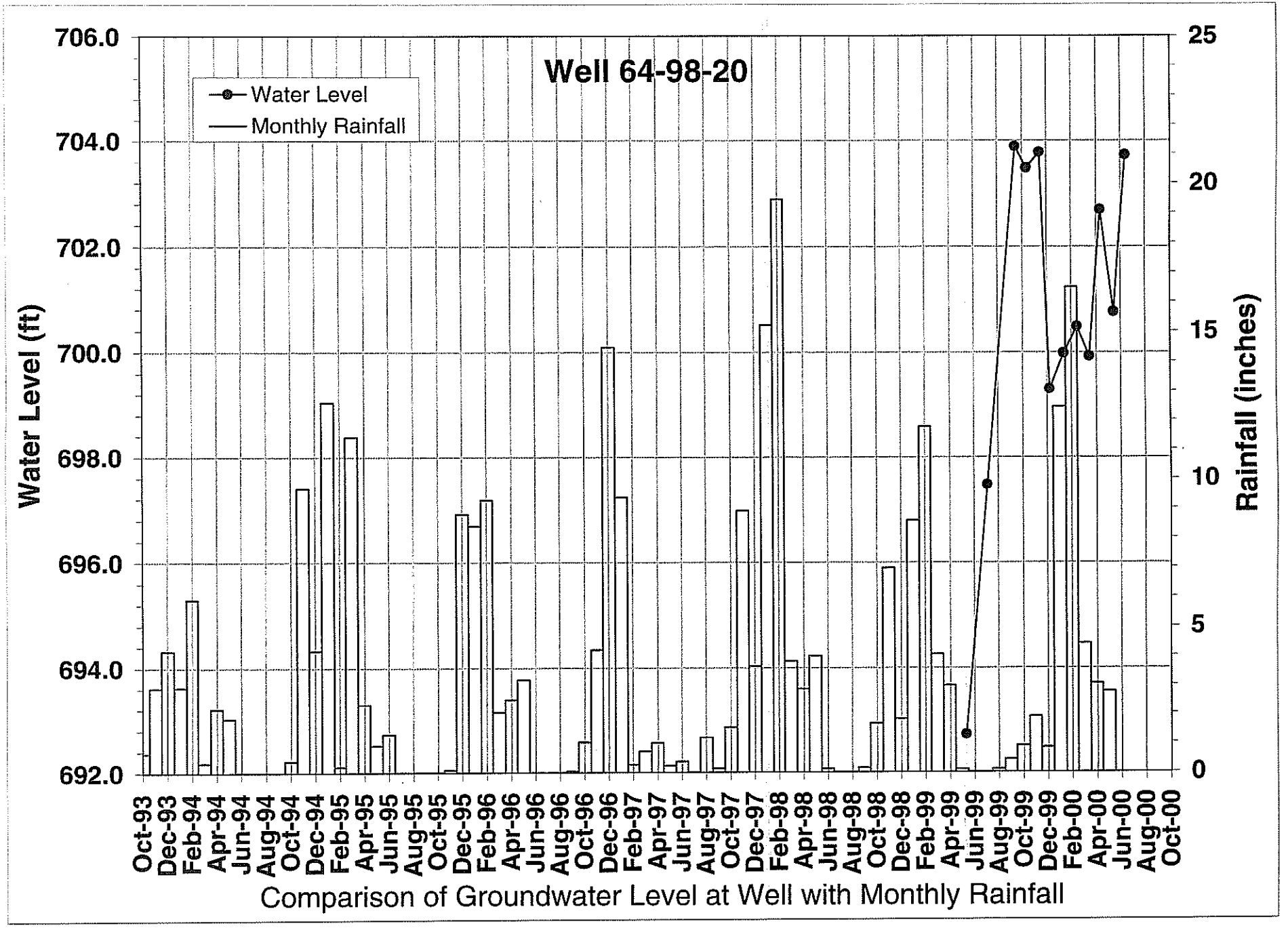

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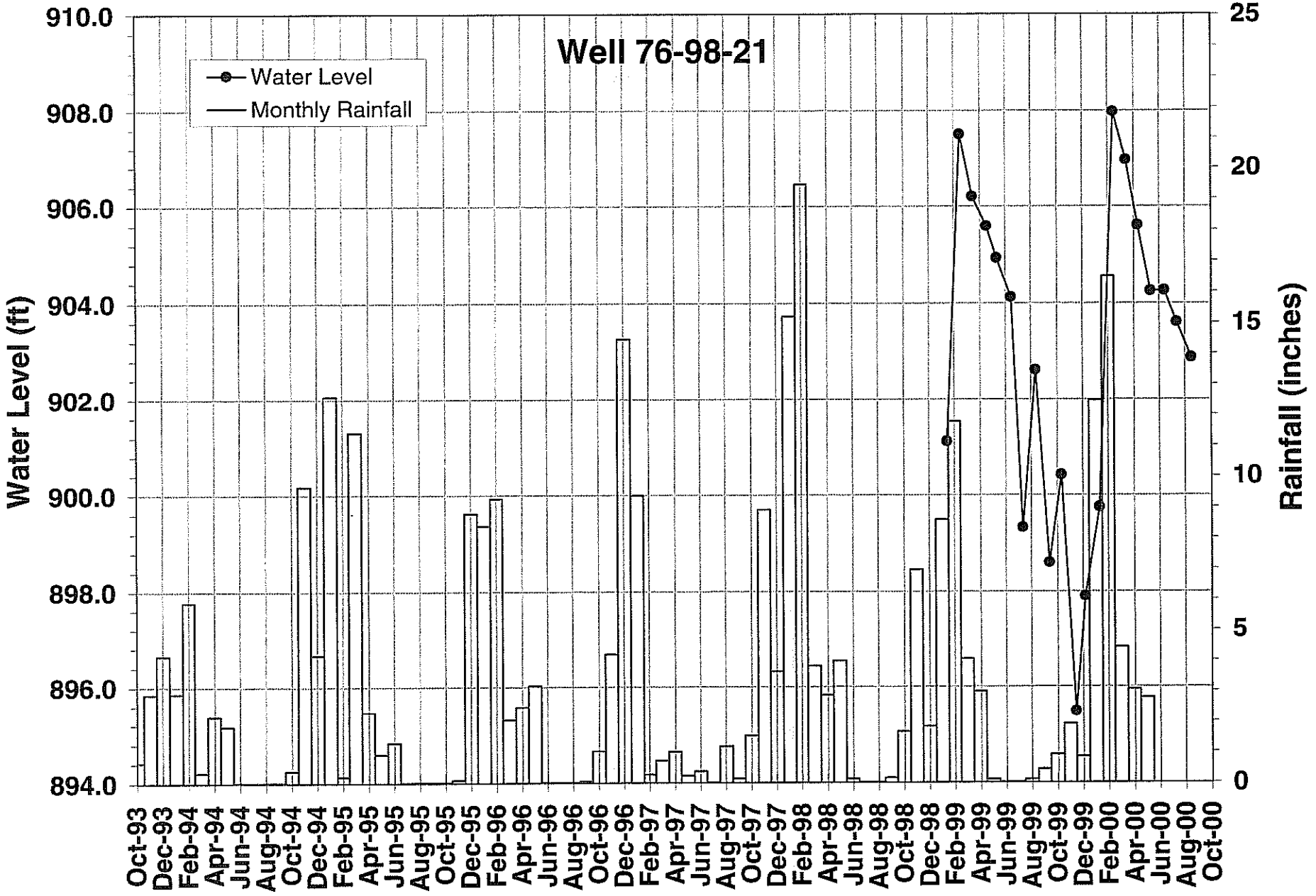

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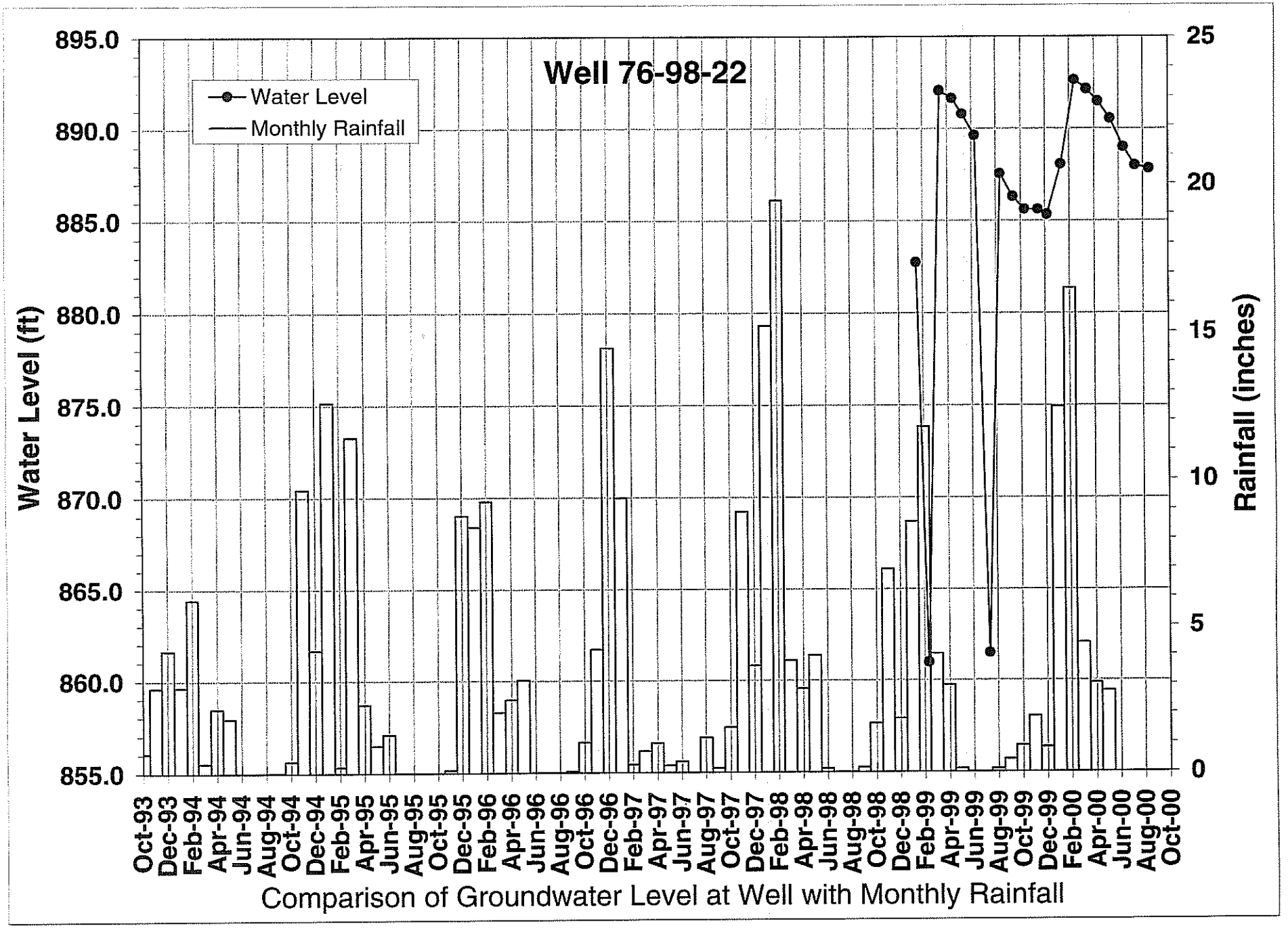

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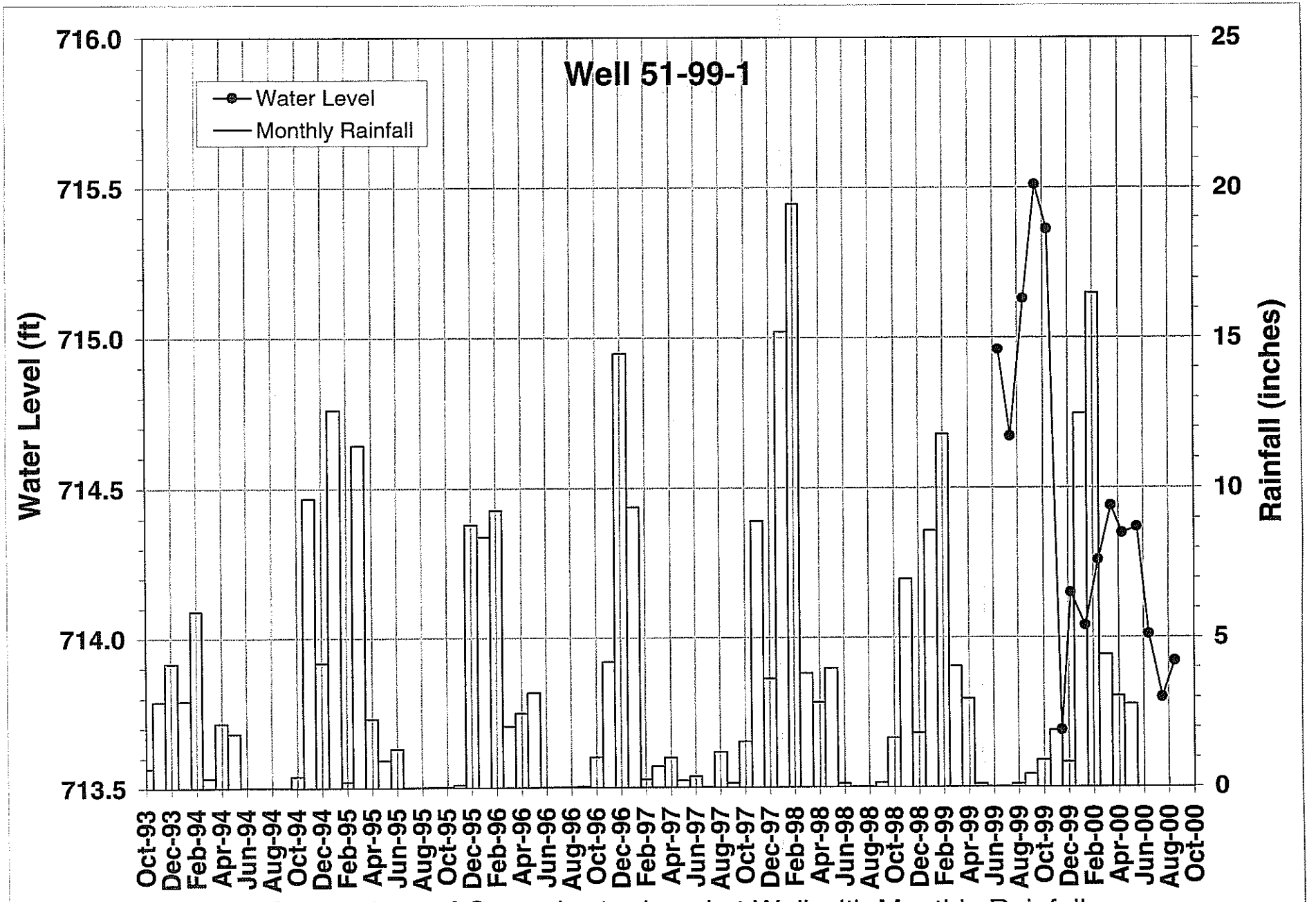

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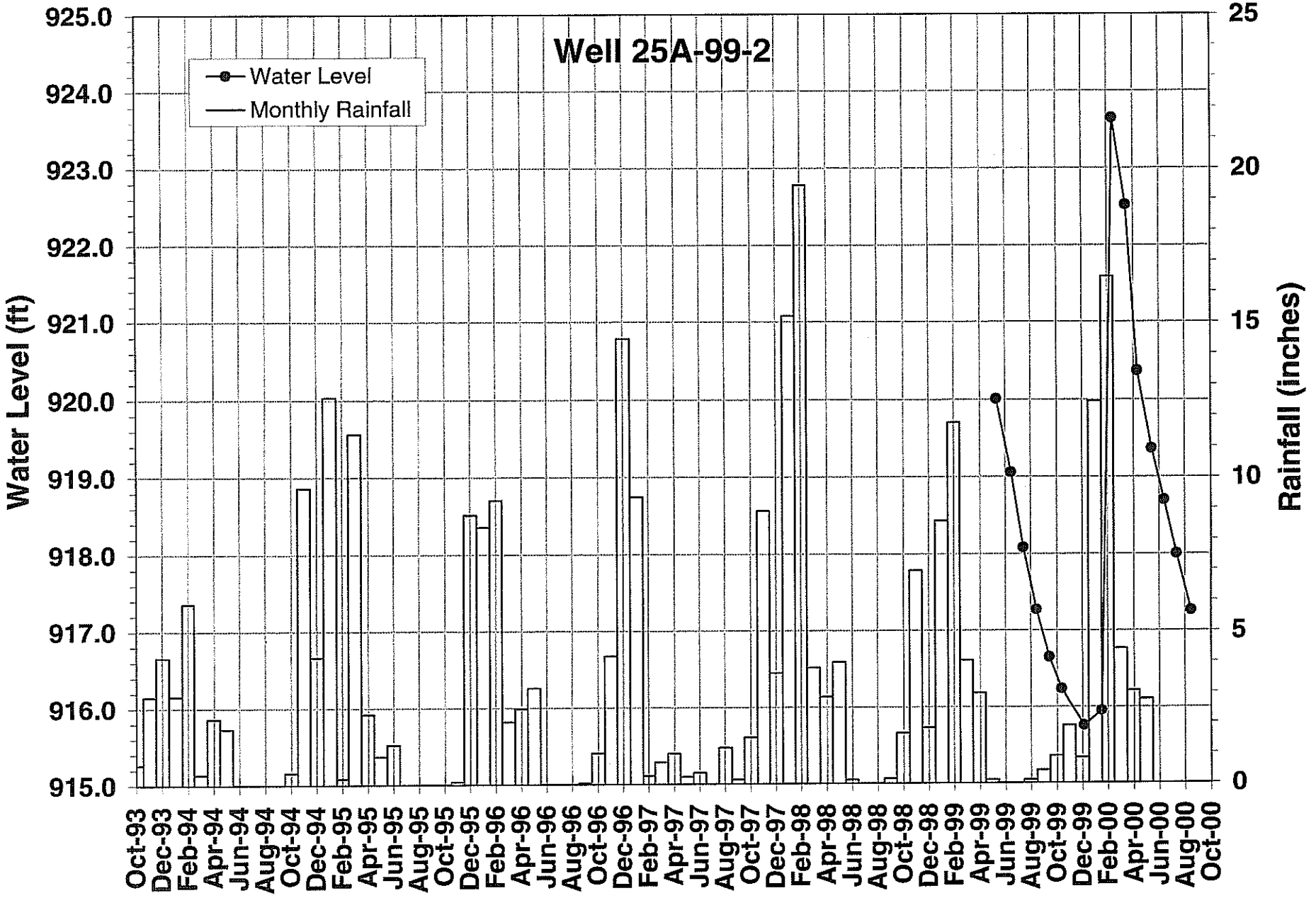

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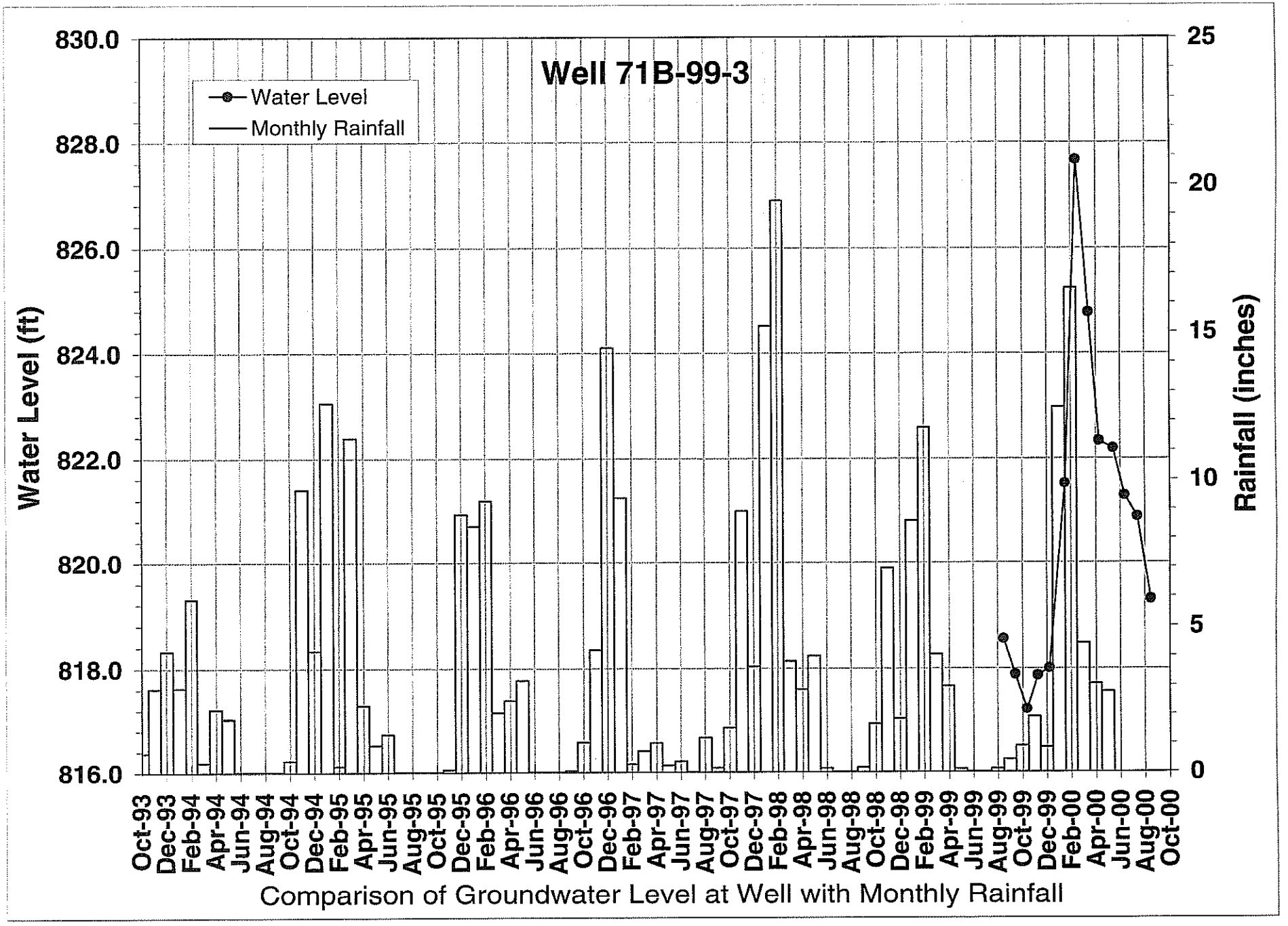

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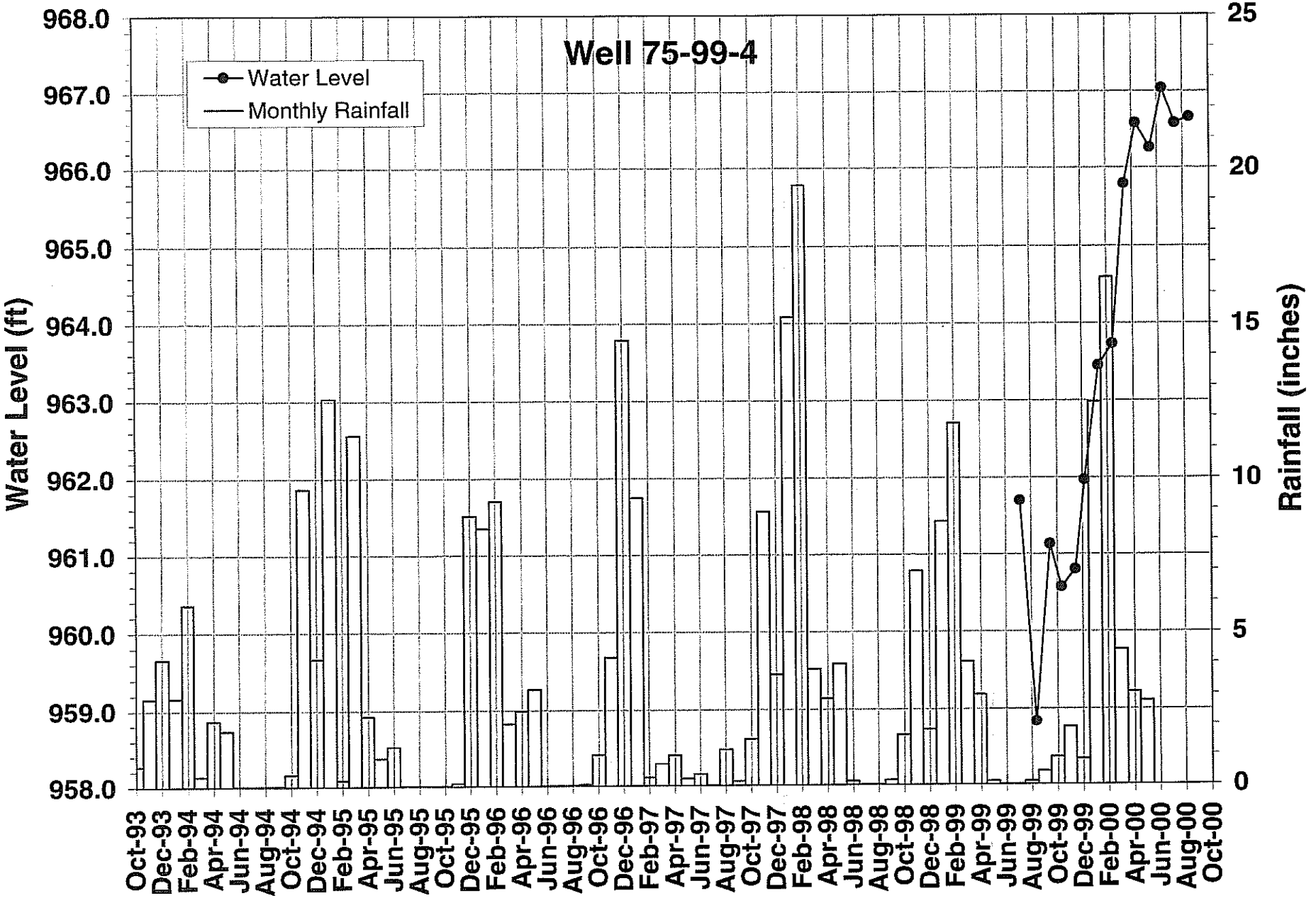

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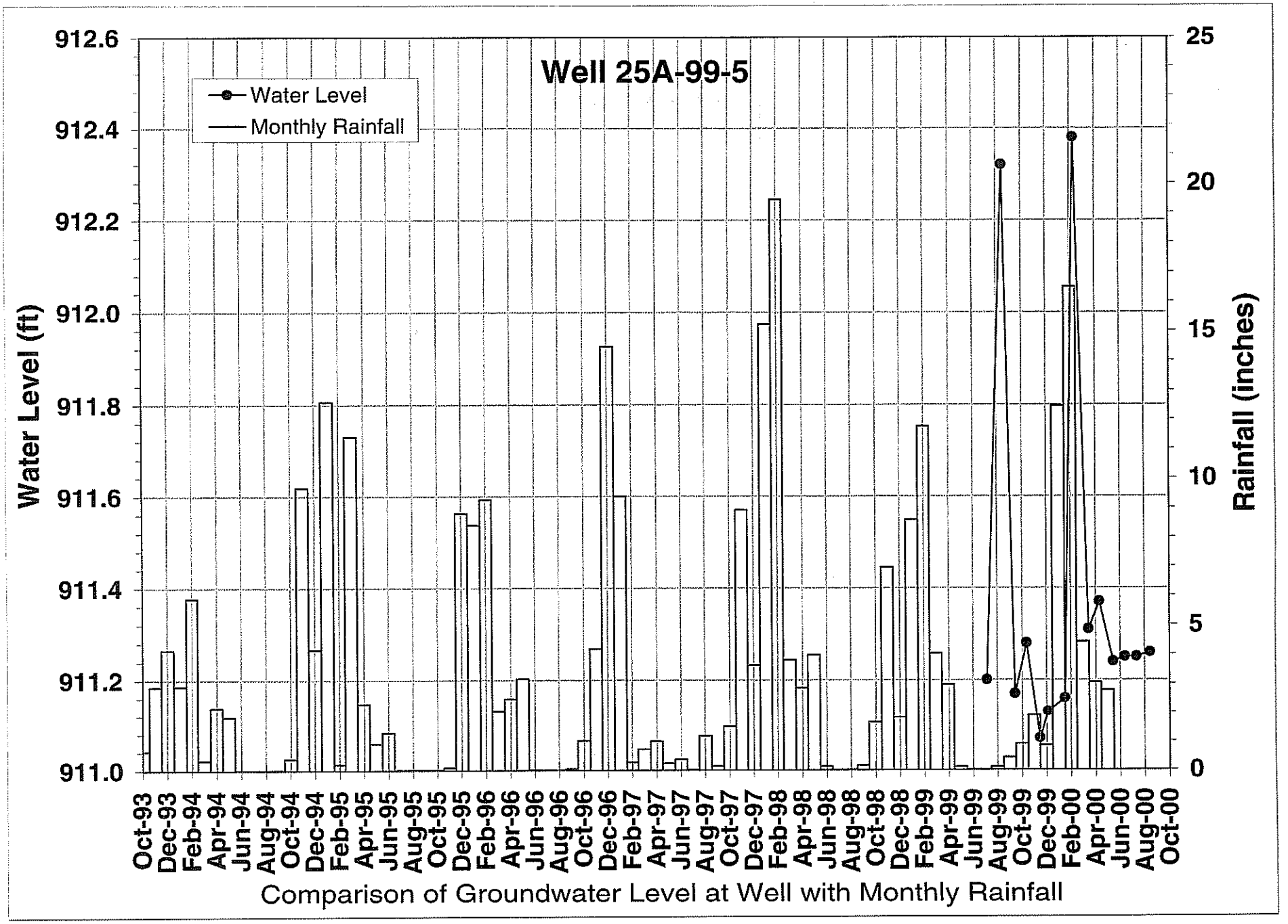

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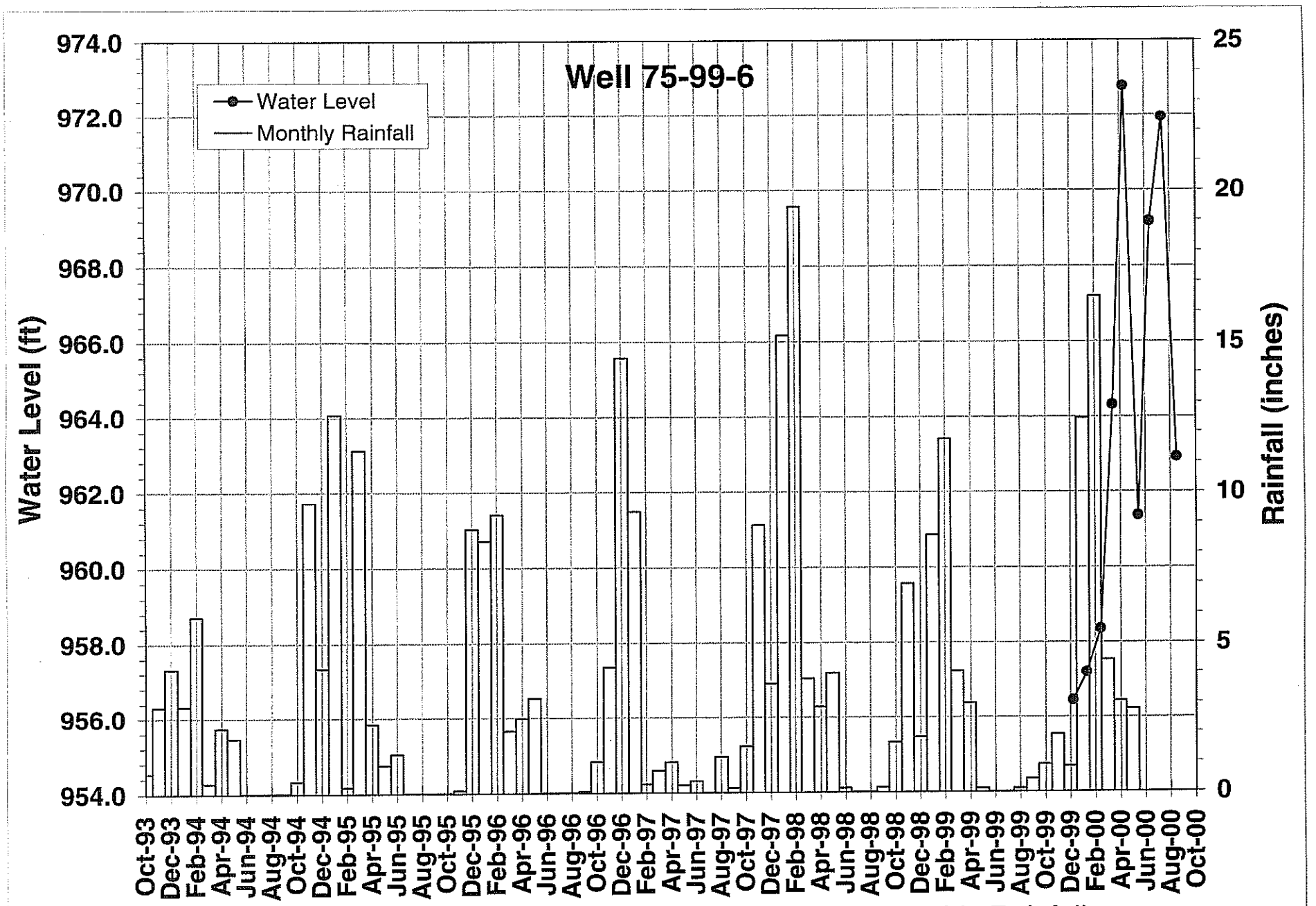

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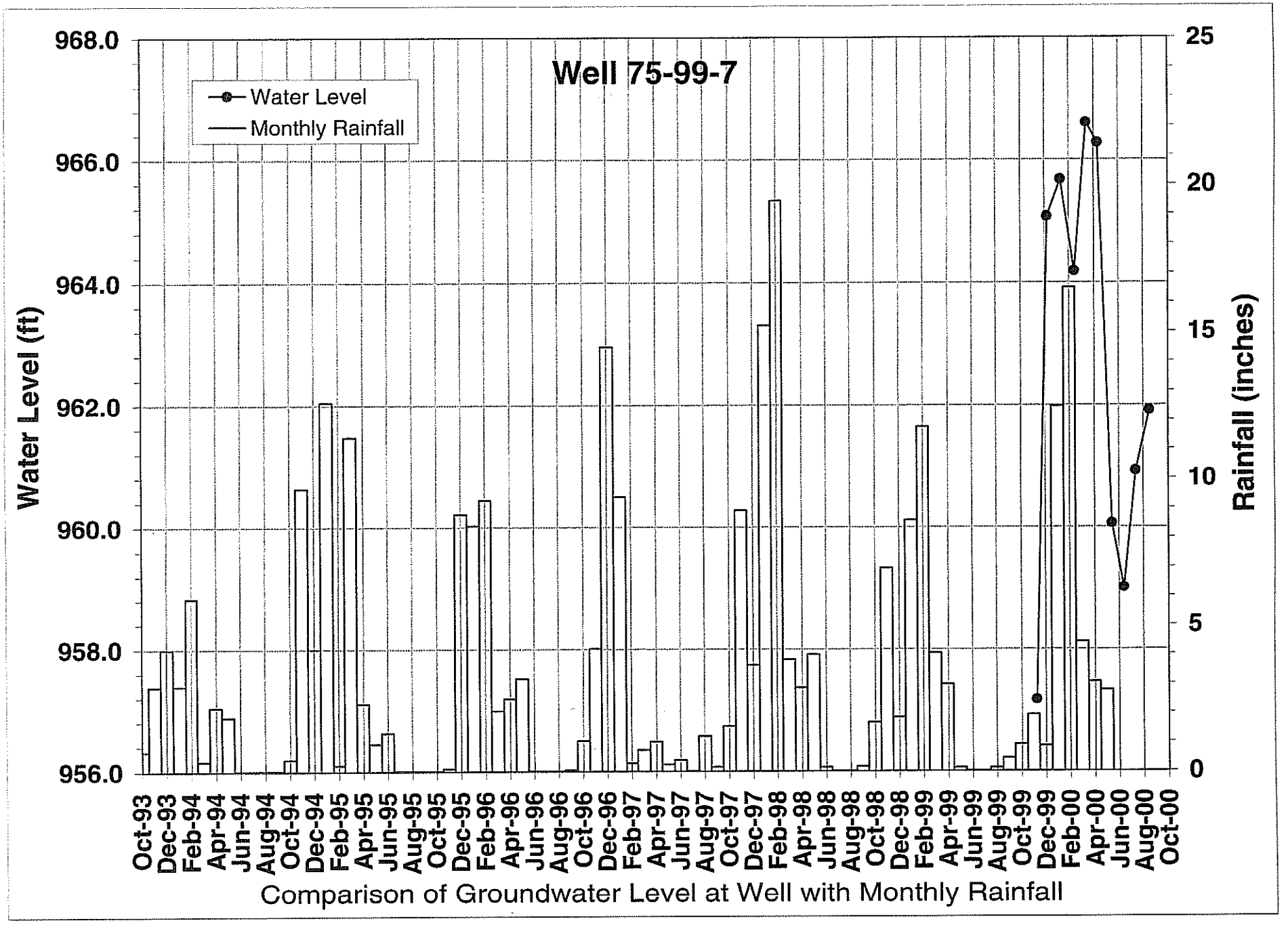

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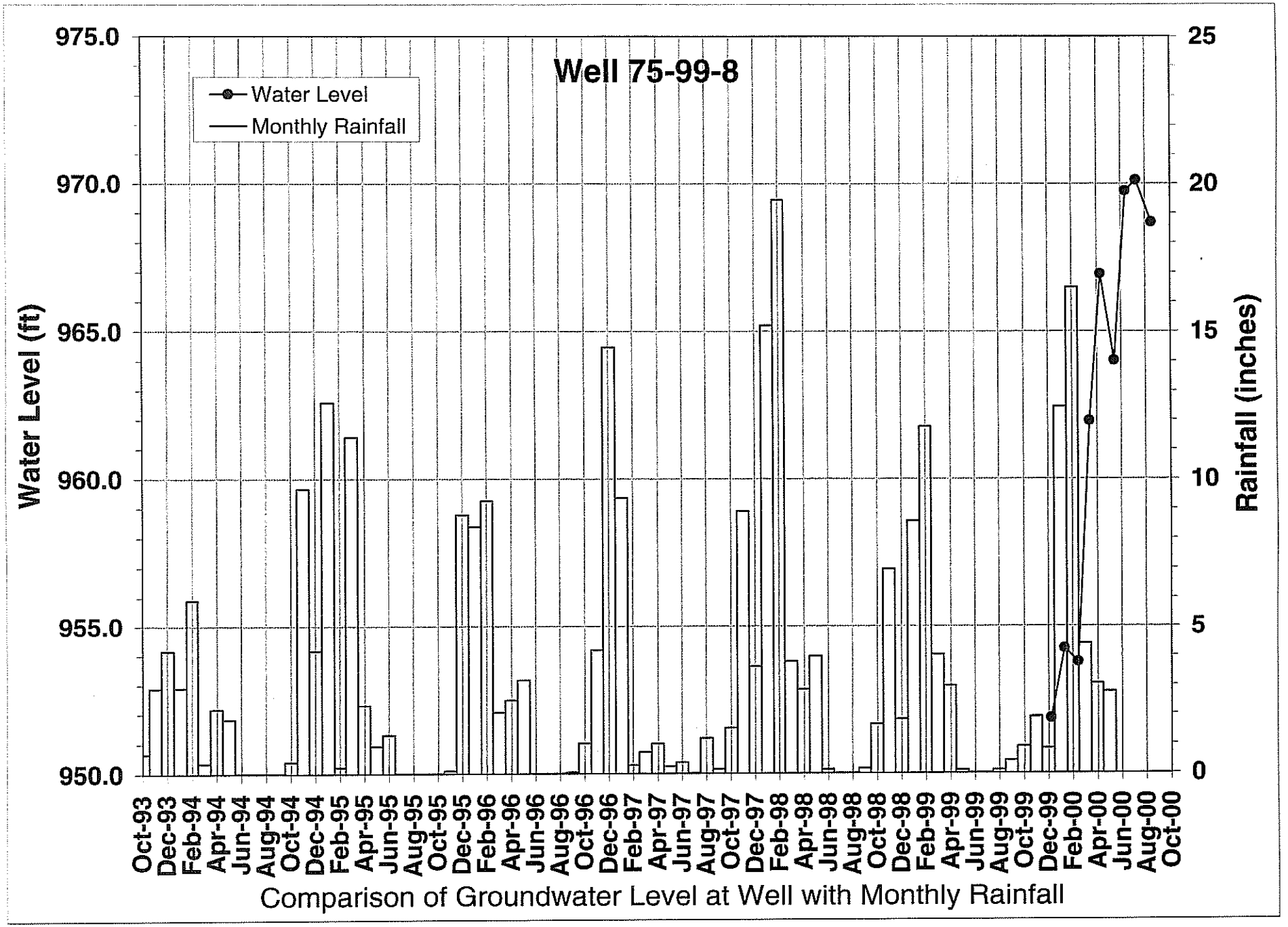

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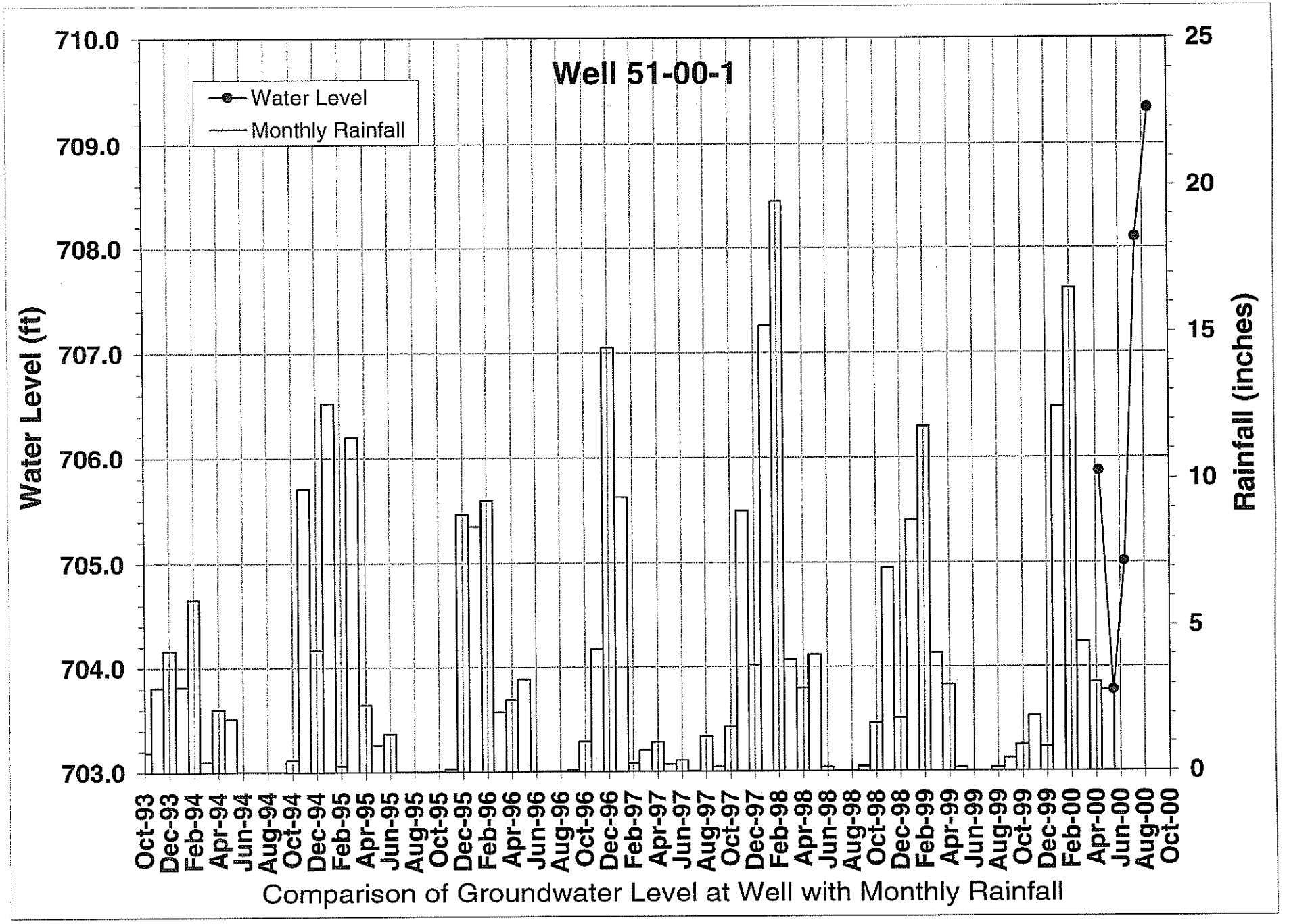

Comparison of Groundwater Level at Well with Monthly Rainfall

Appendix C

No Further Action (NFA) and No Further Investigation (NFI) Request Reports*

*Appendix C contains the No Further Action (NFA) and No Further Investigation (NFI) request reports for SWMUs and AOCs where detailed investigations were required. Additionally, these reports along with the remaining NFA/NFI request reports are available at the Berkeley Lab Information Repositories.

E.O. Lawrence Berkeley National Laboratory
University of California
Environmental Restoration Program

United States Department of Energy

REQUEST FOR
NO FURTHER ACTION (NFA) STATUS
FOR
Sanitary Sewer Lines North and West of Buildings 51 and 51B
(Area of Concern 9-8)
and
Building 25A Sanitary Sewer
(Area of Concern 10-3)

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

January 2000

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A Joint Effort of
Environment, Health and Safety Division and
Earth Sciences Division
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

January 2000

This work was done at the Lawrence Berkeley Laboratory operated by the University of California for the U. S. Department of Energy under contract DE-AC03-76SF00098.

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ATTACHMENT 2: Memorandum from LBNL Facilities Department to Iraj Javandel, Environmental Restoration Program Manger, dated October 29, 1999.

LIST OF ABBREVIATIONS

AOC	Area of Concern
Berkeley Lab	Lawrence Berkeley National Laboratory
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAL-EPA	California Environmental Protection Agency
CAP	Corrective Action program
COPCs	chemicals of potential concern
DCA	dichloroethane
DCE	dichloroethene
DTSC	Cal-EPA Department of Toxic Substances Control
EPA	U. S. Environmental Protection Agency
ERP	Environmental Restoration Program
FY	Fiscal Year (October 1 to September 30)
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
μg/L	micrograms per liter (10^{-6} grams per liter)
NFA	No Further Action
NFI	No Further Investigation
PCB	polychlorinated biphenyl
PCE	tetrachloroethene (perchloroethene)
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RWQCB	Regional Water Quality Control Board
SWMU	Solid Waste Management Unit
TCA	trichloroethane
TCE	trichloroethene
THC	total hydrocarbons
TPH-D	Total Petroleum Hydrocarbons-diesel
TPH-G	Total Petroleum Hydrocarbons-gasoline
VOCs	volatile organic compounds

SECTION 1

PURPOSE AND SCOPE

The purpose of this report is to request approval of No Further Action (NFA) status for the Sanitary Sewer Lines North and West of Buildings 51 and 51B (Area of Concern [AOC] 9-8) and the Building 25A Sanitary Sewer (AOC 10-3), under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP) at Lawrence Berkeley National Laboratory (Berkeley Lab). The California Environmental Protection Agency (CAL/EPA) Department of Toxic Substances Control (DTSC) is the lead regulatory agency for the CAP and has the authority to approve NFA status for this unit. If NFA status is approved, no additional soil sampling would be required and the unit will not be included in the site-wide risk assessment. Groundwater monitoring will continue as required by the Regional Water Quality Control Board (RWQCB). The locations of AOC 9-8 and AOC 10-3 are shown on Figure 1.

Berkeley Lab initially included AOC 9-8 and AOC 10-3 in a report that was submitted to DTSC in January 1999, requesting NFA or No Further Investigation (NFI) status for two Solid Waste Management Units (SWMUs) and four AOCs at Berkeley Lab (Berkeley Lab, 1999). In April 1999, DTSC responded with a Notice of Deficiency to Berkeley Lab's NFA/NFI request (DTSC, 1999). Berkeley Lab submitted comments to DTSC's Notice of Deficiency on May 28, 1999. Berkeley Lab's responses to specific DTSC's comments on AOC 9-8 and AOC 10-3 are attached (Attachment 1).

SECTION 2

DESCRIPTIONS OF UNITS

2.1 SANITARY SEWERS NORTH AND WEST OF BUILDINGS 51 AND 51B (AOC 9-8)

2.1.1 Site Description and History

The Sanitary Sewer Lines North and West of Buildings 51 (the Bevatron) and 51B (AOC 9-8) carried effluent from the Buildings 51 Motor Generator Room Discharge Sump (AOC 9-9). Potential sources of influent to the discharge sump were some Building 51 operations including: the Vacuum Pump Room Sump and Collection Basin (SWMU 9-4) and the Motor Generator Room Sump (SWMU 9-6). Other sources of influent to the sanitary sewers are Building 64, Building 51B, and Building 71 sanitary sewers. The locations of the sewer lines are shown on Figure 2. Soil and groundwater sampling locations are included on the figure.

2.1.2 Constituents Of Potential Concern (COPCs)

The COPCs are halogenated hydrocarbons, mercury, polychlorinated biphenyls (PCBs), and fuel related hydrocarbons.

2.1.3 Geology and Hydrogeology

Geologic cross sections along the sanitary sewer lines (C-C' and D-D') are shown on Figure 3 and Figure 4. The locations of the cross sections are shown on Figure 2. The uppermost bedrock unit consists primarily of Great Valley Group shale. At the easternmost end of cross section CC' (north of Building 51), the bedrock consists of siltstone of the Orinda Formation overlying the Great Valley Group. Where the bedrock does not extend to the surface, it is covered by artificial fill and colluvium. The fill includes clay, silt, and silty sand.

The depth to groundwater measured in monitoring wells during the third quarter (April to June) of fiscal year 1999 (FY99) and the interpreted water table is shown on the cross sections.

Based on results of slug tests conducted in monitoring wells, the Great Valley Group at Berkeley Lab has a hydraulic conductivity of 10^{-5} to 10^{-7}m/s and the Orinda Formation 10^{-7} to 10^{-9}m/s. Results of slug tests conducted in monitoring wells near the sewer lines are shown in the following table. Based on the results, the fill near the sewer lines has a hydraulic conductivity of 10^{-6} to 10^{-8}m/s.

Results of Slug Tests

Well Number	Hydraulic Conductivity (m/sec)
Surficial Deposits (primarily Fill)	
MW51-97-3	1.9×10^{-6}
MW51-97-14	3.5×10^{-7}
MW51-97-12	7.1×10^{-7}
MW51-96-19	7.8×10^{-7}
MW51-96-16	4.5×10^{-8}
Surficial Deposits/Orinda Formation	
MW51-96-15	2.8×10^{-6}
Orinda Formation	
MW51-96-17	1.0×10^{-8}

2.2 BUILDING 25A SANITARY SEWER (AOC 10-3)

2.2.1 Site Description and History

Two sanitary sewer lines emanate from the east side of Building 25A, merge with another line emanating from the east side of Building 26, and continue beneath the road north and east of Buildings 25A and 26. The location of the Building 25A Sanitary Sewer (AOC 10-3) is shown on Figure 5. Soil, soil gas, and groundwater sampling locations are included on the figure.

Building 25A contains mechanical technology and electronics shops, respectively. Operations in Building 25A include plastics soldering and electronics fabrication. Cleaning solvents have been used in Building 25A, and there are solvent fume hoods, sinks, floor drains, and a subfloor waste line that flows out of the east side of the building to the sanitary sewer system.

2.2.2 Constituents Of Potential Concern (COPCs)

The COPCs are halogenated hydrocarbons and metals.

2.2.3 Geology and Hydrogeology

Geologic cross sections along the sanitary sewer line are shown on Figure 6 and Figure 7. The locations of the cross sections are shown on Figure 5. The bedrock units beneath the sanitary sewer line consist of tuff, tuff breccia, and andesite of the Moraga Formation; clayey gravel of the Mixed Unit; and claystone, siltstone, and sandstone of the Orinda Formation. Colluvium and artificial fill (silt and sand) overlie the bedrock along the eastern half of the sanitary sewer line.

The depth to groundwater measured in monitoring wells during the third quarter of FY99 and the interpreted water table are shown on the cross sections. Based on results of slug tests conducted in monitoring wells, the Moraga Formation at Berkeley Lab has a hydraulic conductivity of 10^{-4} to 10^{-6}m/s, the Mixed Unit 10^{-6} to 10^{-9}m/s, and the Orinda Formation 10^{-7} to 10^{-9}m/s. Results of slug tests conducted in monitoring wells near the sewer line are shown in the following table. The tested wells were all screened in the Orinda Formation.

Results of Slug Tests

Well Number	Hydraulic Conductivity (m/sec)
Orinda Formation	
MW25A-98-1	2×10^{-7}
MW25A-98-7	2×10^{-7}
MW26-92-11	2×10^{-5}

SECTION 3

SEWER LINE INVESTIGATIONS

3.1 INTRODUCTION

The following approach was followed to investigate whether a release may have occurred from the Sanitary Sewers North and West of Buildings 51 and 51B (AOC 9-8) and the Building 25A Sanitary Sewer (AOC 10-3). The approach is consistent with Berkeley Lab's response to DTSC's comments (Attachment 1) and discussions held with the DTSC and the City of Berkeley at Berkeley Lab on July 1, 1999.

1. Assess the integrity of the line by conducting a video survey to identify any dislocations, breaks or perforations.

2. If dislocations, breaks, or perforations are identified, collect soil samples to determine whether a release has occurred and to assess the extent of contamination. If no dislocations, breaks, or perforations are identified, request the unit for NFA status.

3.2 RESULTS OF VIDEO SURVEYS

On October 14, 1999, Berkeley Lab conducted a video survey of the sanitary sewer lines east of Building 25A (AOC 10-3). On October 26, 1999, Berkeley Lab conducted a video survey of the sanitary sewer lines north and west of Buildings 51 and 51B (AOC 9-8). The segments of the sewer lines that were video surveyed are shown on Figure 2 and Figure 5 for AOC 9-8 and AOC 10-3, respectively. No defects, root intrusion, or displacement was observed within any of the lines surveyed. The details and results of the surveys are included in the attached memorandums (Attachment 2). Based on the results of the video surveys there is no indication that a chemical release has occurred from the sewer lines.

SECTION 4

SUPPLEMENTAL ENVIRONMENTAL INVESTIGATIONS

4.1 SANITARY SEWERS NORTH AND WEST OF BUILDING 51 AND BUILDING 51B (AOC 9-8)

4.1.1 Summary of Investigations

Soil and groundwater sampling locations related to the Sanitary Sewers North and West of Buildings 51 and 51B are shown on Figure 2.

Soil Gas

Soil-gas samples were collected in the Building 51 area during the RCRA Facility Assessment (RFA), including seven locations along the sanitary sewer lines north and west of Buildings 51 and 51B. The samples were collected from probes inserted to depths between 5 and 11 feet below ground surface (bgs), in order to sample below the invert elevation of the sewer line. The samples were analyzed for volatile organic compounds (VOCs).

Groundwater

A plume of halogenated hydrocarbon-contaminated groundwater (Building 51/64 VOC Plume [AOC 9-13]) is present in the area between Buildings 51 and 64. Groundwater monitoring wells have been installed to help characterize the magnitude and extent of the groundwater contamination. Several of these wells installed in 1996 and 1997 were located near the sanitary sewer lines, including MW51-96-16, MW51-96-17, MW51-97-3, MW51-97-4, MW51-97-12, and MW51-97-14. MW51-97-3, MW51-97-4, MW51-97-12, and MW51-97-14 are also located near manholes in the sanitary sewer line west of Building 51B. Plume characterization and groundwater monitoring are discussed in the Berkeley Lab Quarterly Progress Reports.

Soil Samples

Soil samples (SS51N-02, SS51N-03, SS51W-03, and SS51W-07) were collected along the sewer lines during the RFA to assess whether PCBs from the Building 51 Motor Generator Room and Vacuum Pump Room Sumps and Collection Basins (SWMUs 9-4 and 9-6) could have leached to soil from the sanitary sewers outside Building 51.

Soil samples were also collected from the borings of the monitoring wells installed in 1996 and 1997 and analyzed for VOCs and metals.

4.1.2 Results

Soil

Analytical results are included in Table 1a (organics) and Table 1b (metals). No PCBs were detected in the soil samples collected during the RFA. Low concentrations (0.01 mg/kg maximum) of halogenated hydrocarbons (tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene (DCE), and cis-1,2-DCE) and aromatic hydrocarbons (toluene) were detected in soil samples collected along the sanitary sewer lines. These detections were below the water table in areas of known groundwater contamination. Concentrations of VOCs detected are shown on the cross sections (Figure 8 and Figure 9). All VOCs were detected at concentrations below the United States Environmental Protection Agency (EPA) Region 9 Preliminary Remediation Goal (PRG) for residential soil (EPA, 1999).

Barium, chromium, cobalt, nickel, vanadium, and zinc were detected at concentrations above Berkeley Lab background levels (Berkeley lab, 1995). Nickel was the only metal detected at a concentration above the PRG for residential soil (243 mg/kg and 194 mg/kg). Both of these detections were in samples collected well below the invert elevation of the sanitary sewer line, with the shallower samples from the borings having much lower concentrations.

Groundwater

The Building 51/64 VOC Plume underlies the portion of the sanitary sewer north of Building 51. The groundwater contamination is defined by the presence of several halogenated

hydrocarbons, predominantly 1,1-dichloroethane (DCA), PCE, TCE, cis-1,2-DCE, 1,1-DCE, and vinyl chloride. Several halogenated hydrocarbons have been detected at concentrations above their Maximum Contaminant Levels (MCLs) for drinking water. The extent of the groundwater contamination has been defined, and the source of the contamination has been identified adjacent to the southeast corner of Building 64. The sewer lines are not located in the source area of the plume and are therefore not the source.

4.2 BUILDING 25A SANITARY SEWER (AOC 10-3)

4.2.1 Summary of Investigations

Soil, groundwater, and soil-gas sampling locations related to the Building 25A Sanitary Sewer are shown on Figure 5.

Soil Gas

Soil-gas samples were collected during the RFA at 25 locations along the sanitary sewers emanating from Buildings 25A and 26. The samples were taken from approximately one foot beneath the sanitary sewer line invert elevation and as close as practicable to the line. All samples were analyzed for VOCs, and some samples were also analyzed for total hydrocarbons (THC), total petroleum hydrocarbons as gasoline (TPH-G), and cumene.

To help locate the source of the TCE contamination detected in groundwater west of Building 25A (designated as AOC 10-5), soil-gas probes were installed at 24 locations inside and on the north and west sides of Building 25A in 1998. Eight of the probes were located near the sanitary sewer line or floor drains under the building.

Groundwater

In 1992, groundwater monitoring well MW26-92-11 was installed adjacent to the sanitary sewer line, at a location where the maximum concentration of PCE was detected in soil gas.

In August 1993, groundwater monitoring well MW76-93-7 was installed south of Building 76L to characterize the extent of groundwater contamination (not associated with the

building 25A sewer line) detected in MW76-1. MW76-93-7 was located near a manhole in the Building 25A sewer line.

In 1998 and 1999, groundwater monitoring wells were installed to help locate the source of the TCE contamination detected in groundwater near the western end of Building 25A. Three of these wells (MW25A-98-6, MW25A-98-7, and MW25A-99-2) are also located adjacent to the sanitary sewer line under the building.

Soil Samples

Soil samples were collected from the boring for MW26-92-11 and analyzed for VOCs and benzene, toluene, ethylbenzene, and xylenes (BTEX).

Soil samples collected from the boring for MW76-93-7 and analyzed for VOCs, total petroleum hydrocarbons as diesel (TPH-D), TPH-G, oil & grease, and metals.

In April 1995, soil borings SB25-95-2 and SB25-95-3 were drilled next to the sewer lines emanating from the east side of Building 25A. Soil samples were collected from SB25-95-2 at approximately 4 feet bgs, and samples from SB25-95-3 were collected between 5 and 36 feet bgs. Samples were analyzed for VOCs, fuels, pH, and metals.

Shallow soil samples were collected at eight locations in 1998 (SS25A-98-1 through SS25A-98-8) at floor drains and along the sub-floor waste line system of Building 25A that drain to the sanitary sewer system east of Building 25A. The purpose of the sampling was to evaluate if a release from the floor drains or drain lines under the building was the source of the TCE detected in the groundwater. Soil samples were collected at depths of approximately 2 and 4 feet below the surface at seven of the locations and at 2 feet below the floor surface at one location (SS25A-98-7) and analyzed for VOCs.

Soil samples were collected from the borings for MW25A-98-6, MW25-98-7, and MW25A-99-2 and analyzed for VOCs. In addition, selected composite samples were analyzed for metals.

4.2.2 Results

Soil-Gas

TCE was detected in soil-gas samples from all eight probes installed beneath the floor of Building 25A, and Freon-113 was detected in seven of the probes. The TCE concentrations ranged from 33 ppbv to 7,000 ppbv. The Freon-113 concentrations ranged from 4.8 ppbv to 810 ppbv. The distribution of TCE concentration in the soil gas is in general agreement with the TCE concentration distribution in the groundwater.

Soil

Analytical results are included in Table 2a (organics) and Table 2b (metals). Concentrations of VOCs detected are shown on the cross sections (Figure 10 and Figure 11). Trace concentrations of TCE (0.013 mg/kg) and 1,1,1-trichloroethane (TCA) (0.015 mg/k) were the only VOCs detected in soil samples. Both of these detections were below the water table under Building 25A, in an area of known groundwater contamination. In addition, VOCs were not detected in the samples collected at floor drains and along the sub-floor waste line system beneath Building 25A, indicating the sewer line under the building was not the source of the soil or groundwater contamination. Petroleum hydrocarbons were not detected in the samples for which it was analyzed.

Cadmium, chromium, cobalt, lead, nickel, and silver were detected at concentrations above Berkeley Lab background levels (Berkeley Lab, 1995). Nickel was the only metal also detected above the PRG for residential soil in two samples (190 mg/kg in MW26-92-11 and 165 mg/kg in the composite sample from MW25A-98-7). Both samples from MW26-92-11 that contained nickel above Berkeley Lab background levels were collected in the Orinda Formation. MW25A-98-7 was also sampled in the Orinda Formation. The Orinda Formation has a higher nickel background level (144 mg/kg) than the other geologic formations at Berkeley Lab (Berkeley lab, 1995). The sample collected immediately below the invert elevation of the sewer line at MW26-92-11 contained only 40 mg/kg of nickel.

Levels of pH measured in SB25-95-2 and SB25-95-3 were neutral to slightly basic ranging from 7.6 to 9.0.

Groundwater

Two areas of groundwater contamination are present in the vicinity of the Building 25A sanitary sewer line: 1) PCE in groundwater east of Building 25A and 2) TCE in groundwater beneath and to the west of Building 25A.

PCE (7.0 to 25 μg/L) has been consistently detected in groundwater samples collected from MW26-92-11 in quarterly sampling since October 1992. Traces (generally 1 μg/L or less) of TCE, 1,1,1-TCA, 1,1-DCE, 1,2-DCA, and chloroform have also been detected. Concentrations of PCE detected in MW26-92-11 have shown a decreasing trend. A grab groundwater sample was collected from SB25-95-3 in 1995. PCE (41 μg/L) and traces of 1,1-DCE and TCE were detected. The source of this groundwater contamination is not known.

TCE has been detected in groundwater at concentrations above 100 μg/L in monitoring wells MW25A-98-7 and MW25-99-2 near the western end of Building 25A. The source of the groundwater contamination is not known. Based on results of soil sampling along the sewer line and floor drains under the building, the sewer line is not the source of the contamination.

SECTION 5

RATIONALE FOR NFA RECOMMENDATION

NFA status is recommended for the Sanitary Sewer Lines North and West of Buildings 51 and 51B (AOC 9-8) and the Building 25A Sanitary Sewer (AOC 10-3). Berkeley Lab followed the methodology specified in Berkeley Lab's response to DTSC's comments (Attachment 1) and discussions held with the DTSC and the City of Berkeley at Berkeley Lab on July 1, 1999 to investigate whether a release had occurred from the sewer lines, as follows:

1. Conduct a video survey of sewer lines to identify dislocations, breaks or perforations.
2. If dislocations, breaks, or perforations are identified by the survey, conduct additional sampling.

Based on the results of the video survey and the associated soil sampling, there is no indication that a chemical release has occurred from the sewer line. No defects, root intrusion, or displacement was observed within any of the lines surveyed (Attachment 2).

Supplemental information to support the NFA request includes the following:

- Only trace concentrations (<0.02 mg/kg) of VOCs were detected in any of the soil samples collected along the sewer lines. The locations where the VOCs were detected were below the water table in areas of known groundwater contamination. No VOCs were detected in the soil samples collected below the invert elevation of the sewer lines and above the water table.

- Nickel was the only metal detected at a concentration above both the Berkeley Lab site wide background level and PRG for residential soil. The highest nickel concentrations were detected in the lower sections of the borings, generally within the Orinda Formation. The Orinda Formation has a higher background level for nickel than the other geologic formations at Berkeley Lab. Shallow samples collected from the same borings at depths below the sewer lines contained much lower concentrations of nickel (well below the background level and PRG).

- The source of the groundwater contamination detected in the area of the sanitary sewers north and west of Buildings 51 and 51B has been identified and it is not associated with the sewers. The source area of the groundwater contamination in the area of the Building 25A sanitary sewer has been identified near the west end of Building 25A and it is not associated with the sewer. Groundwater monitoring will continue in both the Building 25A and 51 areas as required by the RWQCB.

SECTION 6

REFERENCES

DTSC, 1999. *Notice of Deficiency* for NFA or NFI Status Request for SWMUs 3-6 and 9-6 and AOCs 8-7, 9-8, 10-3, Lawrence Berkeley National Laboratory, Berkeley, CA, EPA ID no. CA4890 008 986, April 30, 1999.

Berkeley Lab, 1995. *Protocol for Determining Background Concentrations of Metals in Soil at Lawrence Berkeley National Laboratory (Berkeley Lab).* Environmental Restoration Program, Lawrence Berkeley National Laboratory. August 1995.

Berkeley Lab, 1999. *Request for No Further Action (NFA) or No Further Investigation (NFI) Status for Selected Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs).* Lawrence Berkeley National Laboratory Environmental Restoration Program. January 1999.

EPA, 1999. *Region 9 Preliminary Remediation Goals (PRGs) 1998.* USEPA Region IX.

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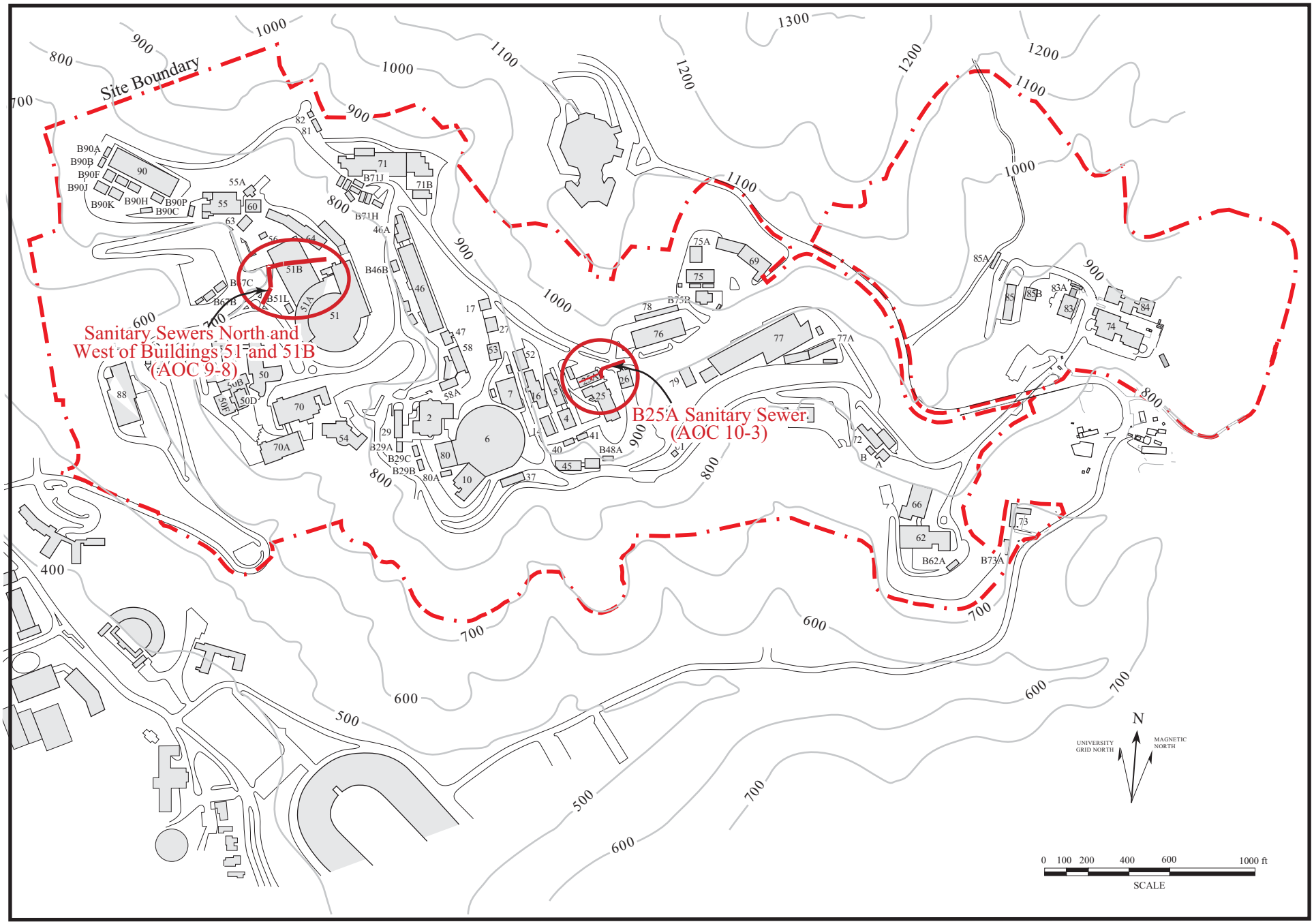

Figure 1. Locations of Sanitary Sewers North and West of Buildings 51 and 51B (AOC 9-8) and Building 25A Sanitary Sewer (AOC 10-3)

1locationmap.ai
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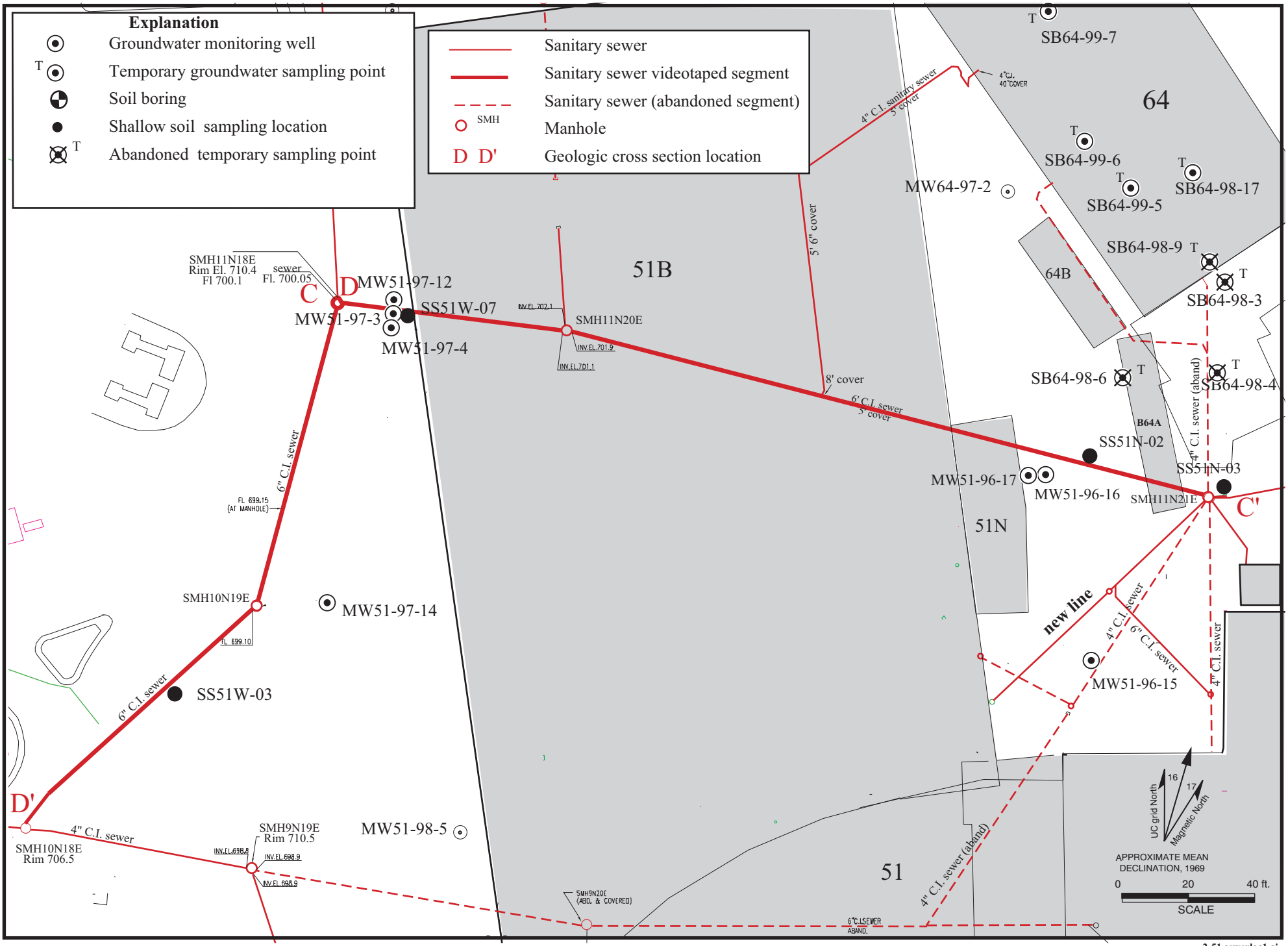

Figure 2. Location of Sanitary Sewers North and West of Buildings 51 and 51B (AOC 9-8).

2-51 sewerloc1.ai
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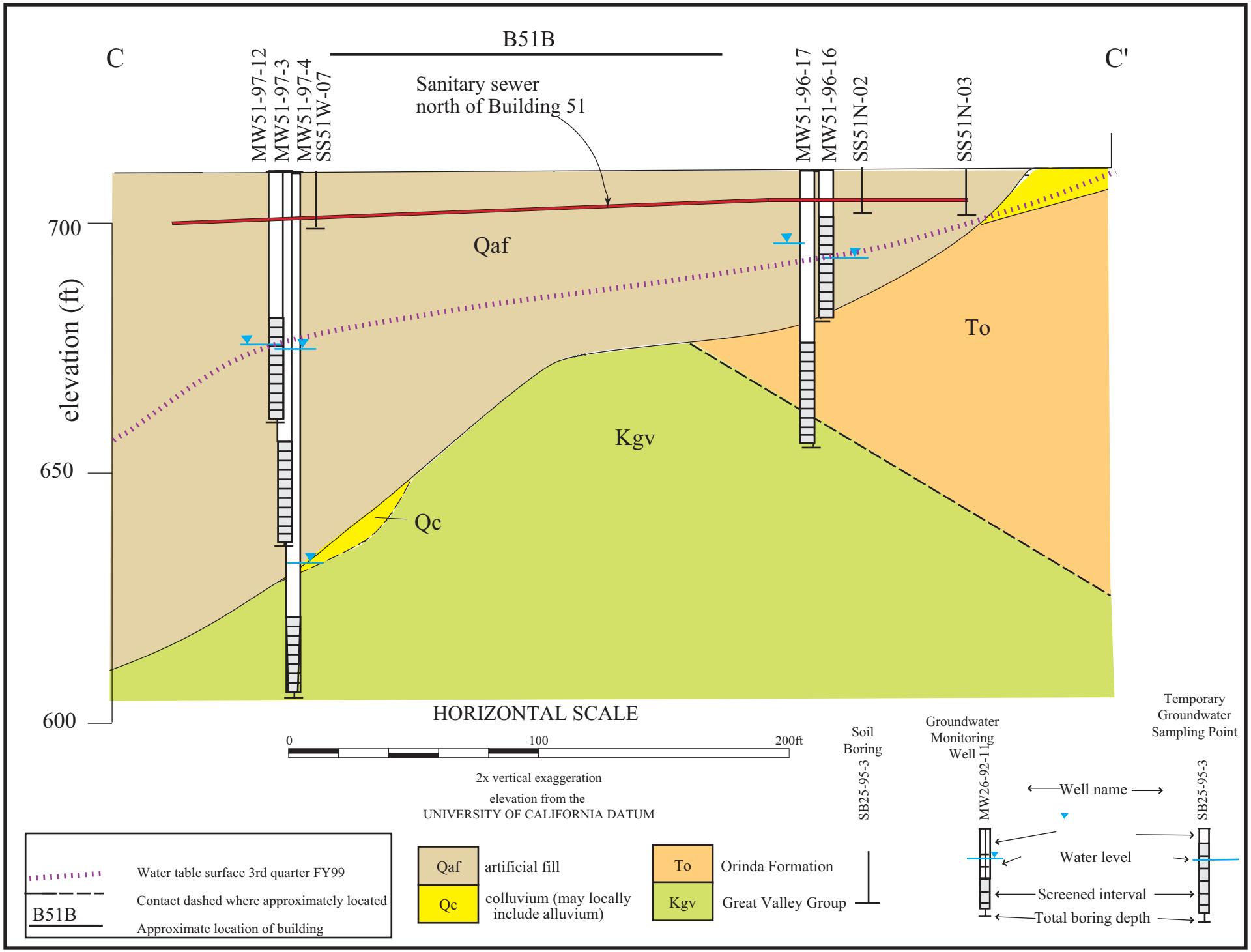


Figure 3. Geologic Cross Section C C', Sanitary Sewers North and West of Buildings 51 and 51B

3-b51seccc
12/99

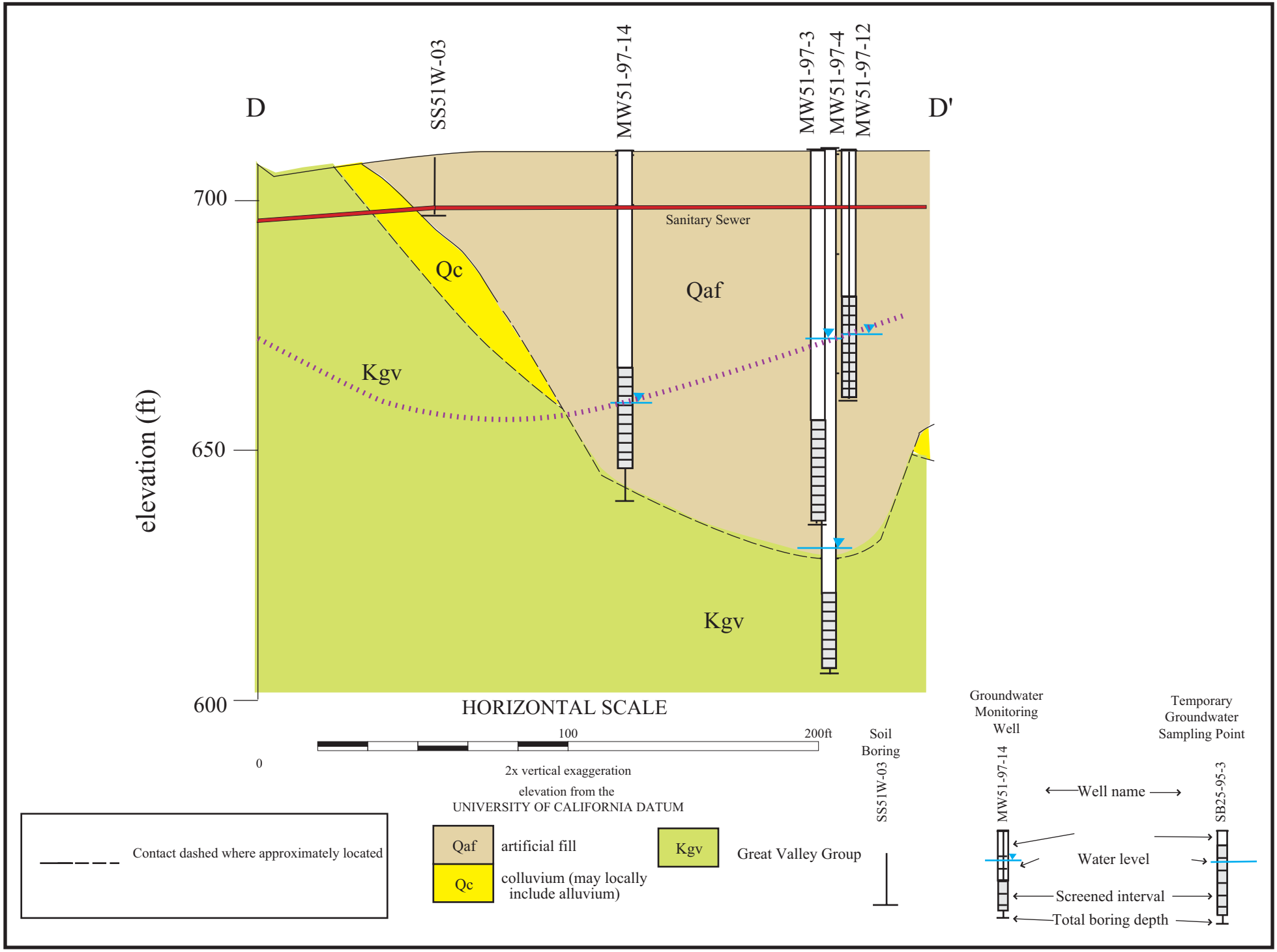
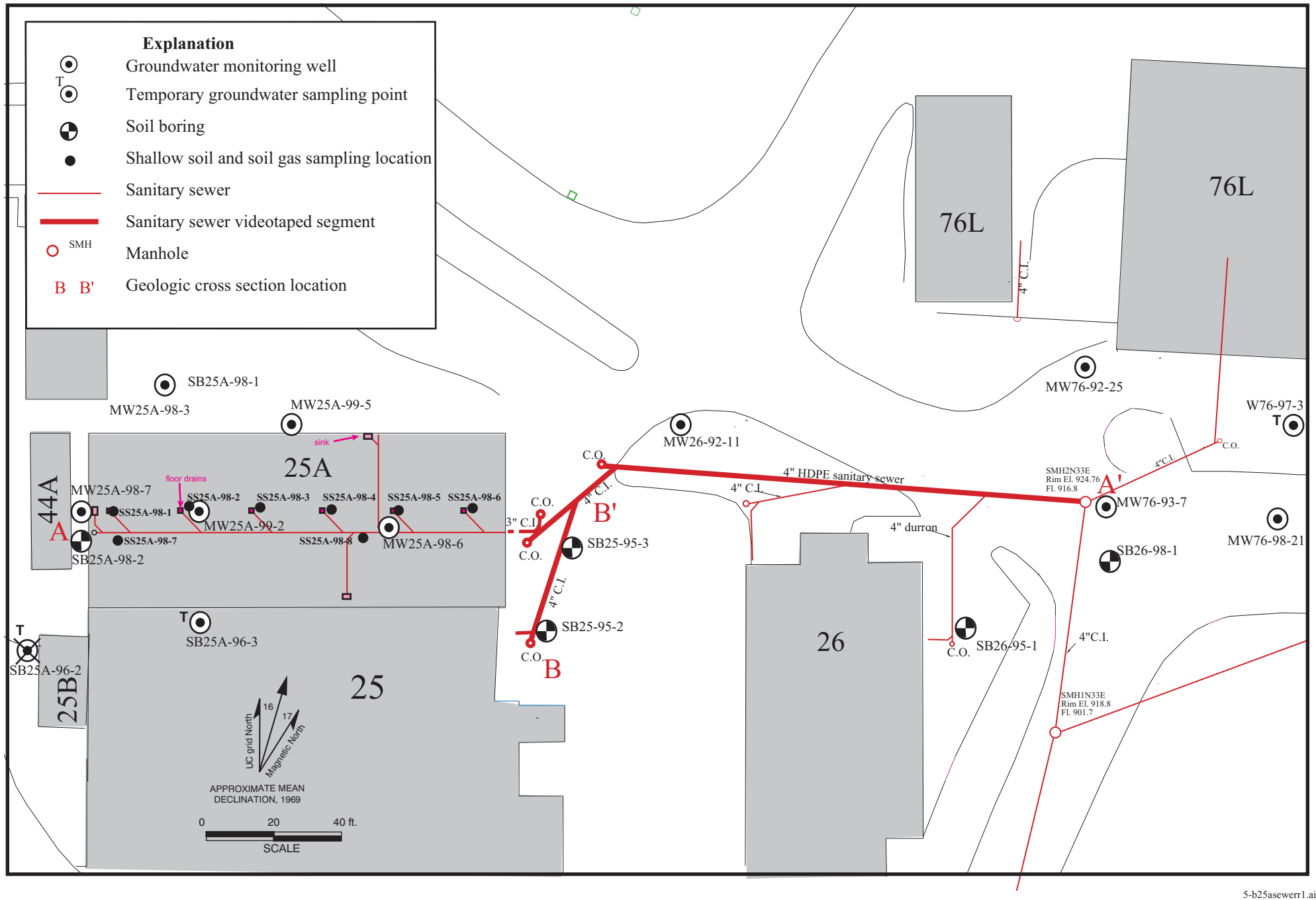


Figure 4. Geologic Cross Section D D', Sanitary Sewers North and West of Buildings 51 and 51B

4-b51secdd'
12/99



5-b25asewerr1.ai
12/99

Figure 5. Location of Building 25A Sanitary Sewer (AOC 10-3).

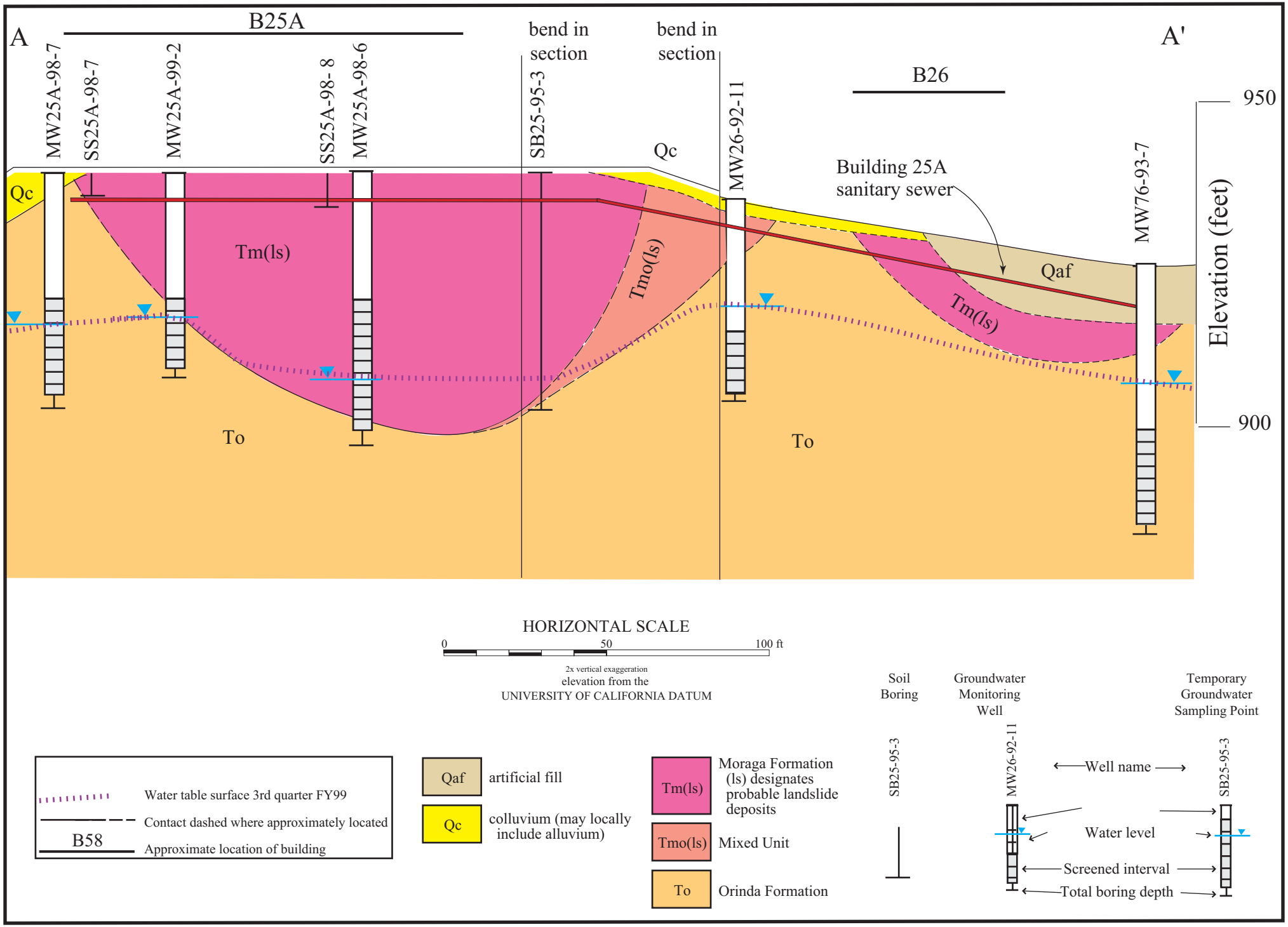


Figure 6. Geologic Cross Section A A', Building 25A Sanitary Sewer

6-b25secaa.ai
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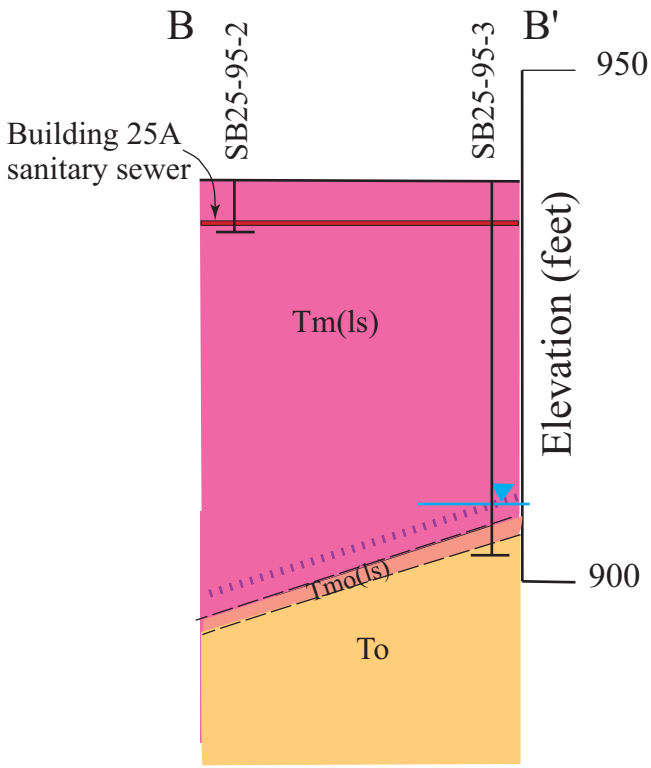

HORIZONTAL SCALE

0 50 100 ft

2x vertical exaggeration
elevation from the
UNIVERSITY OF CALIFORNIA DATUM

Water table surface 3rd quarter FY99

Contact dashed where approximately located

Soil Boring

Tm(ls) — Moraga Formation (ls) designates probable landslide deposits

Tmo(ls) — Mixed Unit

To — Orinda Formation

Figure 7. Geologic Cross Section B B', Building 25A Sanitary Sewer

7-b25secbb
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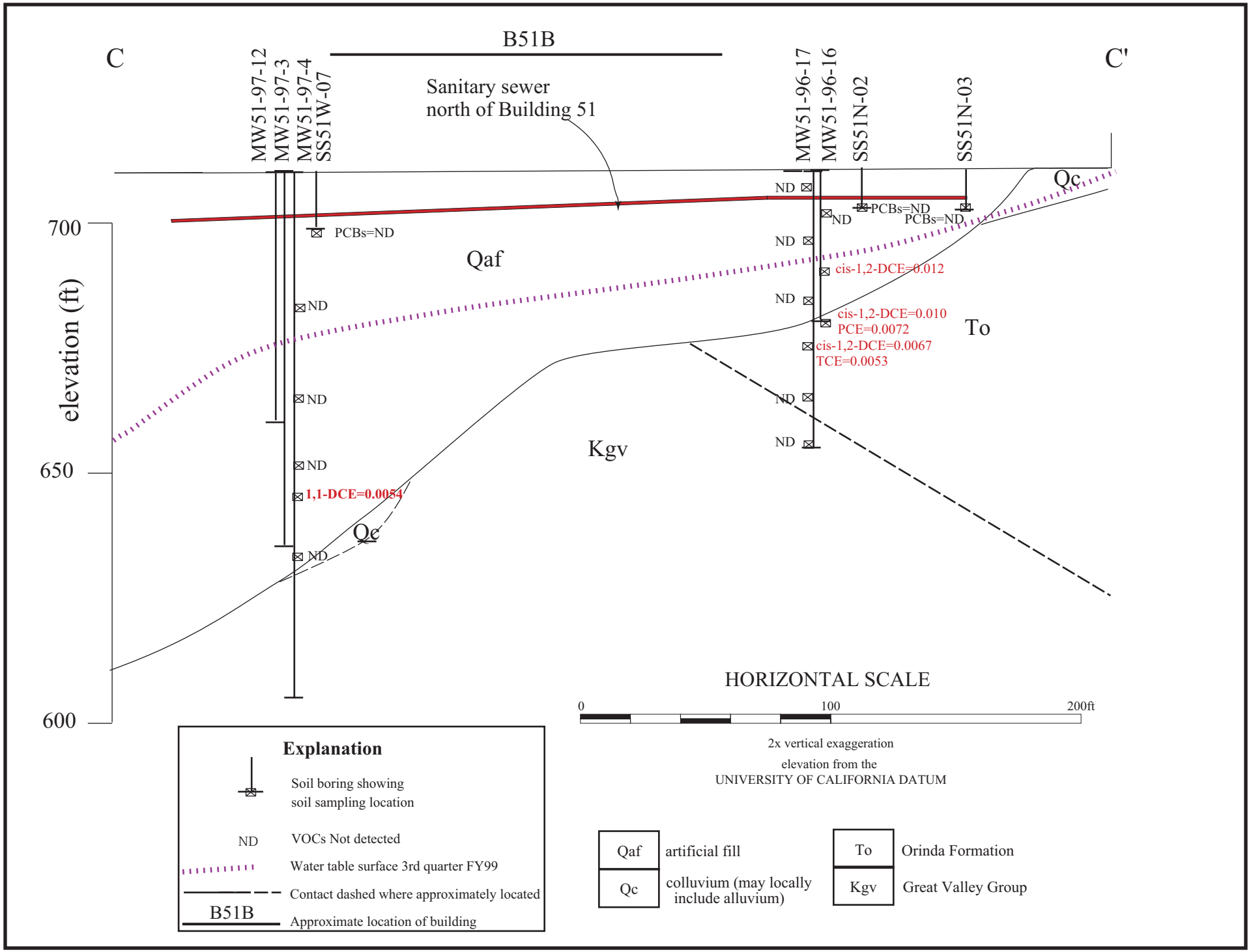
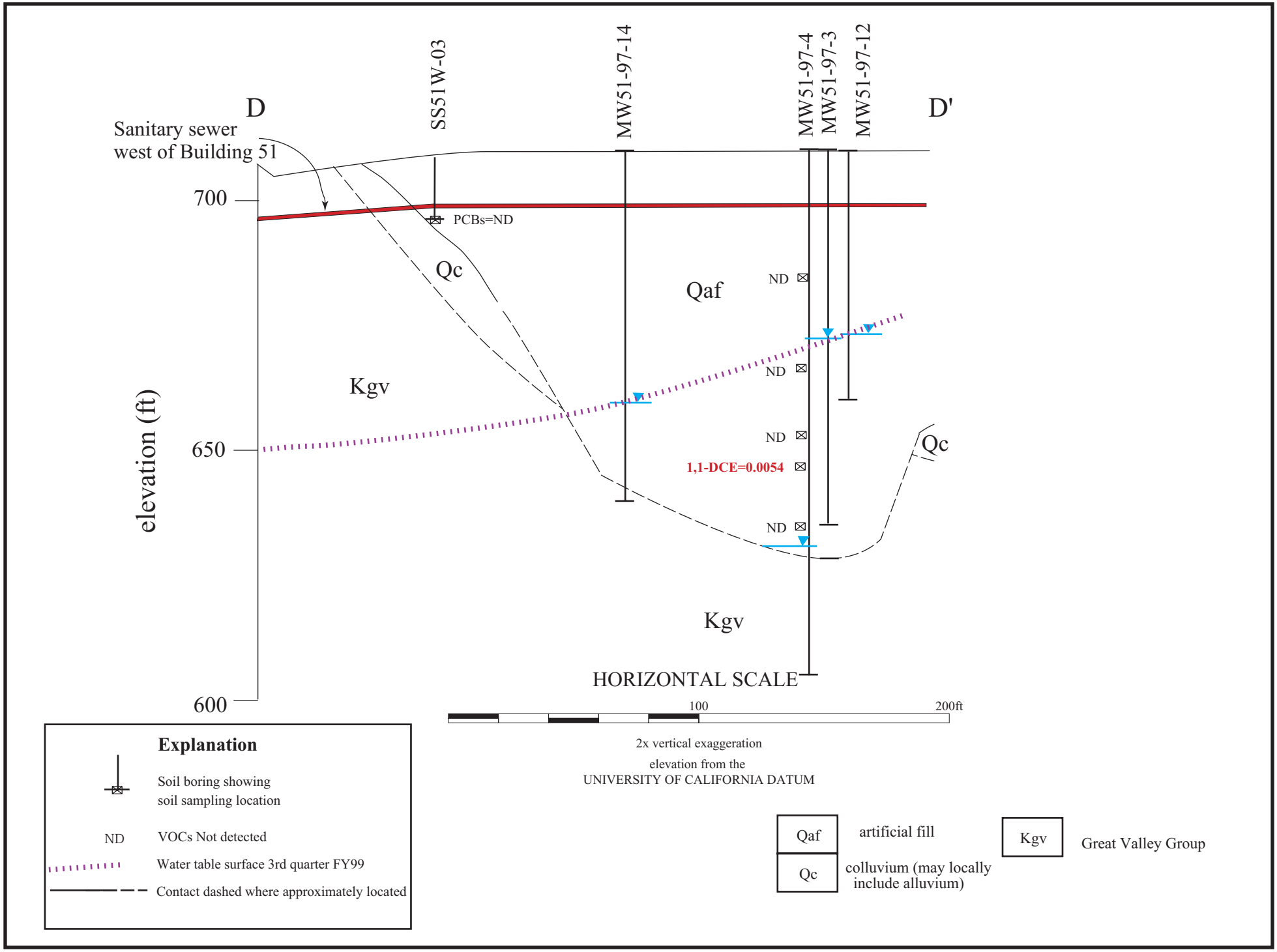


8-b51seccc'chem.ai
12/99

Figure 8. Concentrations of VOCs and PCBs Detected (mg/kg) Sanitary Sewers North and West of Buildings 51 and 51B, Section C C'.



9-b51secdd'chem.ai
12/99

Figure 9. Concentrations of VOCs and PCBs Detected (mg/kg) Sanitary Sewers North and West of Buildings 51 and 51B, Section DD'.

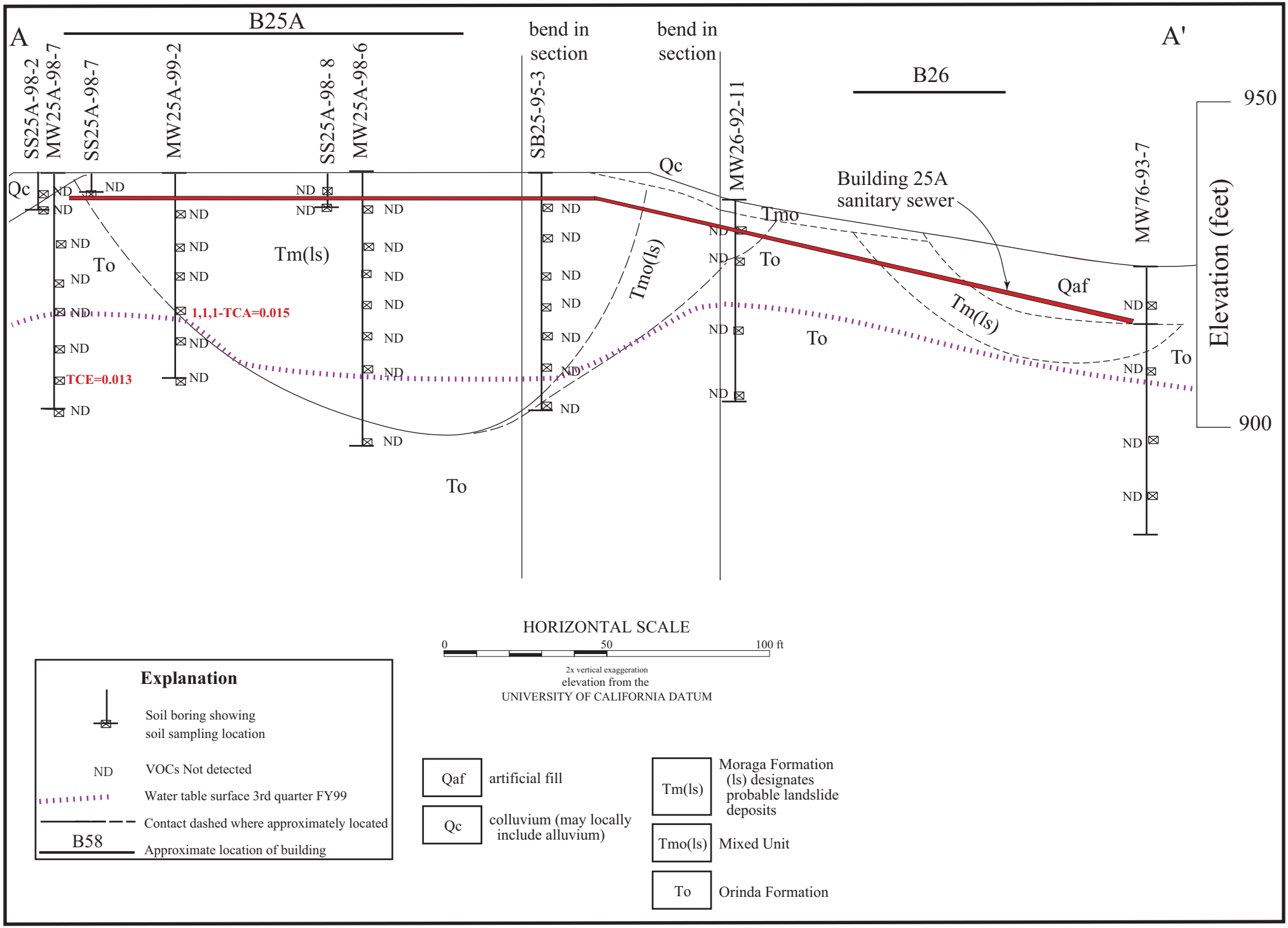


Figure 10. Concentrations of VOCs Detected (mg/kg) Building 25A Sanitary Sewer, Section A A'.

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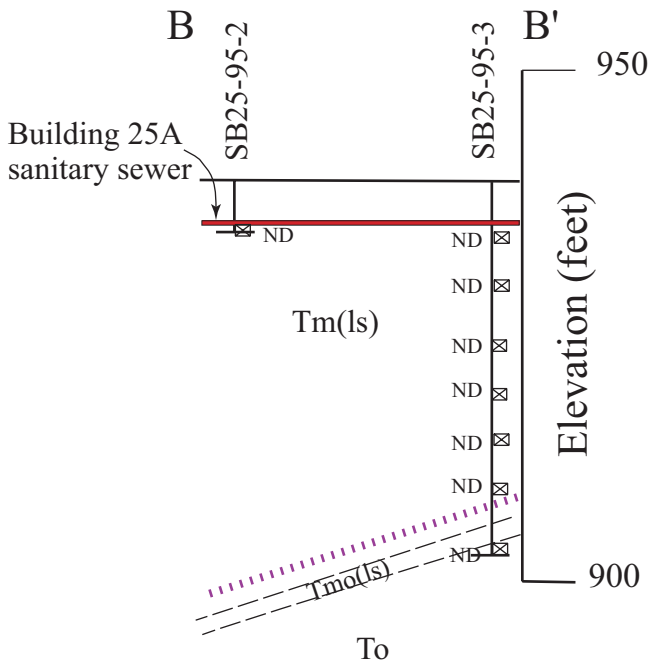

HORIZONTAL SCALE

0 50 100 ft

2x vertical exaggeration
elevation from the
UNIVERSITY OF CALIFORNIA DATUM

Explanation

Soil boring showing soil sampling location

ND VOCs Not detected

Water table surface 3rd quarter FY99

Contact dashed where approximately located

Tm(ls)	Moraga Formation (ls) designates probable landslide deposits
Tmo(ls)	Mixed Unit
To	Orinda Formation

Figure 11. Concentrations of VOCs Detected (mg/kg) Building 25A Sanitary Sewer, Section B B'.

11-B25secbbchem.ai
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Table 2b. Soil Sampling Results for Metals, AOC 10-3: Building 25A Sanitary Sewer System.

Table 1a.
Soil Sampling Results for Organics
AOC 9-8: Sanitary Sewer Lines North and West of Buildings 51 and 51B

				VOCs	PCBs
				8260*	8080
Boring/Sample	Depth (ft)	Date	Lab	mg/kg	mg/kg
SS51W-03-12.7	12.7	Apr-92	C		<0.5
SS51W-07-13	13.0	Apr-92	C		<0.5
SS51N-02-7.7	7.7	Apr-92	C		<0.5
SS51N-03-9	9.0	Apr-92	C		<0.5
MW51-96-16-8	8.0	Sep-96	BC	<0.005	
MW51-96-16-19	19.0			cis-1,2-DCE=0.012	
MW51-96-16-28.5	28.5			cis-1,2-DCE=0.010 PCE=0.0072	
MW51-96-17-3.2	3.2	Sep-96	BC	<0.005	
MW51-96-17-13.5	13.5			<0.005	
MW51-96-17-23.5	23.5			<0.005	
MW51-96-17-33.2	33.2			cis-1,2-DCE=0.0067 TCE=0.0053	
MW51-96-17-43	43.0			<0.005	
MW51-96-17-53	53.0			<0.005	
MW51-97-4-25.4	25.4	May-97	BC	<0.005	
MW51-97-4-45.3	45.3			<0.005	
MW51-97-4-58.7	58.7			<0.005	
MW51-97-4-64.4	64.4			1,1-DCE=0.0054	
MW51-97-4-73.9	73.9			<0.005	
MW51-97-3-COMP (Drum 1)		Jun-97	BC	<0.005	
MW51-97-3-COMP (Drum 2)				<0.005	
MW51-97-3-COMP (Drum 3)				<0.005	
MW51-97-3-COMP (Drum 4)				<0.005	
MW51-97-3-COMP (Drum 5)				<0.005	
MW51-97-3-COMP (Drum 6)				<0.005	
MW51-97-12-COMP(0-20)	0-20	Sep-97	BC	<0.005	
MW51-97-12-COMP(20-35)	20-35			<0.005	
MW51-97-12-COMP(35-40)	35-40			<0.005	
MW51-97-12-COMP(45-50)	45-50			<0.005	
MW51-97-14-0-17Comp	0-17	Sep-97	BC	<0.005	
MW51-97-14-17-32Comp	17-32			<0.005	
MW51-97-14-32-45Comp	32-45			<0.005	
MW51-97-14-45-58Comp	45-58			<0.005	
MW51-97-14-58-70Comp	58-70			<0.005	

BC = Analysis by BC Laboratories
C = Analysis by Chromalab, Inc.

<= Not detected
= Not analyzed

*Detection limit for Methylene Chloride and Total xylene is 0.01
Samples with a "COMP" designation are composite samples.

Table 1b.
Soil Sampling Results for Metals
AOC 9-8: Sanitary Sewer Lines North and West of Buildings 51 and 51B.
(Concentrations in mg/kg)

		Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
*Maximum Background Concentrations***		5.5	19.1	323.6	1.0	2.7	99.6	22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs		30	0.38	5200	150	37	210	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs						9				130			150					
Boring/Sample	**Date**																	
MW51-96-16-8	Sep-96	<10	2.2	129	<1	<1	105	18	26	10	<0.2	<5	78	2	<2	<10	88	51
MW51-96-16-19		<10	8	166	<1	<1	80	14	40	5	<0.2	<5	100	1.8	<2	<10	51	68
MW51-96-16-28.5		<10	5.6	262	<1	<1	40	8	25	6.6	<0.2	<5	43	1.8	<2	<10	39	64
MW51-96-17-3.2	Sep-96	<10	2.3	134	<1	<1	52	14	29	6.8	<0.2	<5	79	1.4	<2	<10	31	84
MW51-96-17-13.5		<10	2.2	156	<1	<1	84	23	27	<5	<0.2	<5	61	1.7	<2	<10	77	58
MW51-96-17-23.5		<10	7.2	132	<1	<1	100	16	33	<5	<0.2	<5	136	1.3	<2	<10	54	56
MW51-96-17-33.2		<10	4.5	172	<1	<1	78	15	47	<5	<0.2	<5	87	1.2	<2	<10	53	69
MW51-96-17-43		<20	13	298	<2	<2	107	17	33	<10	<0.2	<10	129	2.9	<4	<20	79	93
MW51-96-17-53		<20	9.5	319	<2	<2	116	21	29	10	<0.2	<10	194	3.2	<4	<20	64	118
MW51-97-4-COMP(D1)	May-97	<10	5.9	122	<1	<1	56	11	28	<5	<0.2	<5	41	<1	<2	<10	50	57
MW51-97-4-COMP(D2)		<10	5.1	130	<1	<1	59	12	40	<5	<0.2	<5	54	<1	<2	<10	46	60
MW51-97-4-COMP(D3)		<10	4.5	183	<1	<1	56	11	30	<5	<0.2	<5	69	<1	<2	<10	35	63
MW51-97-4-COMP(D4)		<10	4.1	183	<1	<1	51	9.8	55	6.1	<0.2	<5	64	<1	<2	<10	31	71
MW51-97-3-COMP(D1)	Jun-97	<20	3.2	165	<2	<2	106	20	26	<10	<0.2	<10	91	<2	<4	<20	76	68
MW51-97-3-COMP(D2)		<20	2.7	142	<2	<2	107	22	25	<10	<0.2	<10	84	<2	<4	<20	68	60
MW51-97-3-COMP(D3)		<20	3.5	128	<2	<2	89	16	25	<10	<0.2	<10	73	<2	<4	<20	63	59
MW51-97-3-COMP(D4)		<10	3.5	128	<1	<1	61	11	19	<5	<0.2	<5	44	<1	<2	<10	55	55
MW51-97-3-COMP(D5)		<20	7.2	134	<2	<2	50	<10	20	<10	<0.2	<10	42	<2	<4	<20	45	59
MW51-97-3-COMP(D6)		<10	5	140	<1	<1	59	11	20	<5	<0.2	<5	50	<1	<2	<10	53	61
MW51-97-12-COMP(0-20)	Sep-97	<10	4.4	139	<1	<1	76	15	24	5.3	<0.2	<5	71	<1	<2	<10	61	56
MW51-97-12-COMP(20-35)		<10	3.1	144	<1	<1	90	18	26	7.4	<0.2	<5	73	<1	<2	<10	77	61
MW51-97-12-COMP(35-40)		<10	4.8	131	<1	<1	102	18	32	<5	<0.2	<5	93	<1	<2	<10	71	63
MW51-97-12-COMP(45-50)		<10	5.1	149	<1	<1	82	15	27	<5	<0.2	<5	55	<1	<2	<10	67	66
MW51-97-14-0-17Comp	Sep-97	<10	3.5	135	<1	<1	85	18	23	<5	<0.2	<5	72	<1	<2	<10	68	53
MW51-97-14-17-32Comp		<10	3.5	127	<1	<1	87	18	36	6.1	<0.2	<5	72	<1	<2	<10	75	75
MW51-97-14-32-45Comp		<10	4.1	131	<1	<1	82	16	36	5.5	0.21	<5	80	<1	<2	<10	60	58
MW51-97-14-45-58Comp		<10	7.5	165	<1	<1	72	12	35	7.1	<0.2	<5	58	<1	<2	<10	58	66
MW51-97-14-58-70Comp		<10	10	178	<1	<1	58	15	57	11	<0.2	<5	52	<1	<2	<10	53	108

NA	= Not analyzed
<5	= Not detected (reporting limit shown)
25	= Concentration above background but below PRG.
194	= Concentration above both background and PRG.

Table 2a.

Soil Sampling Results for Organics, Fuels, and pH

AOC 10-3: Building 25A Sanitary Sewer System

				VOCs			Fuels	TPH-D	TPH-G	Oil & Grease	pH
				8010/8020*	8240**	8260***	8015M#	8015M	8015M	413.1	9040
Boring/Sample	Depth (ft)	Date	Lab	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	S.U.
MW26-92-11-4	4.0	Mar-92	Q	<0.005							
MW26-92-11-9	9.0			<0.005							
MW26-92-11-20.5	20.5			<0.005							
MW26-92-11-30.2	30.2			<0.005							
MW76-93-7-5.5	5.5	Aug-93	C		<0.005			<1	<1	<50	
MW76-93-7-15.5	15.5				<0.005			<1	<1	<50	
MW76-93-7-26	26.0				<0.005			<1	<1	<50	
MW76-93-7-35.5	35.5				<0.005			<1	<1	<50	
SB25-95-2-3.7	3.7	Apr-95	BC			<0.005	<10				7.68
SB25-95-3-5.3	5.3	Apr-95	BC			<0.005	<10				8.37
SB25-95-3-10	10.0					<0.005	<10				8.22
SB25-95-3-15.7	15.7					<0.005	<10				8.45
SB25-95-3-20.6	20.6					<0.005	<10				8.31
SB25-95-3-25	25.0					<0.005	<10				8.43
SB25-95-3-30	30.0					<0.005	<10				8.33
SB25-95-3-35.5	35.5					<0.005	<10				9.02
SS25A-98-1-2	2.0	Jun-98	BC			<0.005					
SS25A-98-1-4.1	4.1					<0.005					
SS25A-98-2-2	2.0	Jun-98	BC			<0.005					
SS25A-98-2-4	4.0					<0.005					
SS25A-98-3-1.9	1.9	Jun-98	BC			<0.005					
SS25A-98-3-4	4.0					<0.005					
SS25A-98-4-1.8	1.8	Jun-98	BC			<0.005					
SS25A-98-4-4.2	4.2					<0.005					
SS25A-98-5-1.8	1.8	Jun-98	BC			<0.005					
SS25A-98-5-4	4.0					<0.005					
SS25A-98-6-2	2.0	Jun-98	BC			<0.005					
SS25A-98-6-4.2	4.2					<0.005					
SS25A-98-7-2	2.0	Jun-98	BC			<0.005					
SS25A-98-8-2	2.0	Jun-98	BC			<0.005					
SS25A-98-8-4.2	4.2					<0.005					

Table 2a (Continued)

Soil Sampling Results for Organics, Fuels, and pH

AOC 10-3: Building 25A Sanitary Sewer System

				VOCs			Fuels	TPH-D	TPH-G	Oil & Grease	pH
				8010/8020*	8240**	8260***	8015M	8015M	8015M	413.1	9040
Boring/Sample	Depth (ft)	Date	Lab	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	S.U.
MW25A-98-7-10.6	10.6	Aug-98	BC			<0.005					
MW25A-98-7-15.6	15.6					<0.005					
MW25A-98-7-20.3	20.3					<0.005					
MW25A-98-7-25.7	25.7					<0.005					
MW25A-98-7-30.6	30.6					TCE=0.013					
MW25A-98-7-35.9	35.9					<0.005					
SB25A-98-2-3	3.0	Aug-98	BC			<0.005					
SB25A-98-2-3.5	3.5					<0.005					
SB25A-98-2-5.6	5.6					<0.005					
MW25A-98-6-5.0	5.0	Oct-98	BC			<0.005					
MW25A-98-6-11	11.0					<0.005					
MW25A-98-6-15	15.0					<0.005					
MW25A-98-6-20	20.0					<0.005					
MW25A-98-6-25	25.0					<0.005					
MW25A-98-6-30	30.0					<0.005					
MW25A-98-6-41.3	41.3					<0.005					
MW25A-99-2-6	6.0	Apr-99	BC			<0.005					
MW25A-99-2-11	11.0					<0.005					
MW25A-99-2-15.3	15.3					<0.005					
MW25A-99-2-21	21.0					1,1,1-TCA=0.015					
MW25A-99-2-26	26.0					<0.005					
MW25A-99-2-31	31.0					<0.005					

< = Not detected
= Not analyzed

BC = Analysis by BC Laboratories
C = Analysis by Chromalab
Q = Analysis by Quanteq Laboratories

*Detection limit for Total xylenes by method 8020 is 0.02
**Detection limit for Acetone by method 8240 is 0.1
***Detection limit for Methylene Chloride and Total xylene by method 8260 is 0.01
#Detection limit for Light naptha, aviation fuel, gasoline, crude/waste oil, and hydraulic oil by method 8015m is 50
Fuels include: Light Naptha, Aviation Fuel, Stoddard/White Spirits, Heavy Naptha/Ligroin/Petroleum Benzine, Gasoline, JP4, JP5, JP6, JP8, Kerosene/Jet Fuel, Diesel, Crude/Waste Oil, Hydraulic Oil, and WD-40

Table 2b.
Soil Sampling Results for Metals
AOC 10-3: Building 25A Sanitary Sewer System
(Concentrations in mg/kg)

		Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
*Maximum Background Concentrations***		5.5	19.1	323.6	1.0	2.7	99.6	22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs		30	0.38	5200	150	37	210	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs						9				130			150					
Boring/Sample	**Date**																	
MW26-92-11-4	Mar-92	<2	11	91	0.8	0.3	67	17	15	9	<0.2	<0.6	54	<2	5.2	<3	64	56
MW26-92-11-9		<2	7	170	0.8	0.2	59	19	20	6	<0.2	<0.6	40	<2	<0.2	<3	60	36
MW26-92-11-20.5		<2	10	100	0.5	0.2	100	20	32	7	<0.2	<0.6	190	<2	<0.2	4	50	53
MW26-92-11-30.2		<2	11	94	0.6	<0.2	77	16	35	8	<0.2	<0.6	130	2	<0.2	8	50	57
MW76-93-7-5.5	Aug-93	3.0	<0.25	30	0.10	2.1	49	15	34	<0.5	0.06	3.2	130	<0.5	1.0	<2	21	26
MW76-93-7-15.5		<1	<0.25	54	0.28	3.0	38	8.8	42	<0.5	0.06	3.7	130	<0.5	1.1	<2	42	58
MW76-93-7-26		<1	5.0	120	0.29	4.0	43	16	58	5.4	0.12	3.3	91	<0.5	2.0	<2	49	66
MW76-93-7-35.5		3.1	13	180	0.36	2.9	34	13	25	<0.5	<0.05	5.7	68	<0.5	1.8	<2	20	43
SB25-95-2-3.7	Apr-95	<5	<1	114	<0.5	<0.5	34	13	10	<2.5	<0.2	<2.5	12	<0.5	<1	<5	51	52
SB25-95-3-5.3	Apr-95	<5	<0.5	59	<0.5	<0.5	18	24	19	<2.5	<0.2	<2.5	40	<0.5	<1	<5	23	61
SB25-95-3-10		<5	<0.5	47	<0.5	<0.5	34	15	18	<2.5	<0.2	<2.5	19	<0.5	<1	<5	35	54
SB25-95-3-15.7		<5	<0.5	62	<0.5	<0.5	19	14	22	<2.5	<0.2	<2.5	12	<0.5	<1	<5	26	56
SB25-95-3-20.6		<5	<0.5	92	<0.5	<0.5	31	23	26	<2.5	<0.2	<2.5	28	<0.5	<1	<5	43	60
SB25-95-3-25		<5	<1	81	<0.5	<0.5	32	20	29	<2.5	<0.2	<2.5	25	<0.5	<1	<5	61	60
SB25-95-3-30		<5	1.5	204	<0.5	<0.5	108	21	14	<2.5	<0.2	<2.5	52	<0.5	<1	<5	63	55
SB25-95-3-35.5		<5	1.4	130	<0.5	<0.5	74	16	43	3.3	<0.2	<2.5	61	<0.5	<1	<5	61	69
MW25A-98-7Comp	Aug-98	<20	4.0	147	<2	<2	100	18	35	<10	<0.2	<10	165	<2	<4	<20	63	67
SB25A-98-2Comp	Aug-98	<20	6.4	117	<2	<2	85	20	39	11	<0.2	<10	139	<2	<4	<20	68	70
MW25A-98-6Comp	Oct-98	<10	1.5	104	<1	<1	87	14	22	60	<0.2	<5	62	<1	<2	<10	66	45

RFA = Sample was collected during the RCRA Facility Assessment

NA	= Not analyzed
<5	= Not detected (reporting limit shown)
100	= Concentration above background but below PRG.
190	= Concentration above both background and PRG.

Attachment 1

LBNL Response to the April 30, 1999 DTSC Notice of Deficiency,
dated May 28, 1999

LBNL RESPONSE TO DTSC COMMENTS
(Notice of Deficiency for NFA or NFI Status Request for SWMUs 3-6 and 9-6 and AOCs 8-7, 9-8, and 10-3, Lawrence Berkeley National Laboratory, Berkeley, CA. EPA ID No. CA 4890 008 986. Dated April 30, 1999)

The following are Lawrence Berkeley National Laboratory (LBNL) Environmental Restoration Program (ERP) responses to comments received from the Department of Toxic Substances Control (DTSC), in a letter dated April 30, 1999 from Salvatore Ciriello to Iraj Javandel of LBNL. Each of the DTSC's comments is given, followed by the LBNL response in boxed text.

For AOC 9-8, Sanitary Sewer Lines BLDG.'s 51 and 51B

5. Characterize the full extent of the contamination associated with this unit, clearly identifying any migration of contaminants to ground and surface waters.

LBNL Response

Refer to the first general comment about the definition of "contamination" associated with this unit.

The statement "the contamination associated with this unit" presumes that there is contamination resulting from leaks in the sanitary sewer lines. Based on the results of surveys of the sewer lines, concentrations of contaminants detected, depths relative to the water table where the samples were collected, and contaminants detected in groundwater, the groundwater is the source of the contamination detected in the soil.

The LBNL RFA discusses surveys of the LBNL sanitary sewer system that were conducted in 1977 and 1991 to identify areas of corrosion or breakage. No corroded or damaged segments were identified along the Building 51 sanitary sewers by the surveys. Groundwater contamination by halogenated hydrocarbons has been identified in the area underlying AOC 9-8. A source area for the contamination has been determined. Given the sewer survey results and the RFI soil sampling results, the trace concentrations (0.055 mg/kg maximum concentration) of chlorinated hydrocarbons detected in soil samples collected near the sewer lines are believed to be associated with the groundwater contamination. Five of the soil samples that contained halogenated hydrocarbons were collected below the water table. At three locations where halogenated hydrocarbons were detected below the water table, no contamination was detected in samples collected above the water table but below the elevation of the sewer lines. As reported in the LBNL RFA report, PCBs, a known constituent in past effluent from Building 51, were not detected in soil samples collected along the sanitary sewer lines.

There is no known direct migration pathway from the Building 51 sanitary sewer lines to surface water. Surface water and sediment samples have been collected from site creeks (including North Fork Strawberry Creek downgradient from the unit) and analyzed for chemicals of

potential concern. As reported in the quarterly progress reports, no PCBs were detected in sediment samples from North Fork Strawberry Creek.

Proposed Work

LBNL will use a two-phase approach to further determine whether the Building 51 and 51B sanitary sewer lines released waste. First, LBNL will conduct a survey of the Building 51 and 51B sanitary sewer lines to identify any dislocations, breaks, or perforations caused by corrosion. If dislocations, breaks, or perforations are identified, a work plan will be prepared and submitted to DTSC for additional sampling. If no dislocations, breaks, or perforations are identified, AOC 9-8 will be resubmitted for NFI status.

6. Provide drawings with dimensions showing horizontal location and depth of samples collected.

LBNL Response

Scale drawings showing the locations (horizontal and vertical) of samples with respect to the pipe will be provided in a future work plan and/or a revised NFA/NFI request report.

7. Preliminary Remediation Goals (PRG's) cannot be used as detection limits in these investigations. The presence of halogenated compounds above background should actually be an indication that further investigation might be needed in order to clearly ascertain the origin of the contaminants and to discard or identify the presence of any existing hot spots. Once sufficient sampling under a statistically representative plan is conducted, then PRG's can be used as a threshold as agreed.

LBNL Response

LBNL does not use Preliminary Remediation Goals (PRGs) as detection limits or to define the extent of contamination. As approved by the DTSC, LBNL uses USEPA Region IX PRGs for residential soil (USEPA, 1998) as the approved action levels (ALs) to determine if further action may be required. PRGs are a presumptive contaminant concentration in soil above which inclusion of the unit in the Corrective Measures Study (CMS) may be required.

Based on the results of surveys of the sewer lines, concentrations of contaminants detected, depths relative to the water table where the samples were collected, and contaminants detected in groundwater, the groundwater is the source of the contamination detected in the soil. All detections of halogenated hydrocarbons in soil samples were at locations where the groundwater is contaminated with halogenated hydrocarbons. Five of the soil samples where halogenated hydrocarbons were detected were collected below the water table. The other four soil samples where halogenated hydrocarbons were detected were collected within 10 feet above the water table. The presence of halogenated compounds at trace levels (0.055 mg/kg maximum concentration) does not mean that further investigation will be beneficial in "clearly ascertaining" the origin of contamination and identifying the presence of any hot spots,

particularly when a more probable source of the contamination (contaminated groundwater) is present.

The concept of "sufficient sampling under a statistically representative plan" needs to be clarified.

8. The statement suggesting that results of the soil gas sampling conducted may be partitioning from ground water is not sufficient to justify dismissal of the data or to reduce the scope of the investigation.

LBNL Response

The soil-gas sampling results were not used to "reduce the scope of the investigation" nor were the results dismissed. The soil-gas sampling was conducted during the RFA as an initial site-screening tool.

For AOC 10-3 BLDG. 25A Sanitary Sewer

9. Provide drawings with dimensions showing horizontal locations and depths of samples to evaluate results appropriately.

LBNL Response

Scale drawings showing the locations (horizontal and vertical) of samples with respect to the pipe will be provided in a future work plan and/or a revised NFA/NFI request report.

10. Explain clearly the strategy pursued to identify releases or to discard with certainty the possibility of such releases.

LBNL Response

The strategy that LBNL used "to identify releases or to discard with certainty the possibility of such releases" was to survey the sewer lines for perforations or breaks and to collect and analyze environmental samples along the sewer lines. The LBNL RFA discusses surveys of the LBNL sanitary sewer system in 1977 and 1991. One corroded segment and one possible dislocated segment were identified in the sanitary sewer line east of Buildings 25A and Building 26.

During the LBNL RFA, soil-gas samples were collected at 25 locations along the sanitary sewers emanating from Buildings 25A and 26 as an initial screening of the sanitary sewer lines. In addition, a shallow soil sample was collected during the RFA at the possible dislocation in the sewer line identified in the 1991 survey. A groundwater monitoring well was installed at the location where the maximum concentration of PCE was detected in the soil-gas samples (soil samples were collected from the boring for the monitoring well for further characterization).

During the RFI, additional soil samples were collected along the sanitary sewer lines from three soil borings located at bends and junctures of the sewer lines. Bends and junctures are likely stress points in sewer lines, where dislocations are more likely to occur. Also, several soil and soil-gas samples were collected at floor drains along the sub-floor waste line system of Building 25A that drains to the sanitary sewer system east of Building 25A. Floor drain connections are also stress points in the sewer line where breaks caused by dislocations are more likely to occur. The results of this sampling are discussed in the LBNL NFA/NFI request report.

Proposed Work

LBNL will use a two-phase approach to supplement the previous characterization work to determine whether the Building 25A and 26 sanitary sewer lines discharged wastes. First, LBNL will re-survey the Building 25A and 26 sanitary sewer lines to identify any dislocations or corroded sections. If dislocations, breaks, or perforations are identified by the survey, a work plan for additional sampling will be prepared and submitted to DTSC. If no dislocations, breaks, or perforations are identified, AOC 10-3 will be resubmitted for NFA status.

11. Clarify the kind of waste that is suspect to have been released by this unit. According to the DTSC's RFA, this unit was also suspect of releasing plating wastes containing cyanides and metals.

The types of waste handles by AOC 10-3 are provided in the NFA/NFI request report. The portion of the above comment, "…this unit was also suspect of releasing plating wastes containing cyanides and metals," refers to a different AOC than the one in question. The DTSC RFA suspected releases of plating wastes from operations of the plating shop in Building 25 to the sanitary sewer. The Building 25 sanitary sewer is DTSC's AOC-5, which is LBNL's AOC 10-4. The locations of the Building 25 sanitary sewer and the Building 25A sanitary sewer are shown on Figure 6a of the LBNL NFA/NFI request report.

12. The statement that results of soil-gas sampling conducted may be partitioning from ground water is not sufficient to justify dismissal of the data or to reduce the scope of the investigation for this particular unit.

The soil-gas sampling results were not used to "reduce the scope of the investigation" nor were the results dismissed. The soil-gas sampling was conducted as an initial site-screening tool.

Attachment 2

Memorandums from LBNL Facilities Department to Iraj Javandel,
Environmental Restoration Program Manager,
dated October 29, 1999

BERKELEY LAB

FACILITIES DEPARTMENT

MEMORANDUM October 29, 1999

To: Iraj Javandel

From: Joseph Walling and Bob Torres

Subject: Inspection of Sanitary Sewer lines east of Building 25A

As per your request, on October 14, 1999, we surveyed the sanitary sewer lines, east of Building 25A and north of Building 26, using a R.S. Technical Services Inc. 1200-series camera. As shown on the attached map, the sewer system at this location consists of two branches, one coming out of Building 25A and another one out of the restrooms and Boiler Room #2. The length of the first one is about 28ft. and the second one is approximately 38 ft. long. After joining together, the line will continue from clean out (C.O.) #3 to the Manhole #SMH2N33E which is about 137 ft. long. No defects, root intrusion or displacement was observed along any one of these three lines. All of our observations were recorded on a video tape that has been submitted to you for your record. Please contact Joseph Walling, Berkeley Lab Utility Coordinator, at 486-4842 for additional information if needed.

cc: Jackie Thomas

BERKELEY LAB

FACILITIES DEPARTMENT

MEMORANDUM October 29, 1999

To: Iraj Javandel

From: Joseph Walling and Bob Torres Robert Torres Joseph Walling

Subject: Inspection of Sanitary Sewer lines north and west of Building 51

As per your request, on October 26, 1999, we surveyed the sanitary sewer lines, north of Building 51 between Man holes # SMH11N21E and SMH11N18E and west of the building between Manholes # SMH11N18E and SMH10N18E, using an R. S. Technical Services Inc. 1200-series camera. As shown on the attached map, the effluent from the Building 51 basement sump pump has been flowing to the Manhole # SMH11N21E. From Manhole # SMH11N21E to the edge of Building 51B the line consists of 6-inch cast iron pipe with about 5 ft. cover. From there, the depth of the pipe increases to 8 ft. and at SMH11N18E the depth to the sewer line is about 10 ft. The total length of the pipes surveyed was about 440 ft. No defects, root intrusion or displacement was observed within any section of the lines inspected. All of our observations were recorded on a video tape that has been submitted to you for your record. Please contact Joseph Walling, Berkeley Lab Utility Coordinator, at 486-4842 for additional information if needed.

cc: Jackie Thomas

E.O. Lawrence Berkeley National Laboratory
University of California
Environmental Restoration Program

United States Department of Energy

REQUEST FOR
NO FURTHER ACTION (NFA) STATUS
FOR
Building 70A Sanitary Sewer
(Area of Concern 8-7)

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

September 1999

REQUEST FOR
NO FURTHER ACTION (NFA) STATUS
FOR
Building 70A Sanitary Sewer
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Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

A Joint Effort of
Environment, Health and Safety Division and
Earth Sciences Division
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

September 1999

This work was done at the Lawrence Berkeley Laboratory operated by the University of California for the U. S. Department of Energy under contract DE-AC03-76SF00098.

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ATTACHMENT 1: LBNL Response to the April 30, 1999 DTSC Notice of Deficiency, dated May 28, 1999.

ATTACHMENT 2: Memorandum from LBNL Facilities Department to Iraj Javandel, Environmental Restoration Program Manger, dated September 24, 1999.

ATTACHMENT 3: Photograph #1: Position of the Test Pit Relative to Building 70A.

Photograph #2: Location of Root Intrusion at the Top of the Sanitary Sewer Line.

SECTION 1

INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of this report is to request approval of No Further Action (NFA) status for Building 70A Sanitary Sewer (Area of Concern [AOC] 8-7), under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP) at Lawrence Berkeley National Laboratory (Berkeley Lab). The California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) is the lead regulatory agency for the CAP and has the authority to approve NFA status for this unit. If NFA status is approved, no additional sampling would be required and the unit will not be included in the site-wide risk assessment. The location of AOC 8-7 is shown on Figure 1.

Berkeley Lab initially included AOC 8-7 in a report that was submitted to DTSC in January 1999, requesting NFA or No Further Investigation (NFI) status for two Solid Waste Management Units (SWMUs) and four AOCs at Berkeley Lab (Berkeley Lab, 1999). In April 1999, DTSC responded with a Notice of Deficiency to Berkeley Lab's NFA/NFI request (DTSC, 1999). DTSC's comments on AOC 8-7 were as follows:

1. Provide diagrams with dimensions showing exact locations of samples taken with respect to suspect pipe and groundwater gradient.
2. Chemicals of potential concern listed do not correspond to all wastes generated by laboratories in Building 70A (semi conductor manufacturing) which should also include metals and cyanide.

Berkeley Lab submitted comments to DTSC's Notice of Deficiency on May 28, 1999. Berkeley Lab's responses to DTSC's comments on AOC 8-7 are attached (Attachment 1). Diagrams with dimensions showing exact locations of samples taken with respect to the sanitary sewer line and groundwater gradient are included on Figure 1 and Figure 2.

1.2 SITE DESCRIPTION AND HISTORY

The Building 70A sanitary sewer emanates from the west side of Building 70A. Potential contributors to the sewer influent have been facilities in Building 70A, including the new and inactive waste neutralization units (SWMU 8-2). Before the installation of these neutralization units, wastewater was discharged untreated to the sanitary sewer. The location of the Building 70A sanitary sewer and soil and soil-gas sampling locations are shown on Figure 1.

1.3 CONSTITUENTS OF POTENTIAL CONCERN (COPCs)

The COPCs are halogenated VOCs, acid wastes, metals, and radioactive constituents.

1.4 GEOLOGY AND HYDROGEOLOGY

The geology consists of Great Valley Group shale that extends from beneath the asphalt base rock at the surface to a depth of 50 feet. Below the shale are interlayered siltstones, fine-grained sandstones, and shales also of the Great Valley Group. The approximate groundwater gradient is illustrated on Figure 1. Depth to groundwater was measured at 122 feet in MW70A-96-14 during the third quarter of FY99. Based on results of slug tests conducted in monitoring wells, the Great Valley Group at Berkeley Lab has a hydraulic conductivity of 10^{-5} to 10^{-7}m/s.

1.5 SCREENING PROCESS FOR NO FURTHER ACTION (NFA) OR NO FURTHER INVESTIGATION (NFI) STATUS

After sampling has been completed to assess whether a release has occurred at a SWMU or AOC, and the magnitude and extent of any contamination have been evaluated, the unit is screened in accordance with the DTSC approved procedure described in the following paragraphs. The purpose of the screening is to determine whether the unit should be recommended for either NFA or NFI status. The first step is to compare the detected concentrations of analytes to Berkeley Lab background levels. The second step is to compare concentrations above background levels to United States Environmental Protection Agency (USEPA) Region IX Preliminary Remediation Goals (PRGs) for residential soil (USEPA, 1998).

Soil analytical data are compared to background levels to determine if contamination is present. For compounds that are not naturally occurring, such as most organic compounds, any detection is assumed to be contamination, unless another source, such as laboratory contamination of the sample, can be verified. For naturally occurring analytes such as metals, detected concentrations are compared to statistically-derived background levels to identify, with a certain degree of confidence, which constituents are present at concentrations that represent contamination. Berkeley Lab has used the 95% upper tolerance limit method (USEPA, 1989) to estimate background concentrations of metals in soil (Berkeley Lab, 1995).

Concentrations of analytes detected above background levels are then compared to USEPA Region IX PRGs (USEPA, 1998) or Cal-Modified PRGs for residential soil, where Region IX PRGs either have not been established, or are greater than the Cal-modified values. To implement a conservative approach to site screening, Berkeley Lab uses PRGs established for residential soils instead of less-stringent PRGs for soil at industrial sites.

Where concentrations of contaminants in soil are within Berkeley Lab background levels or below PRGs for residential soil, the SWMU or AOC is recommended for NFA status. Where concentrations of contaminants in soil are above both Berkeley Lab background levels and PRGs for residential soil, the SWMU or AOC is recommended for NFI status. No further site characterization will be required by DTSC for SWMUs and AOCs approved for either NFA or NFI status. SWMUs and AOCs approved for NFI status will be included in the risk assessment to be conducted as part of the Corrective Measures Studies (CMS) phase of the RCRA CAP. SWMUs and AOCs that are approved for NFA status will not be included in the CMS.

SECTION 2

SEWER LINE INVESTIGATIONS

2.1 INTRODUCTION

The following approach was followed to investigate whether a release had occurred from the Building 70A Sanitary Sewer. The approach is consistent with Berkeley Lab's response to DTSC's comments (Attachment 1) and discussions held with the DTSC and the City of Berkeley at Berkeley Lab on July 1, 1999.

1. Conduct a video survey of sewer line to identify dislocations, breaks or perforations caused by corrosion.

2. If dislocations, breaks, or perforations are identified by the survey, additional sampling will be conducted. If no dislocations, breaks, or perforations are identified the unit would be submitted for NFA status.

2.2 RESULTS OF VIDEO SURVEY AND RECENT SOIL SAMPLING

On September 15, 1999, Berkeley Lab conducted a video survey of the Building 70A Sanitary Sewer. The details of the survey and results are attached in a memorandum (Attachment 2). The only compromise to the integrity of the pipe identified by the survey was a root intrusion at a joint approximately 160 feet downflow from Building 70A. A test pit was dug at the location of the root intrusion to allow the collection of soil samples from beneath the pipe. The location of the test pit is shown on Figure 1. Photographs of the position of the test pit relative to Building 70A and the location of root intrusion at the top of the sanitary sewer line are included in Attachment 3. No leakage from the sewer line was observed in the test pit.

Soil samples were collected at two locations in the pit immediately beneath the sewer line. Samples at both locations were analyzed for volatile organic compounds (VOCs) (EPA Method 8260); metals; pH; and gross alpha, gross beta, and gamma radiation. Analytical results are included in Table 1 (VOCs and pH), Table 2 (metals), and Table 3 (radionuclides). The pH measured was neutral (7.5 and 7.6). Concentrations of metals detected were within Berkeley

Lab background levels. No VOCs were detected. Gross alpha radiation was not detected. Gross beta radiation was reported as consistent with the amount of naturally occurring potassium 40 and products of decay of naturally occurring radionuclides found in the sample. Gamma radiation was reported as naturally occurring radionuclides. Based on the results of the video survey and the soil sampling there is no indication that a chemical release has occurred from the sewer line.

SECTION 3

SUPPLEMENTAL ENVIRONMENTAL INVESTIGATIONS

3.1 SUMMARY OF INVESTIGATIONS

Soil, groundwater, and soil-gas sampling locations related to the Building 70A Sanitary Sewer are shown on Figure 1. In 1995, ten shallow soil-gas probes were installed along the Building 70A Sanitary Sewer line. Soil-gas samples collected from each of the probes were analyzed for fuels and VOCs. Based on the results of soil-gas sample analysis, shallow soil samples were collected in October 1996 at five locations along the sewer line (SB70A-96-1, -2, -3, -4, and -5 on Figure 1), at approximately 1 to 3 feet below the invert elevation of the sewer line (5 to 7 feet bgs) (Figure 2). Soil samples were analyzed for VOCs, metals, pH, and gross alpha, gross beta, and gamma radiation.

Two groundwater monitoring wells (MW70A-96-13 and MW70A-96-14) were installed west of Building 70A in 1996, downgradient from the Building 70A Sanitary Sewer (Figure 1). Soil samples from the well borings were analyzed for VOCs and metals.

3.2 RESULTS

Analytical results are included in Table 1 (VOCs and pH), Table 2 (metals), and Table 3 (radionuclides). Concentrations of VOCs detected, levels of pH, and concentrations of metals detected above background levels are shown on Figure 2 (cross section along the sewer line and plan view of the test pit).

<u>Soil-Gas</u>

Traces (38 to 206 ppbv total) of VOCs were detected in all soil-gas samples. The maximum concentrations detected were 120 ppbv perchloroethylene (PCE), 86 ppbv 1,1,1-trichloroethane (TCA), 13 ppbv trichloroethylene (TCE), 21 ppbv m,p-xylenes, 6.8 ppbv o-xylene, 25 ppbv 1,2,4-trimethylbenzene, and 6.5 ppbv 1,3,5-trimethylbenzene. TPH-G was detected at concentrations of 94 ppbv to 450 ppbv.

Soil

No VOCs were detected. Levels of pH, measured in soil were neutral (7.4 to 7.7). Cobalt, copper, mercury, and zinc were detected at concentrations above Berkeley Lab site background levels. The copper and mercury were within the background levels of the Great Valley Group. Only one zinc and one cobalt sample were above the background levels of the Great Valley Group, the geologic unit where the samples were collected; however, these samples were only approximately 2% to 4% above the background level. None of these metals were detected at concentrations above the PRGs for residential soil. Gross alpha radiation was not detected and gross gamma radiation (27 ±13 to 36 ±15 pCi/g) was reported as naturally occurring potassium-40 (^{40}K). Gross beta radiation detections ranged from 14 ±2 to 23 ±2 pCi/g.

Groundwater

No VOCs have been detected in groundwater samples collected from MW70A-96-13 or MW70A-96-14 in quarterly groundwater sampling since January 1997.

SECTION 4

RATIONALE FOR NFA RECOMMENDATION

NFA status is recommended for the Building 70A Sanitary Sewer (AOC 8-7). Berkeley Lab followed the methodology specified in Berkeley Lab's response to DTSC's comments (Attachment 1) and discussions held with the DTSC and the City of Berkeley at Berkeley Lab on July 1, 1999 to investigate whether a release had occurred from the Building 70A Sanitary Sewer.

1 Conduct a video survey of sewer line to identify dislocations, breaks or perforations caused by corrosion.

2 If dislocations, breaks, or perforations, are identified by the survey, additional sampling would be conducted.

Based on the results of the video survey and the associated soil sampling there is no indication that a chemical release has occurred from the sewer line. The video survey indicated only one location where the integrity of the pipe was compromised. Soil samples were collected from soil immediately beneath the pipe at the location of the root intrusion that was identified, to evaluate whether a chemical release had occurred. No VOCs were detected. Metals were within background levels and pH was neutral.

Supplemental information to support the NFA request includes the following:

- The sanitary sewer line at the location of the root intrusion was repaired on September 25, 1999.
- No groundwater contamination has been detected in the two groundwater monitoring wells downgradient from the sanitary sewer line.
- No VOCs were detected in soil samples collected from the 1996 borings drilled adjacent to, and sampled beneath, the invert elevation of the sanitary sewer line. Levels of pH, measured in the soil were neutral. Cobalt, copper, mercury, and zinc were detected at concentrations above Berkeley Lab site background levels (but below PRGs for residential soil). The copper and mercury were within the background levels of the Great Valley Group, the geologic unit where the samples were collected. Only one zinc and one cobalt sample were above the background

levels of the Great Valley Group; however, these samples were only approximately 2% to 4% above the statistically determined Great Valley Group background level.

SECTION 5

REFERENCES

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Figure 2. Cross Section Along Building 70A Sanitary Sewer Line (AOC 8-7) and Details of Test Pit Showing Sampling Results.

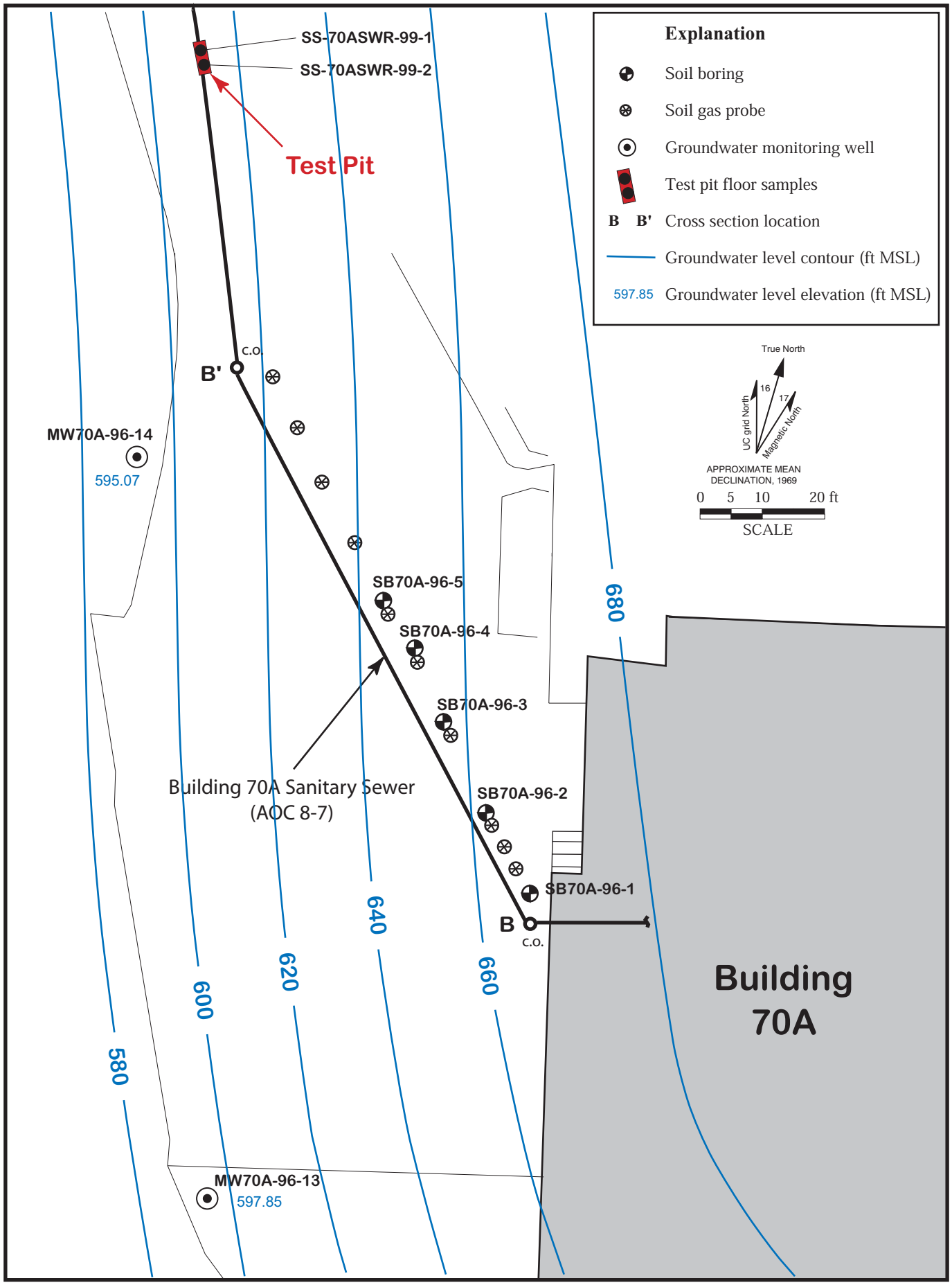

Figure 1. Locations of Test Pit, Soil Borings, Soil Gas Probes, and Monitoring Wells with Water Level Elevation Contours (3rd Quarter FY1999), Building 70A Sanitary Sewer (AOC 8-7).

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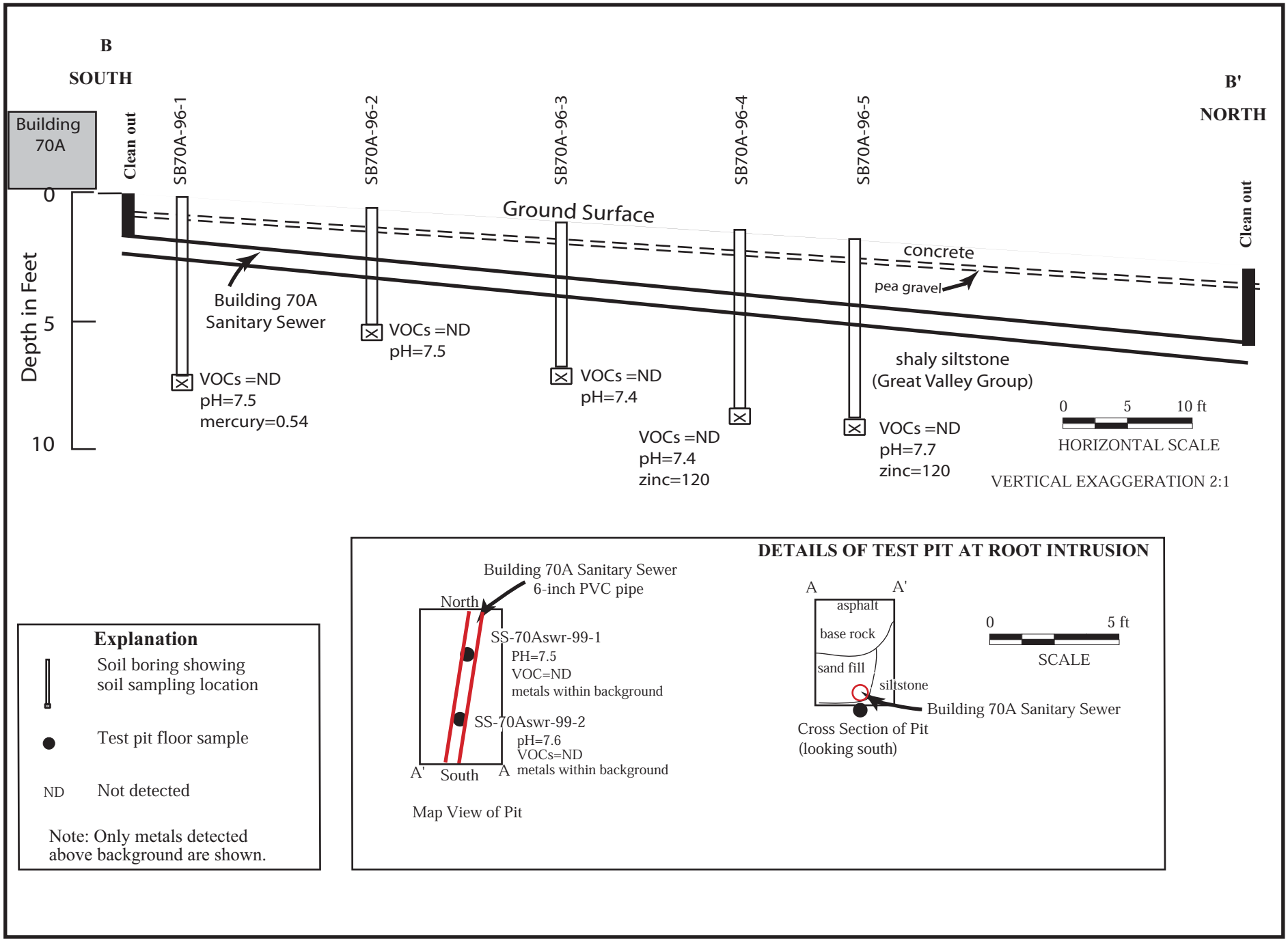

Figure 2. Cross Section Along Building 70A Sanitary Sewer Line (AOC 8-7) and Details of Test Pit Showing Sampling Results

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Table 1.
Soil Sampling Results for VOCs and pH
AOC 8-7: Building 70A Sanitary Sewer System

		Analyte	VOCs	pH
		Method	8260	9040
Boring/Sample	**Date**	**Lab**	**mg/kg**	**S.U.**
SB70A-96-1-7	Oct-96	CLS	ND	7.5
SB70A-96-2-5	Oct-96	CLS	ND	7.5
SB70A-96-3-5.5	Oct-96	CLS	ND	7.4
SB70A-96-4-7	Oct-96	CLS	ND	7.4
SB70A-96-5-7	Oct-96	CLS	ND	7.7
MW70A-96-13-8.2	Sep-96	BC	ND	
MW70A-96-13-18			ND	
MW70A-96-13-48			ND	
MW70A-96-13-68			ND	
MW70A-96-13-78			ND	
MW70A-96-14-10	Sep-96	BC	ND	
MW70A-96-14-20.5			ND	
MW70A-96-14-30			ND	
MW70A-96-14-40			ND	
SS-70ASWR-99-1-4.0	Sep-99	BC	ND	7.51
SS-70ASWR-99-2-3.6	Sep-99	BC	ND	7.62

BC = Analysis by BC Laboratories

CLS= Analysis by California Laboratory Services

ND	= Not detected
	= Not analyzed

Table 2.
Soil Sampling Results for Metals
AOC 8-7: Building 70A Sanitary Sewer System
(Concentrations in mg/kg)

		Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Maximum Background Concentrations		5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs		30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs						9		0.2			130			150					
Boring/Sample	**Date**																		
SB70A-96-1-7	Oct-96	<0.9	<1	170	0.94	<1	36	NA	18	48	10	0.54	<4	44	<1	<0.4	<1	52	100
SB70A-96-2-5	Oct-96	<0.9	4.1	120	0.85	<1	26	NA	14	34	13	<0.2	<4	37	<1	<0.4	<1	39	80
SB70A-96-3-5.5	Oct-96	<0.9	2.1	150	0.73	<1	29	NA	16	41	11	<0.2	<4	37	<1	<0.4	<1	43	97
SB70A-96-4-7	Oct-96	<0.9	2.1	130	0.91	<1	36	NA	22	59	12	<0.2	<4	45	<1	<0.4	<1	51	120
SB70A-96-5-7	Oct-96	<0.9	1.7	83	0.84	<1	34	NA	18	60	12	<0.2	<4	48	<1	<0.4	<1	49	120
MW70A-96-13-8.2	Sep-96	<10	14	178	<1	<1	40	NA	15	44	12	<0.2	<5	34	2.4	<2	<10	48	92
MW70A-96-13-18		<10	18	170	<1	<1	33	NA	13	45	14	<0.2	<5	39	2.2	<2	<10	43	103
MW70A-96-13-48		<10	18	32	<1	<1	17	NA	<5	19	<5	<0.2	<5	8.7	1.1	<2	<10	20	42
MW70A-96-13-68		<10	14	138	<1	<1	64	NA	16	61	14	<0.2	<5	67	2.5	<2	<10	59	105
MW70A-96-13-78		<20	12	75	<2	<2	68	NA	15	63	15	<0.2	<10	67	3.4	<4	<20	65	122
MW70A-96-14-10	Sep-96	<10	12	188	<1	<1	43	NA	26	60	14	<0.2	<5	51	3.0	<2	<10	59	127
MW70A-96-14-20.5		<10	9.3	110	<1	<1	40	NA	18	80	13	<0.2	<5	56	2.4	<2	<10	52	142
MW70A-96-14-30		<10	10	179	<1	<1	44	NA	18	44	9.2	<0.2	<5	52	2.6	<2	<10	59	109
MW70A-96-14-40		<10	8.9	137	<1	<1	44	NA	19	49	10	<0.2	<5	57	2.6	<2	<10	53	109
SS-70ASWR-99-1-4.0	Sep-99	<10	10	173	<1	<1	34	NA	13	14	12	<0.2	<5	41	<1	<2	<10	50	88
SS-70ASWR-99-2-3.6		<10	9.5	181	<1	<1	40	NA	14	46	13	<0.2	<5	45	<1	<2	<10	63	90

NA	= Not analyzed
<5	= Not detected (reporting limit shown)
25	= Concentration above background but below PRG.

Table 3.

Results of Radionuclides Analyses of Soil Samples

AOC 8-7: Building 70A Sanitary Sewer System

Sample Number	DATE	Gross Alpha	Gross Beta	Gamma
		All results are in units of picocuries per gram (pCi/g)		
SB70A-96-1-7	**Oct 96**	<10	**19 ± 2**	**36 ± 15**
SB70A-96-2-5	**Oct 96**	<10	**15 ± 2**	**30 ± 15**
SB70A-96-3-5.5	**Oct 96**	<10	**14 ± 2**	**27 ± 13**
SB70A-96-4-7	**Oct 96**	<10	**21 ± 2**	**27 ± 13**
SB70A-96-5-7	**Oct 96**	<10	**23 ± 2**	**31 ± 15**
SS-70ASWR-99-1	**Sep 99**	<10	**6 ± 1**	**K-40=5.2 ± 0.7** **Th-232=0.5 ± 0.4** **U-nat=0.7 ± 0.3**
SS-70ASWR-99-2	**Sep 99**	<10	**9 ± 2**	**K-40=5.4 ± 0.7** **Th-232=0.17 ± 0.07** **U-nat=0.5 ± 0.3**

Note: All gamma results were reported as naturally-occurring elements

< = not detected (less than method detection amount).

Analyses performed by Lawrence Berkeley Laboratory Analytical Services Group.

Attachment 1

LBNL Response to the April 30, 1999 DTSC Notice of Deficiency,
dated May 28, 1999

For AOC 8-7, BLDG. 70A Sanitary Sewer

11. Provide diagrams with dimensions showing exact location of samples taken with respect to suspect pipe and groundwater gradient.

LBNL Response

Scale drawings showing the locations (horizontal and vertical) of samples with respect to the pipe and locations (horizontal) of samples relative to the groundwater gradient will be provided in a revised NFA/NFI request report.

12. Chemicals of potential concern (COPC's) listed do not correspond to all wastes generated by laboratories in Building 70A (semi conductor manufacturing) which should also include metals and cyanides.

LBNL Response

The DTSC RFA states that the Building 70A semi-conductor fabrication laboratories discharged acid wastes into the sanitary sewer until 1985, when an acid neutralization unit was built to treat these wastes. Various waste acids (nitric, hydrofluoric, and hydrochloric) were the only wastes discharged to the Building 70A sanitary sewer identified in the DTSC RFA. The LBNL RFA discusses surveys in 1977 and 1991 of the LBNL sanitary sewer system that were conducted to identify areas of corrosion or breakage. No corroded or damaged segments were identified along the Building 70A sanitary sewer.

Soil samples were collected adjacent to the Building 70A sanitary sewer line during the RFI and analyzed for pH to address possible releases of acid wastes. If a release(s) of acid waste had occurred from the line, low soil pH values would be the defining indicator of a release. Levels of pH measured were neutral to slightly basic. Soil samples were also analyzed for metals, as described in the NFA/NFI request report. Soil samples were not analyzed for cyanide; however, it is unlikely that cyanide would have been disposed in the sanitary sewer with acid waste, since cyanide gas would likely have been produced from the reaction between cyanide and acids. All analytical results are given in the NFA/NFI request report.

Proposed Work

Although no investigations were required for AOC 8-7 in the DTSC RFA or LBNL RFI Work Plan, LBNL will conduct additional investigations to address DTSC concerns. LBNL will use a two-phase approach to further evaluate whether the Building 70A sanitary sewer line has released waste. First, LBNL will conduct a survey of the Building 70A sanitary sewer line to identify any dislocations, breaks, or perforations caused by corrosion. If dislocations, breaks, or perforations are identified by the survey, a workplan will be prepared and submitted to DTSC for additional sampling. If no dislocations, breaks, or perforations are identified, AOC 8-7 will be resubmitted for NFA status.

Attachment 2

Memorandum from LBNL Facilities Department to Iraj Javandel,
Environmental Restoration Program Manager,
dated September 24, 1999

BERKELEY LAB

FACILITIES DEPARTMENT

MEMORANDUM September 24, 1999

To: Iraj Javandel

From: Bob Torres Robert Torres

Subject: Sanitary Sewer Inspection

As per your request, Joe Walling and I inspected the sanitary sewer line west of Building 70A on September 15, 1999, using an R.S. Technical Services Inc. 1200-Series camera. The first section of the line consisted of 90 feet of cast iron pipe. No defects, root intrusion or displacement was observed in this section. The following section of the line consisted of 70 feet of PVC (Schedule 80) pipe. A root intrusion was observed at a joint of this section located about 55 feet from the cast iron / PVC connection cleanout. All of our observation were recorded on a video tape submitted to you. Please contact Joe Walling (Berkeley Lab Utility Coordinator) at 486-4842 for additional information if needed.

Attachment 3

Photograph #1: Position of the Test Pit Relative to Building 70A.

Photograph #2: Location of Root Intrusion at the Top of the Sanitary Sewer Line.

Photograph #1: Position of the Test Pit Relative to Building 70A.

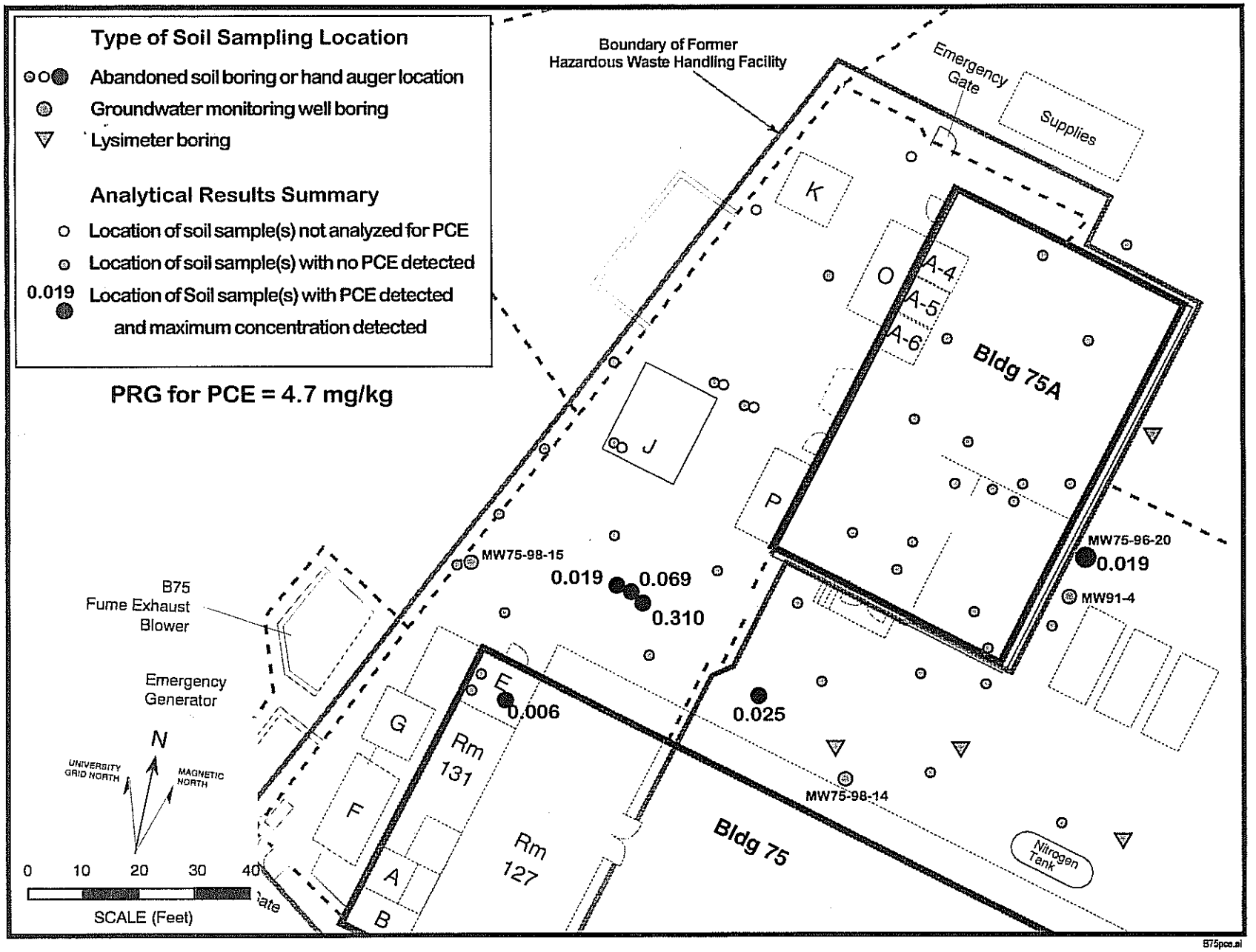
Photograph #2: Location of Root Intrusion at the Top of the Sanitary Sewer Line.

APPENDIX A

Maps Showing the Locations and Concentrations of Analytes (Excluding PCBs) Detected in Soil Samples

(Berkeley Lab, 1999f)

Halogenated and Non-Aromatic Hydrocarbons



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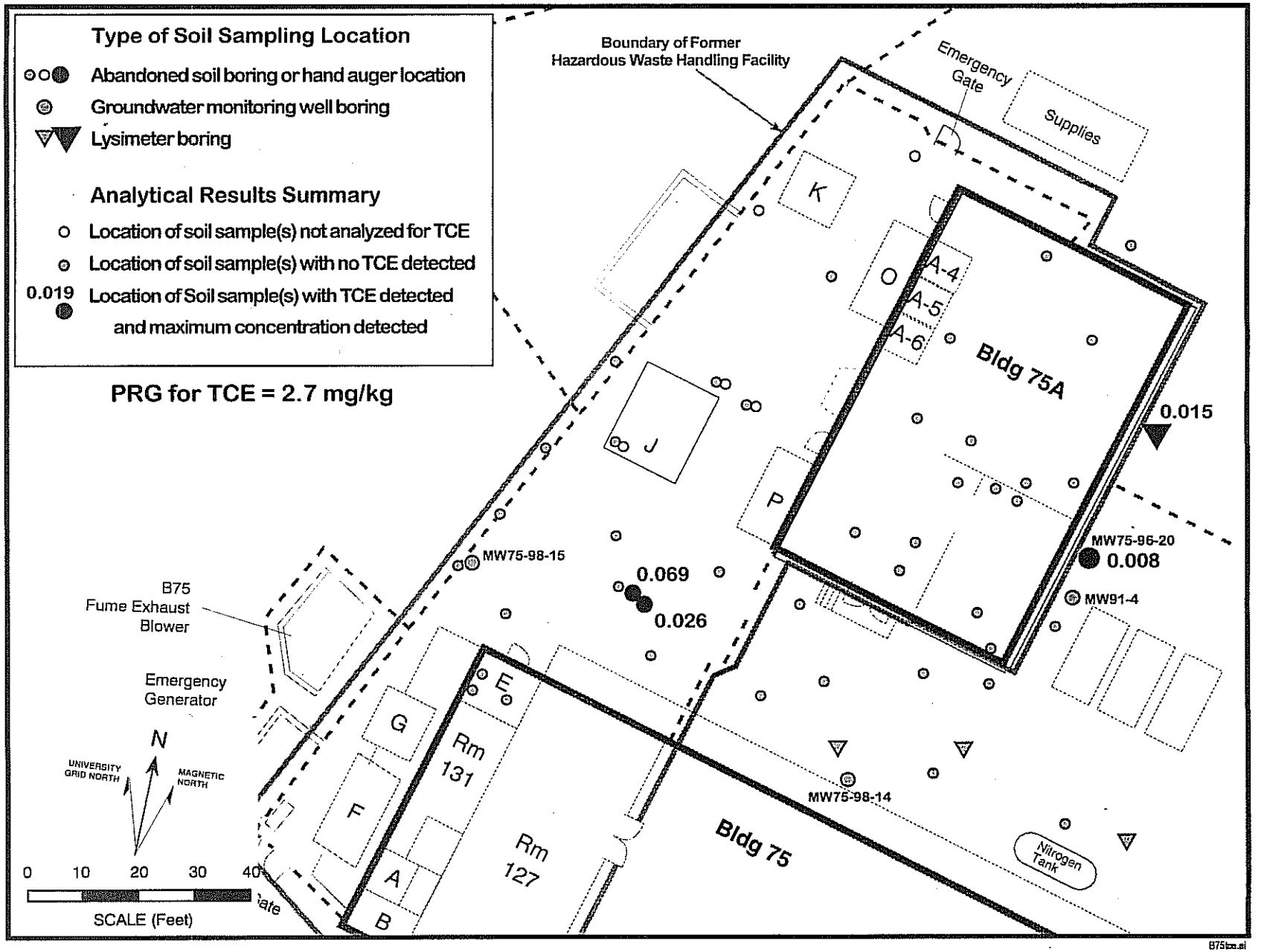
PCE in Soil, Building 75 Former Hazardous Waste Handling Facility



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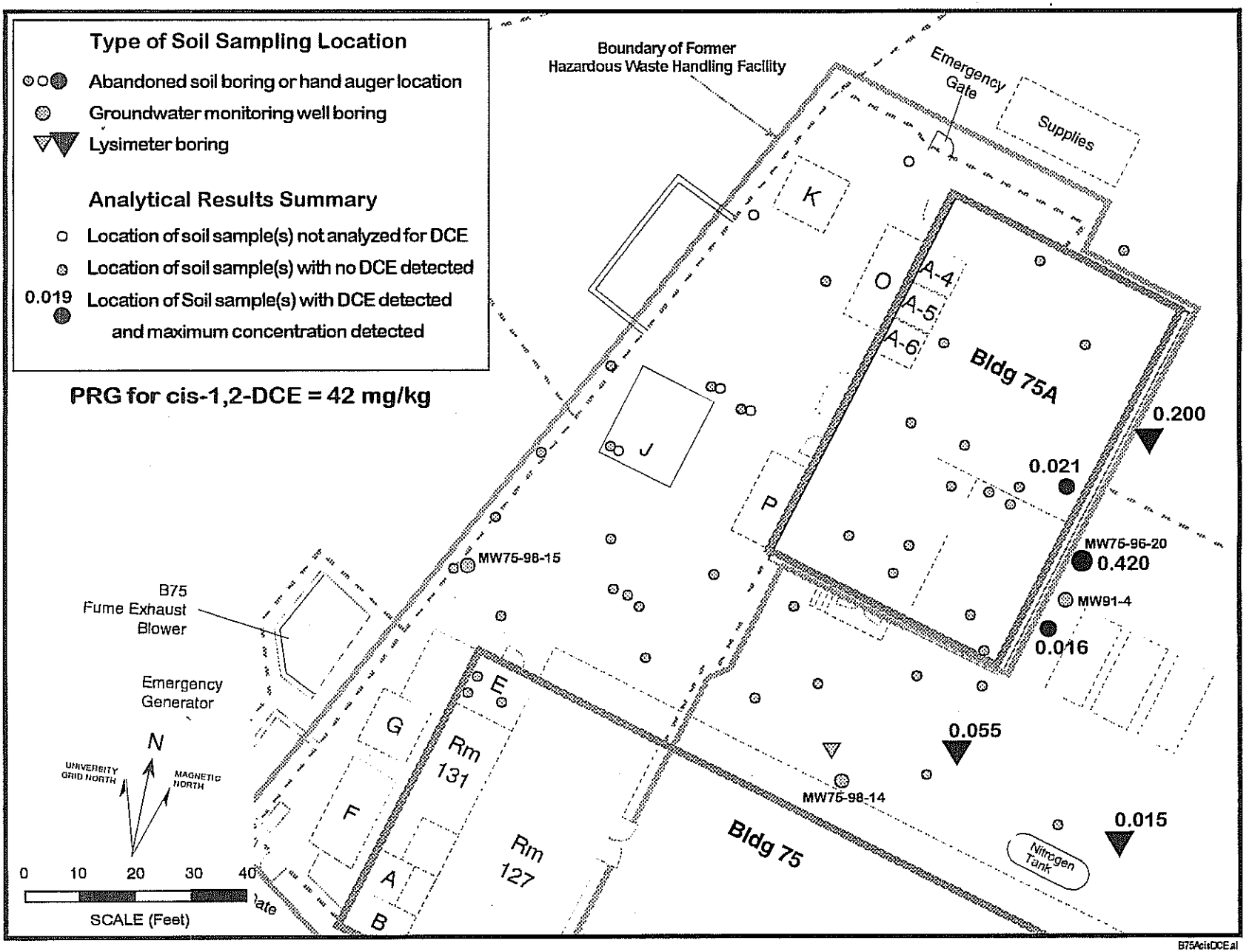
TCE in Soil, Building 75 Former Hazardous Waste Handling Facility



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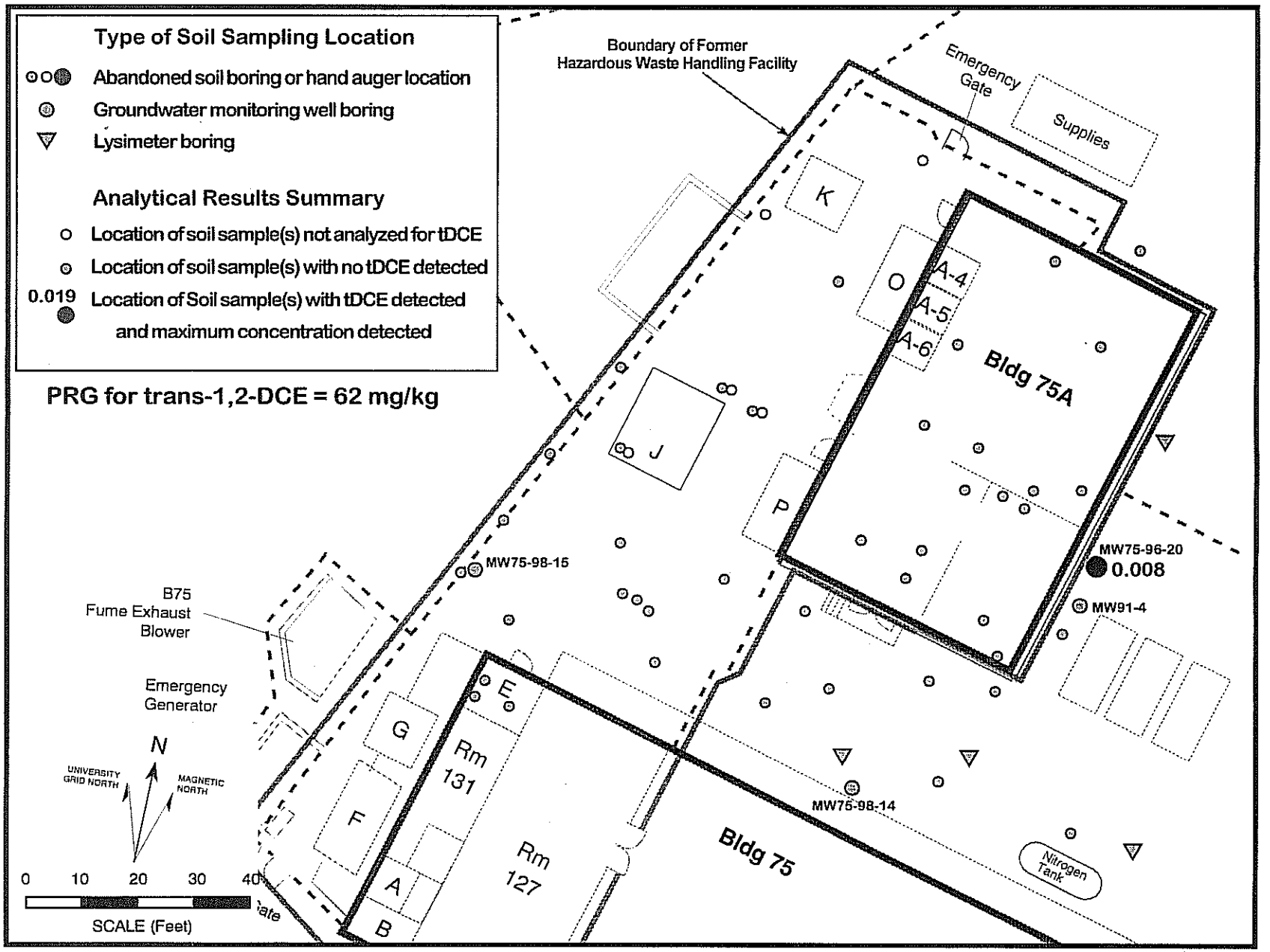

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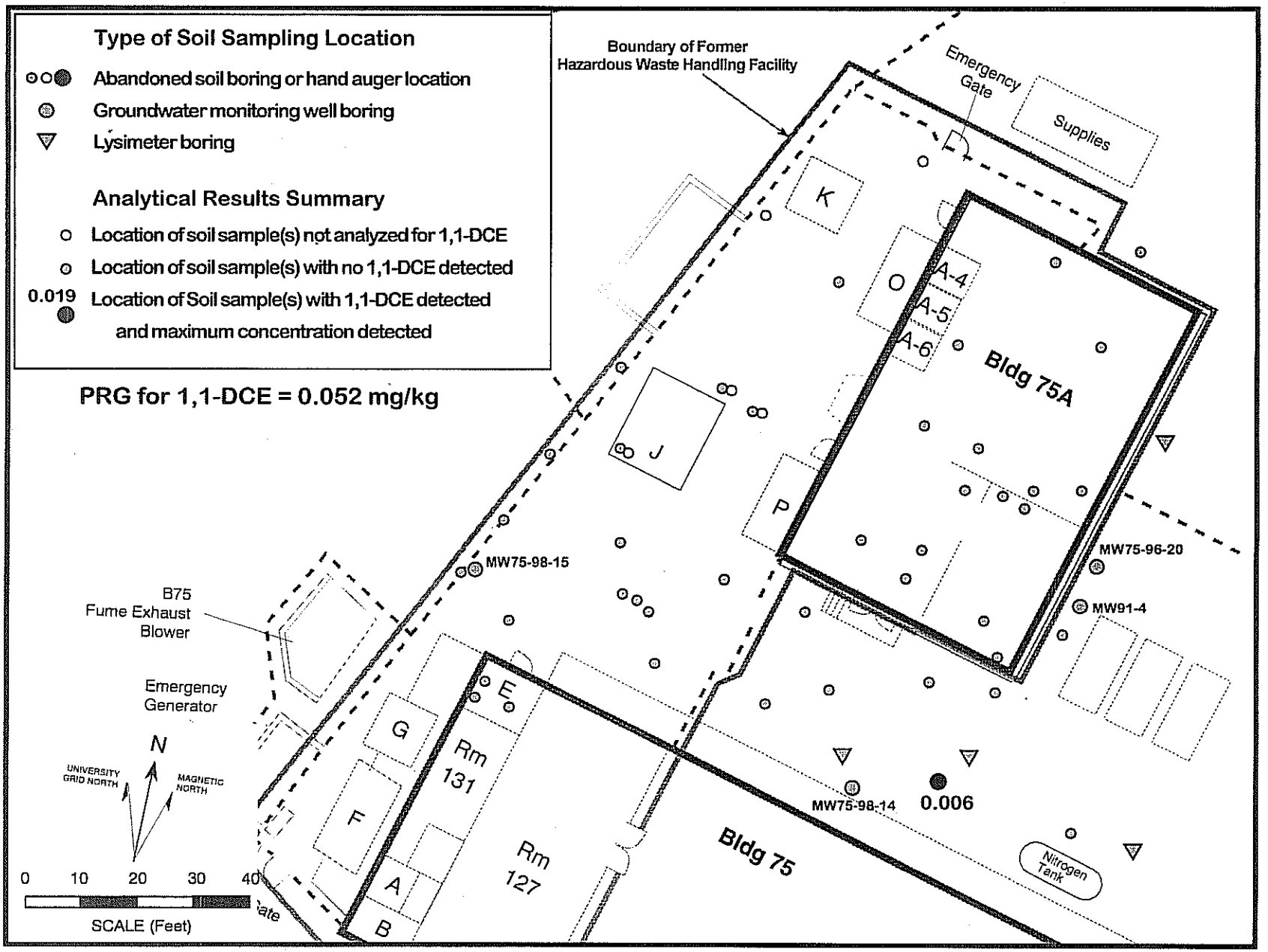
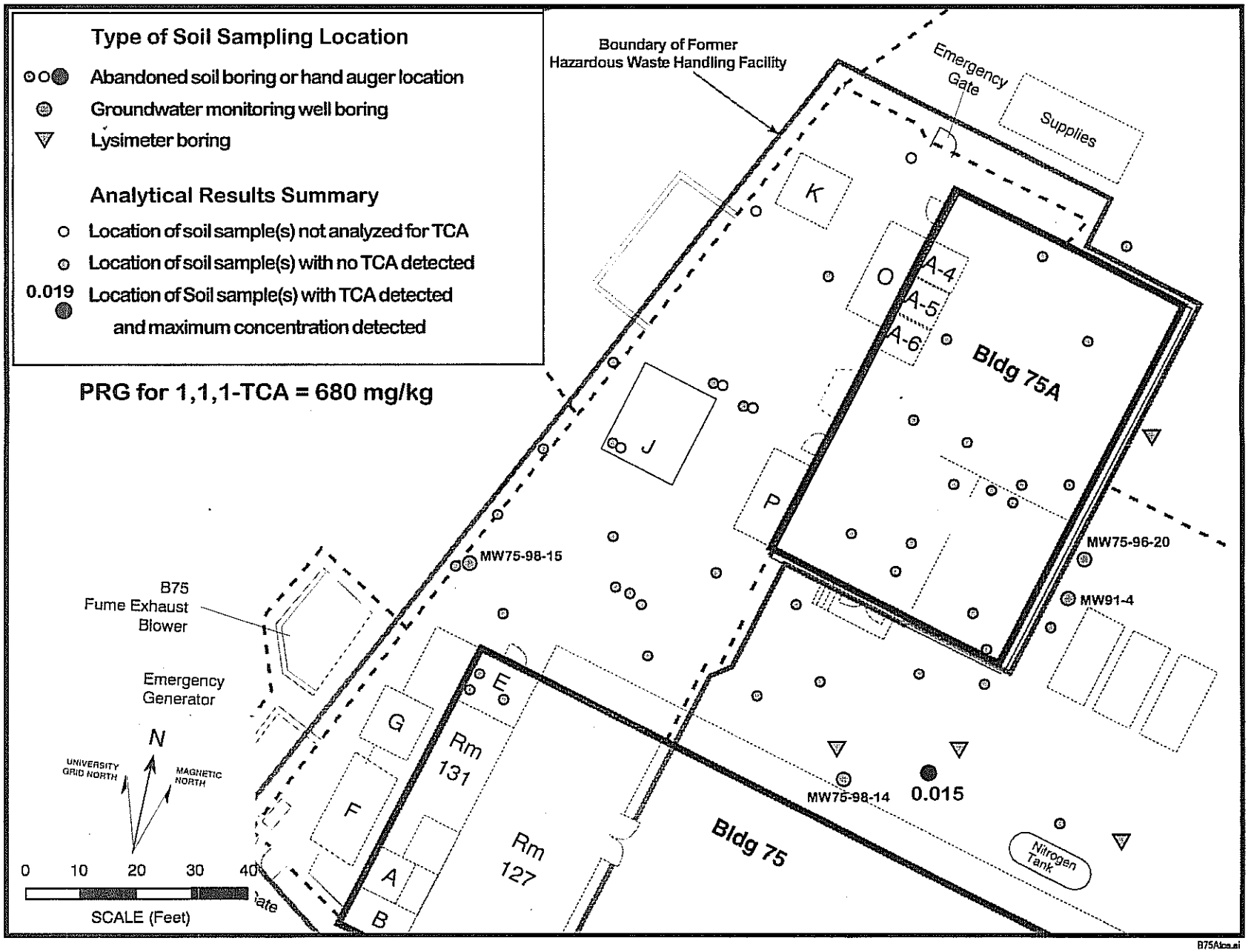


1,1-DCE in Soil, Building 75 Former Hazardous Waste Handling Facility



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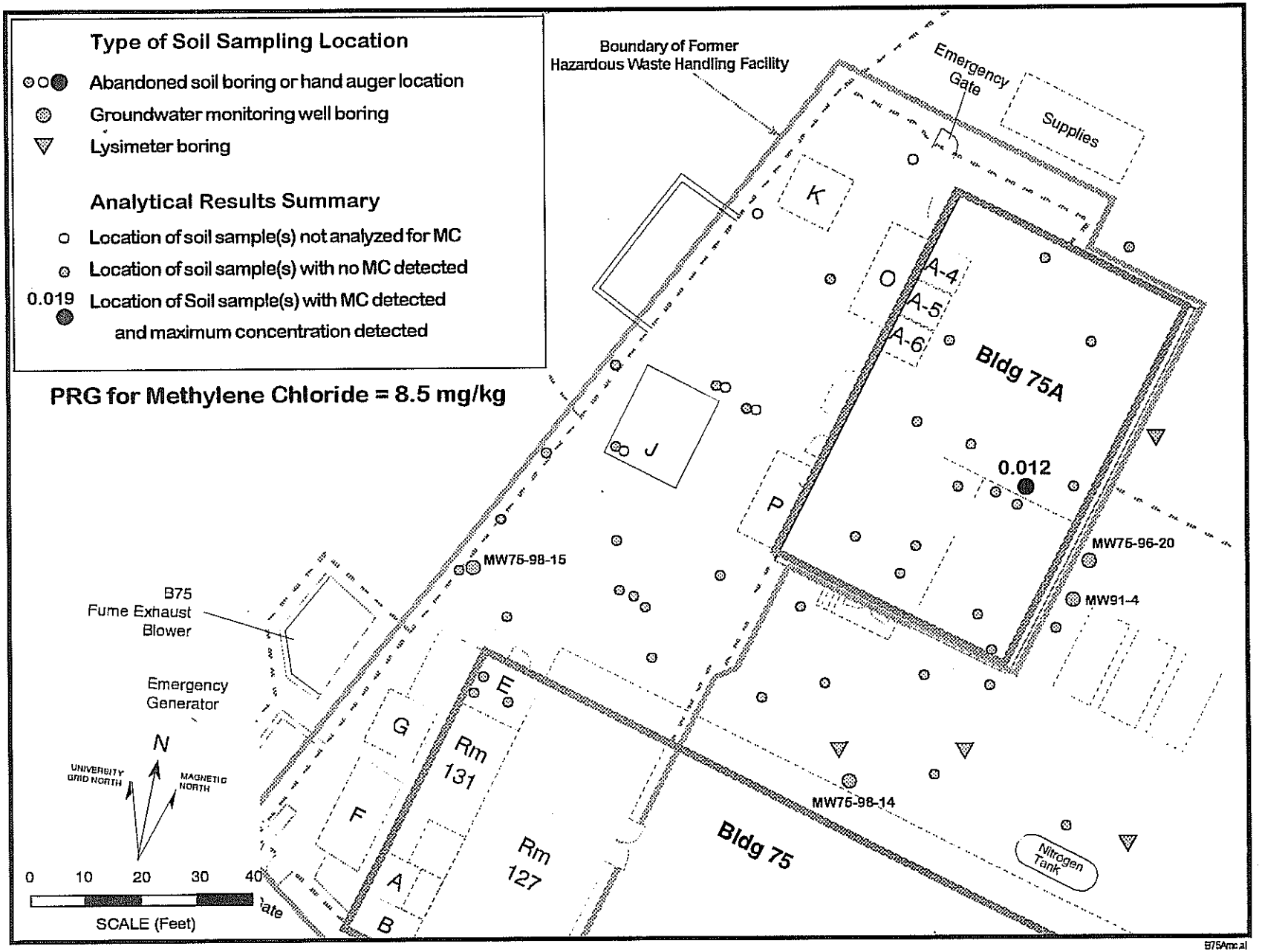
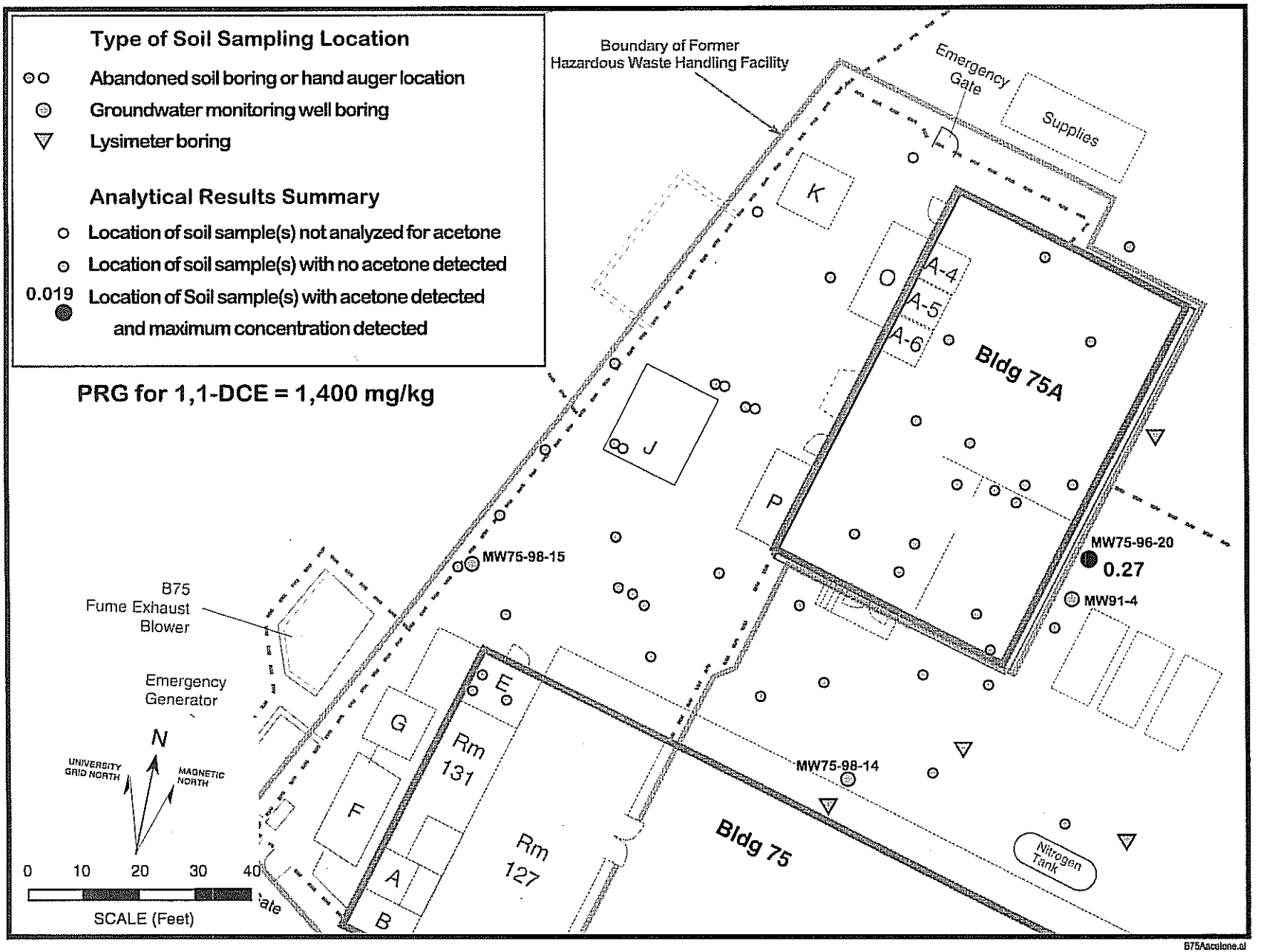


Methylene Chloride in Soil, Building 75 Former Hazardous Waste Handling Facility



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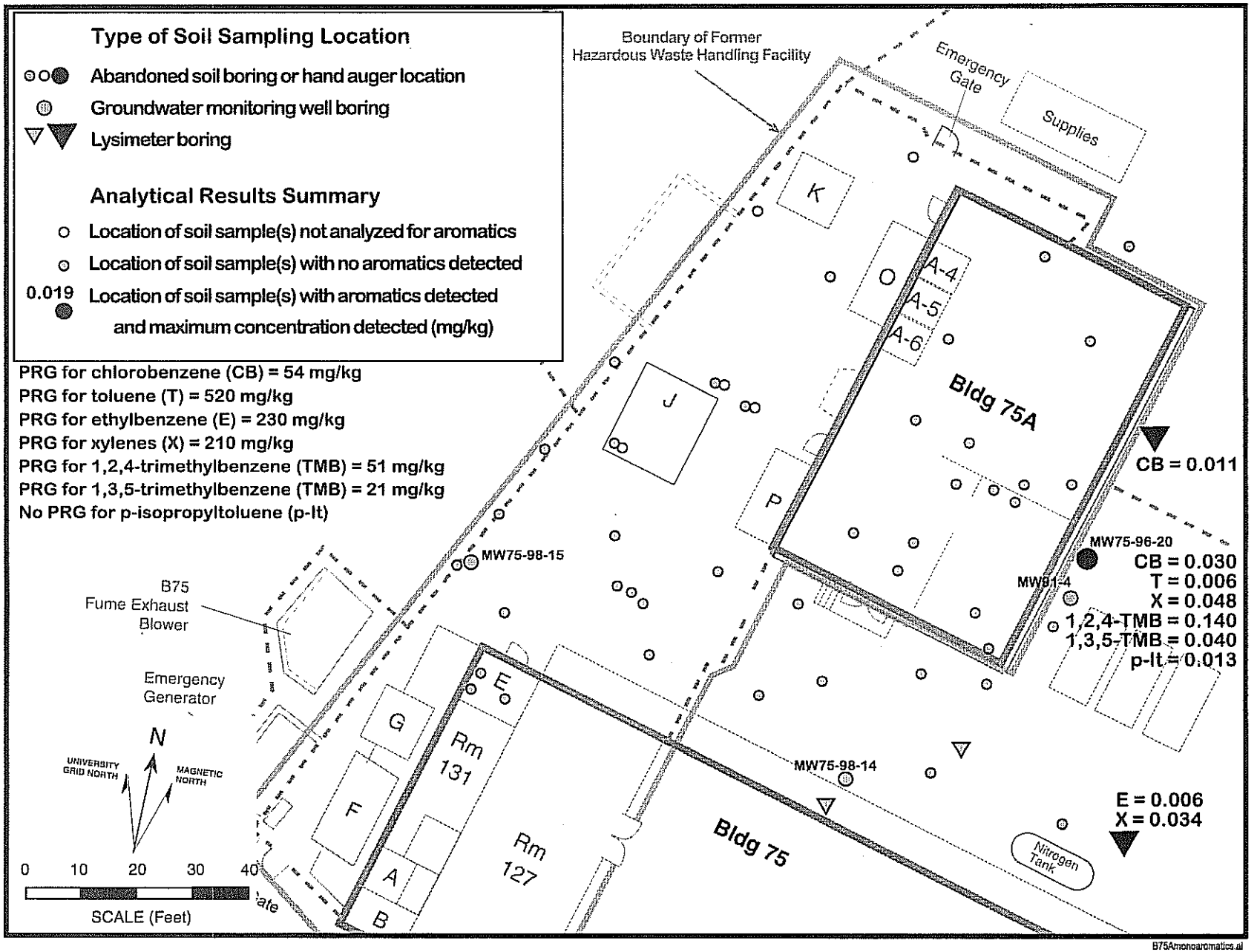
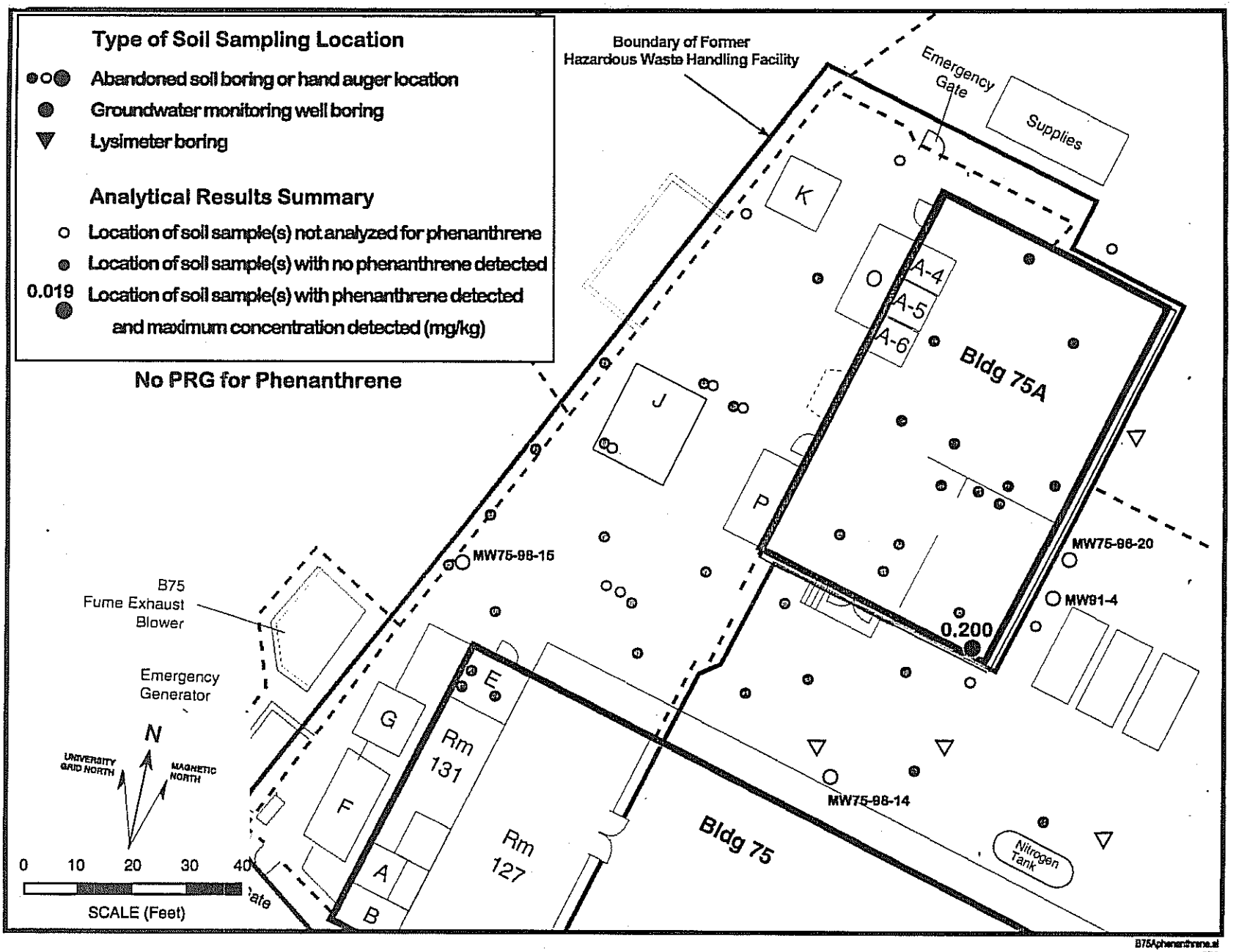
Acetone in Soil, Building 75 Former Hazardous Waste Handling Facility

Monoaromatic Hydrocarbons



Monoaromatics in Soil, Building 75 Former Hazardous Waste Handling Facility

Semi-Volatile Organic Compounds



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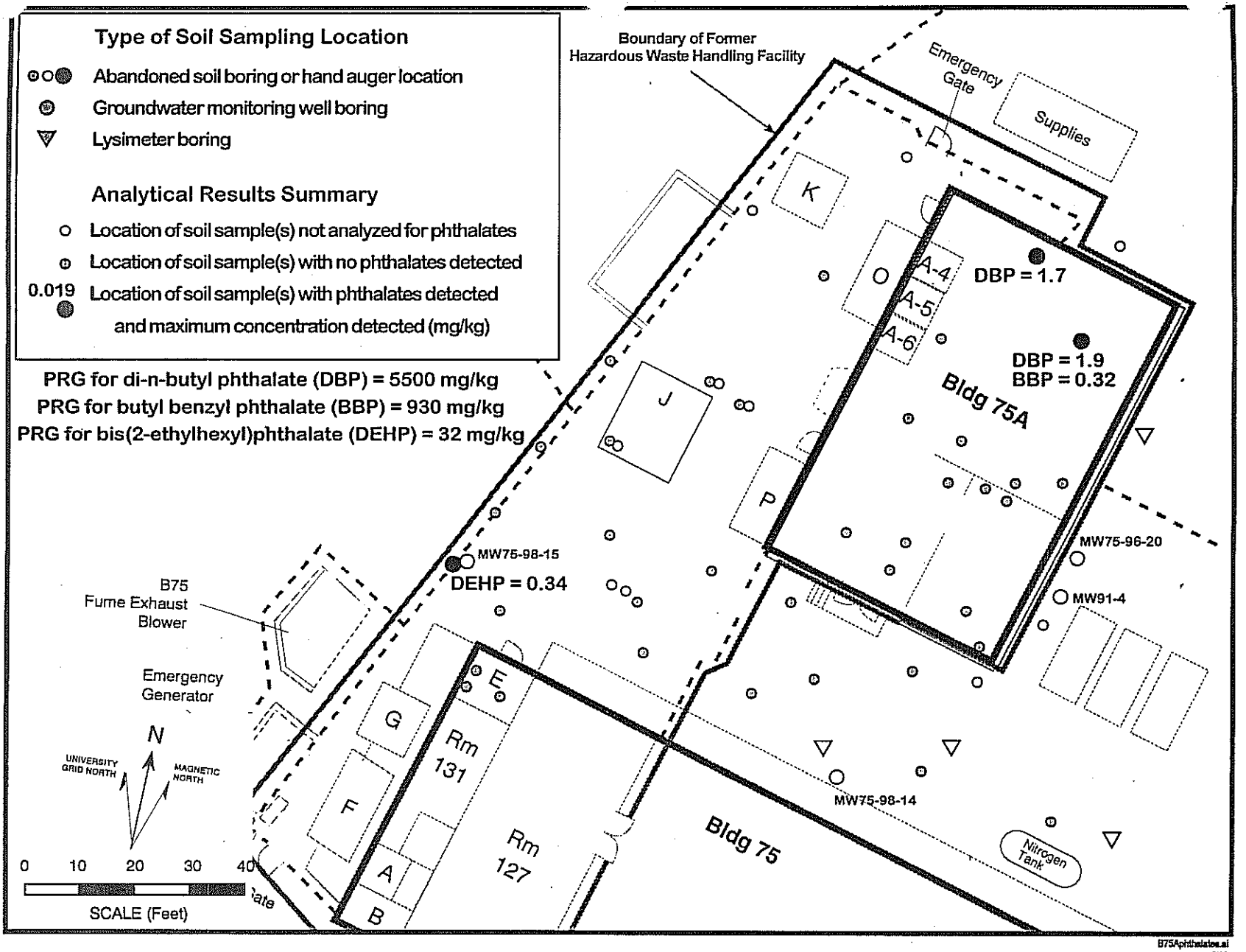
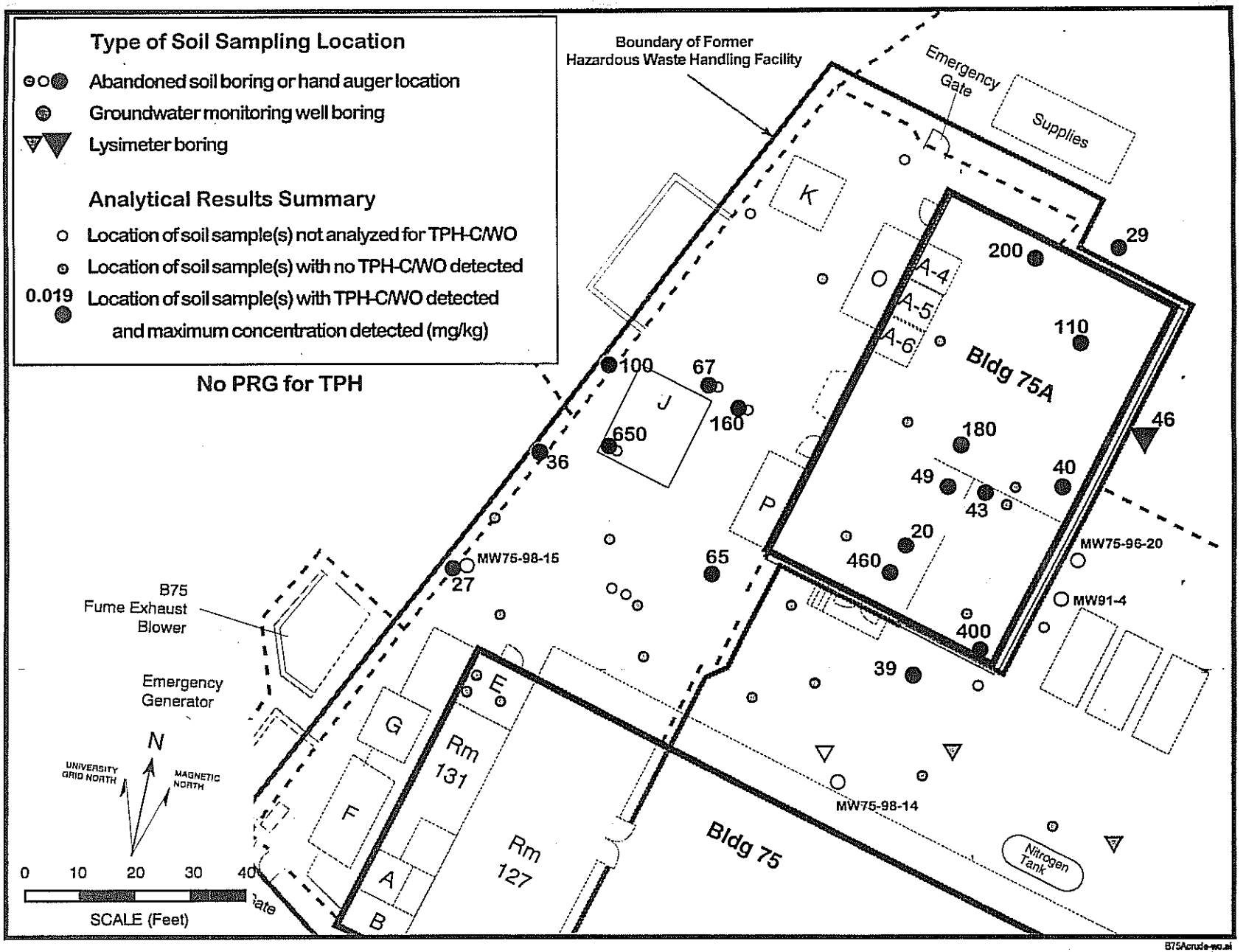
Phenanthrene in Soil, Building 75 Former Hazardous Waste Handling Facility



Phthalates in Soil, Building 75 Former Hazardous Waste Handling Facility

Total Petroleum Hydrocarbons



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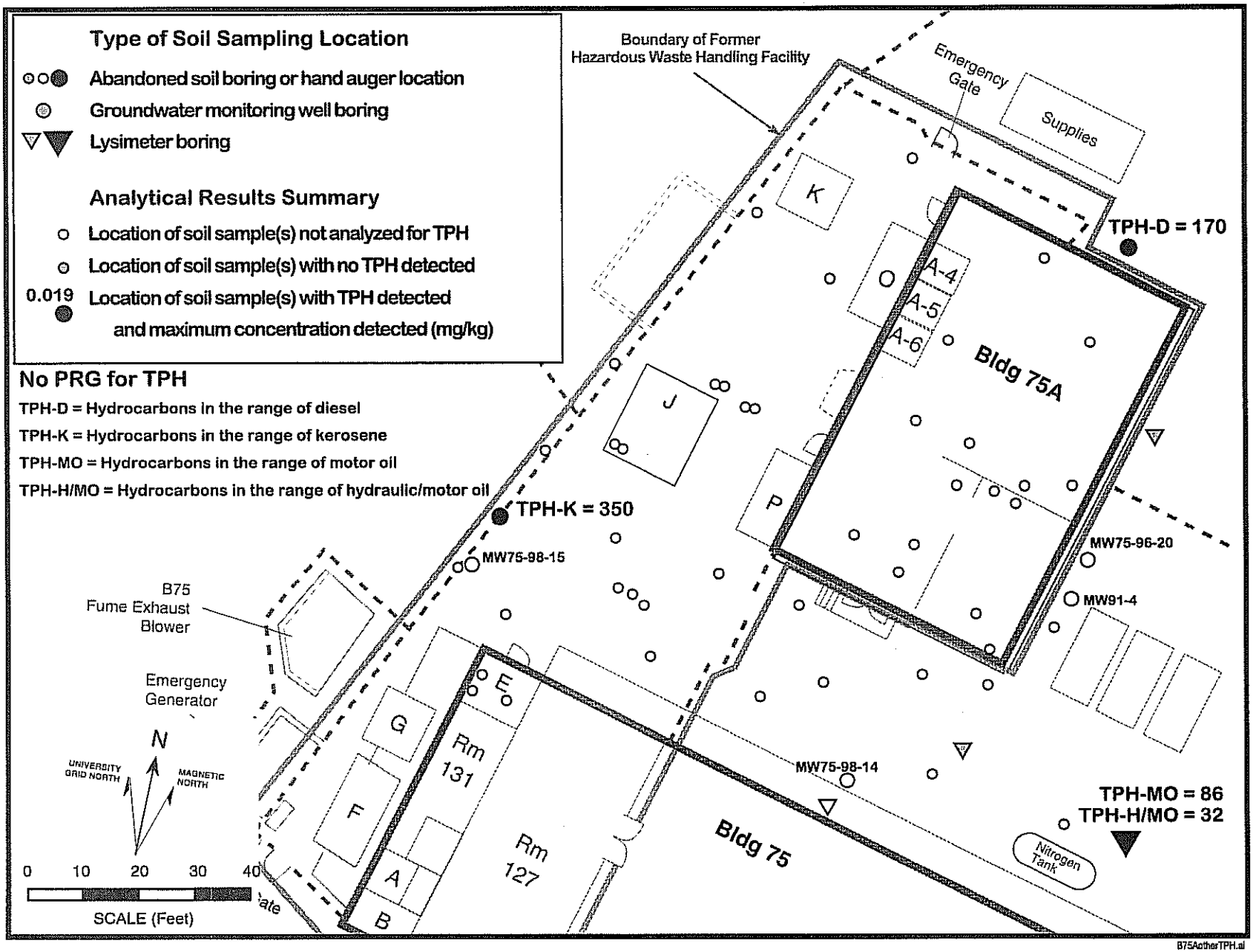
Hydrocarbons (TPH) in the Range of Crude/Waste Oil in Soil, Building 75 Former Hazardous Waste Handling Facility



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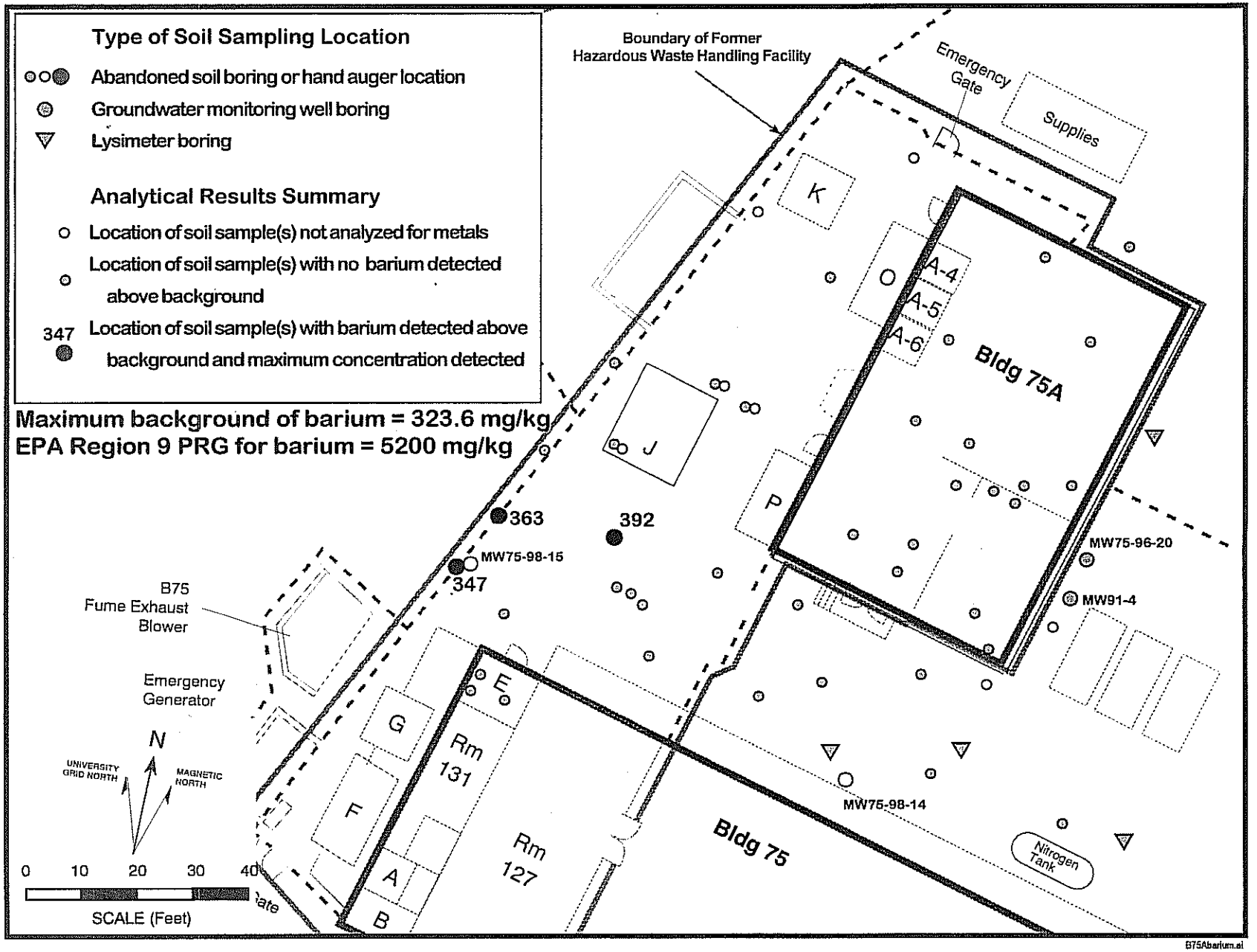
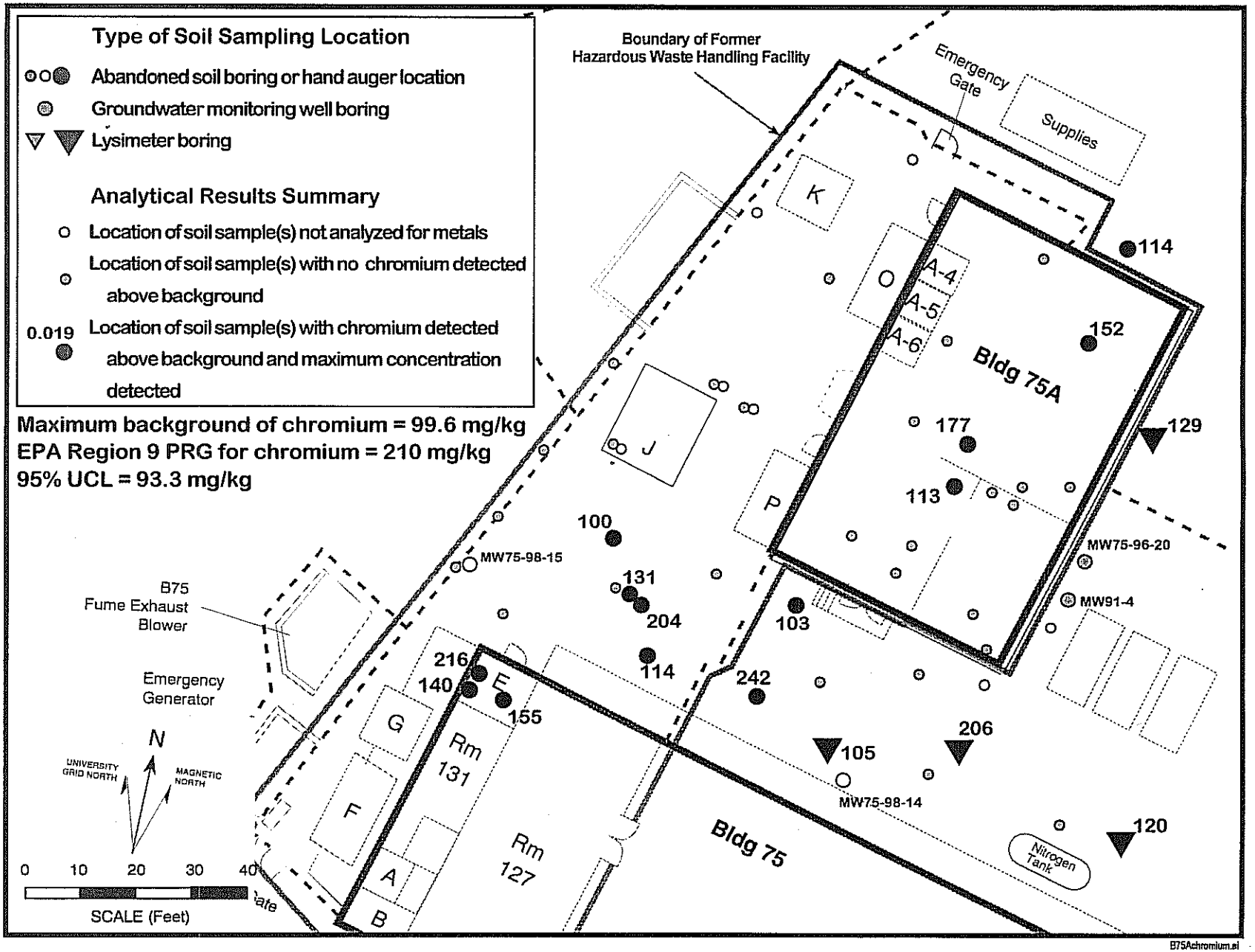
Hydrocarbons (TPH) in Other Boiling Point Ranges in Soil, Building 75 Former Hazardous Waste Handling Facility

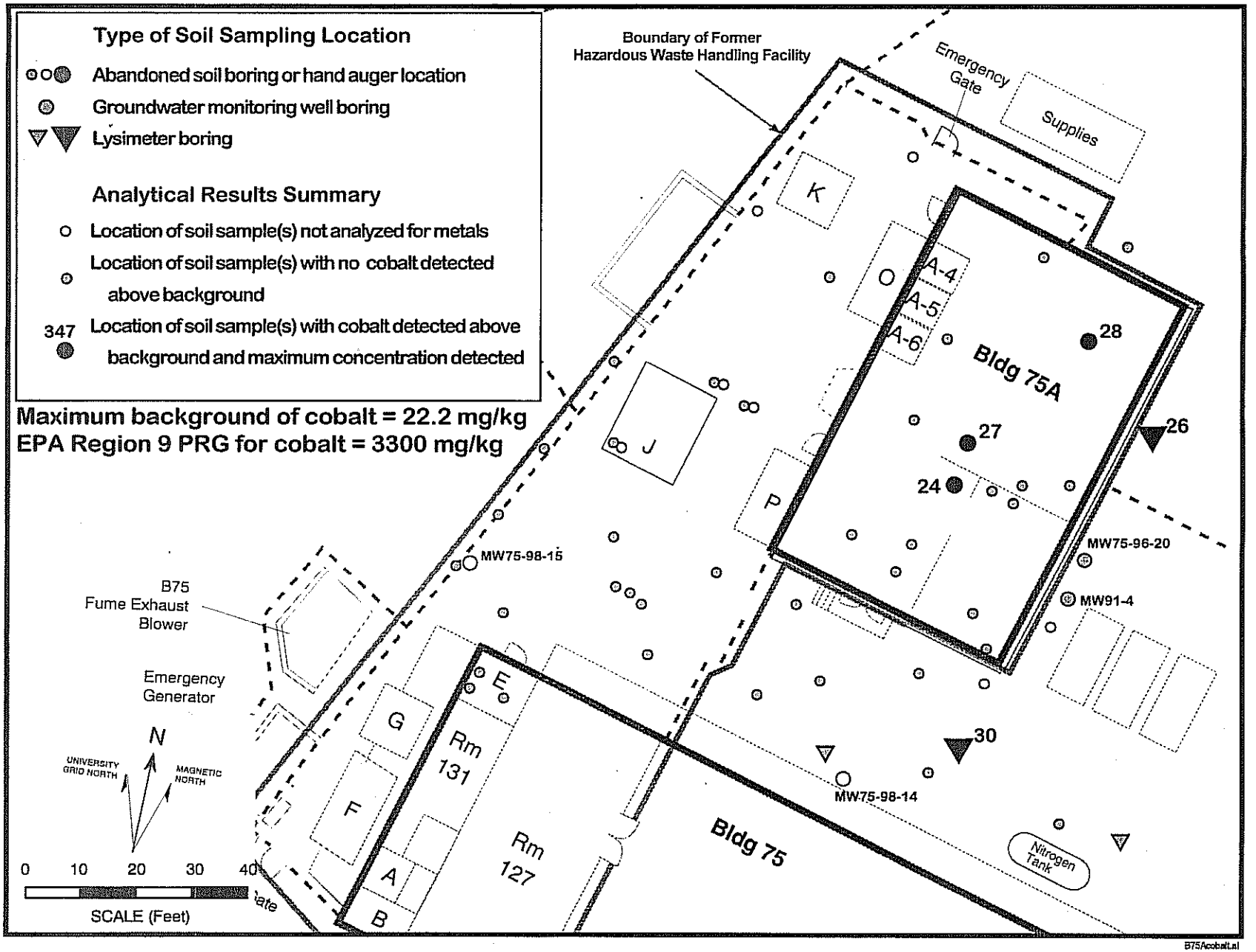
Metals Above Background Levels



Barium in Soil, Building 75 Former Hazardous Waste Handling Facility



Total Chromium in Soil, Building 75 Former Hazardous Waste Handling Facility



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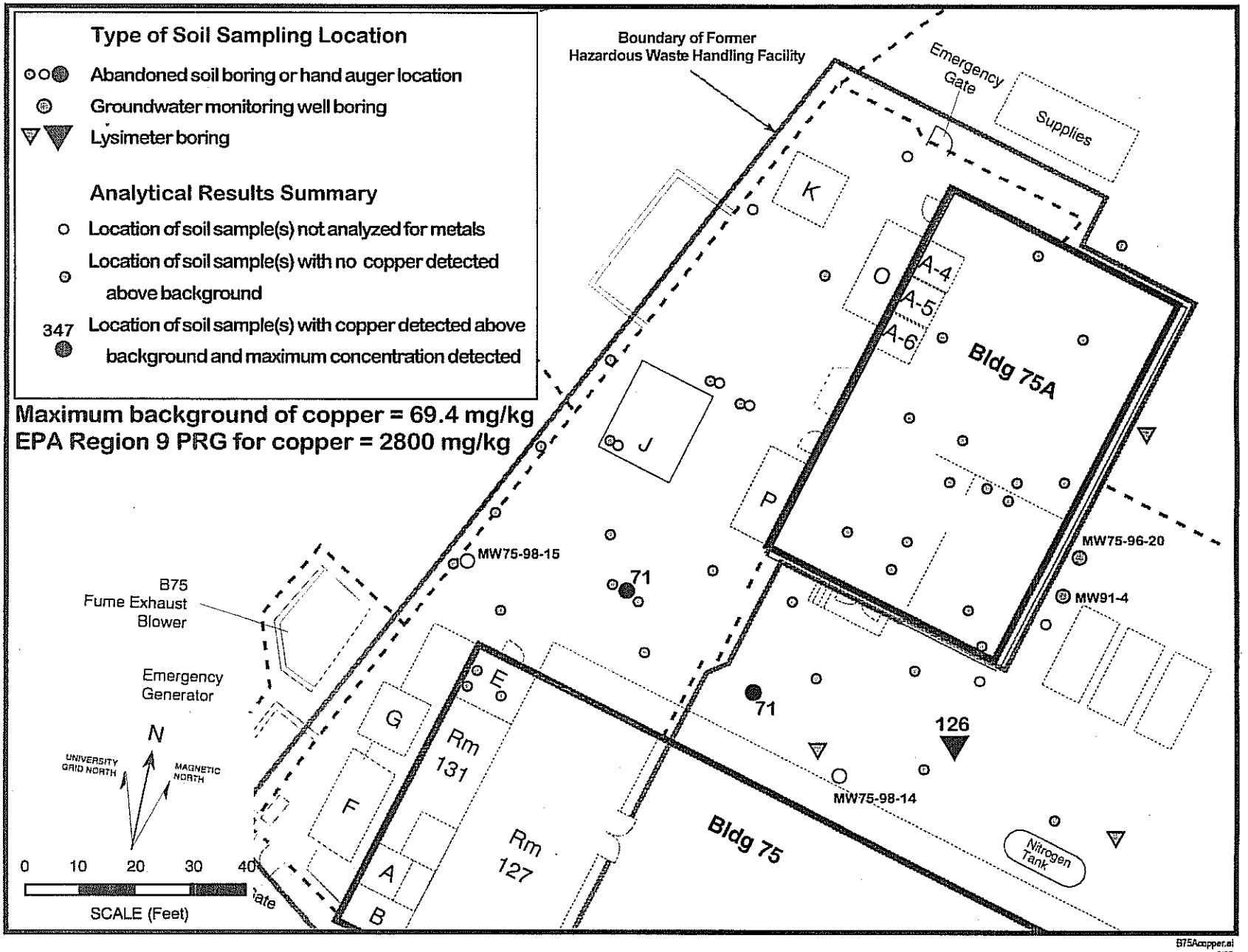
Cobalt in Soil, Building 75 Former Hazardous Waste Handling Facility



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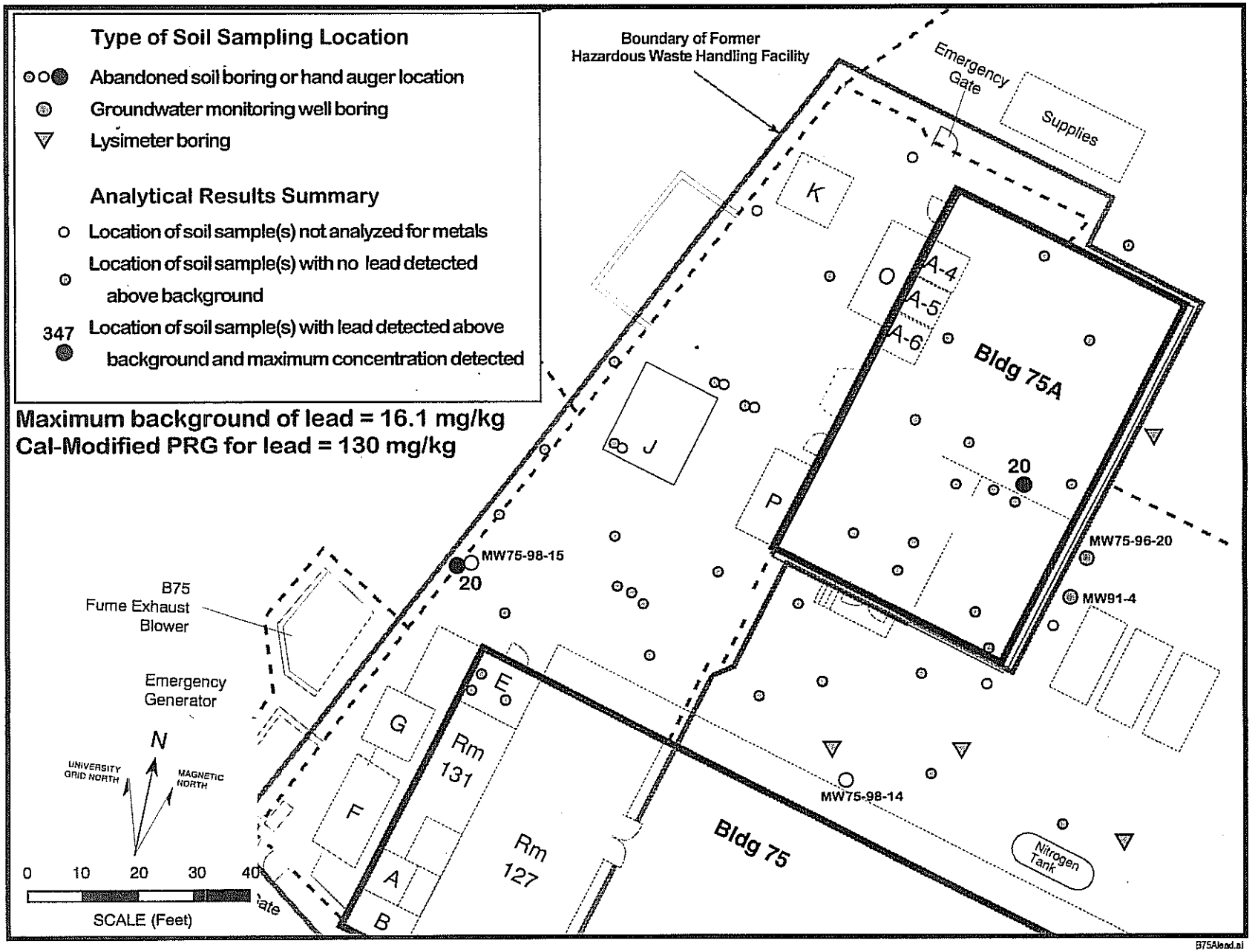
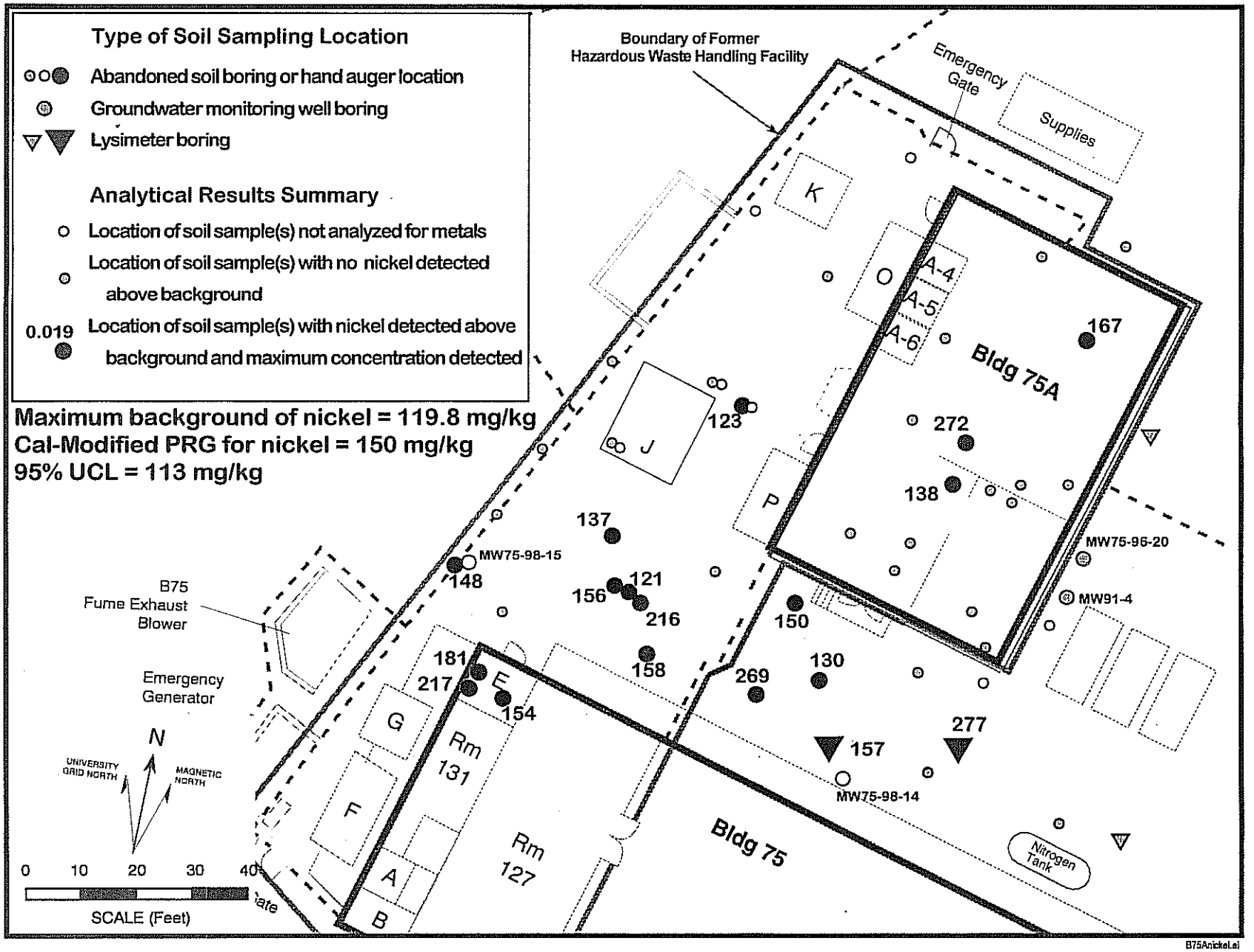
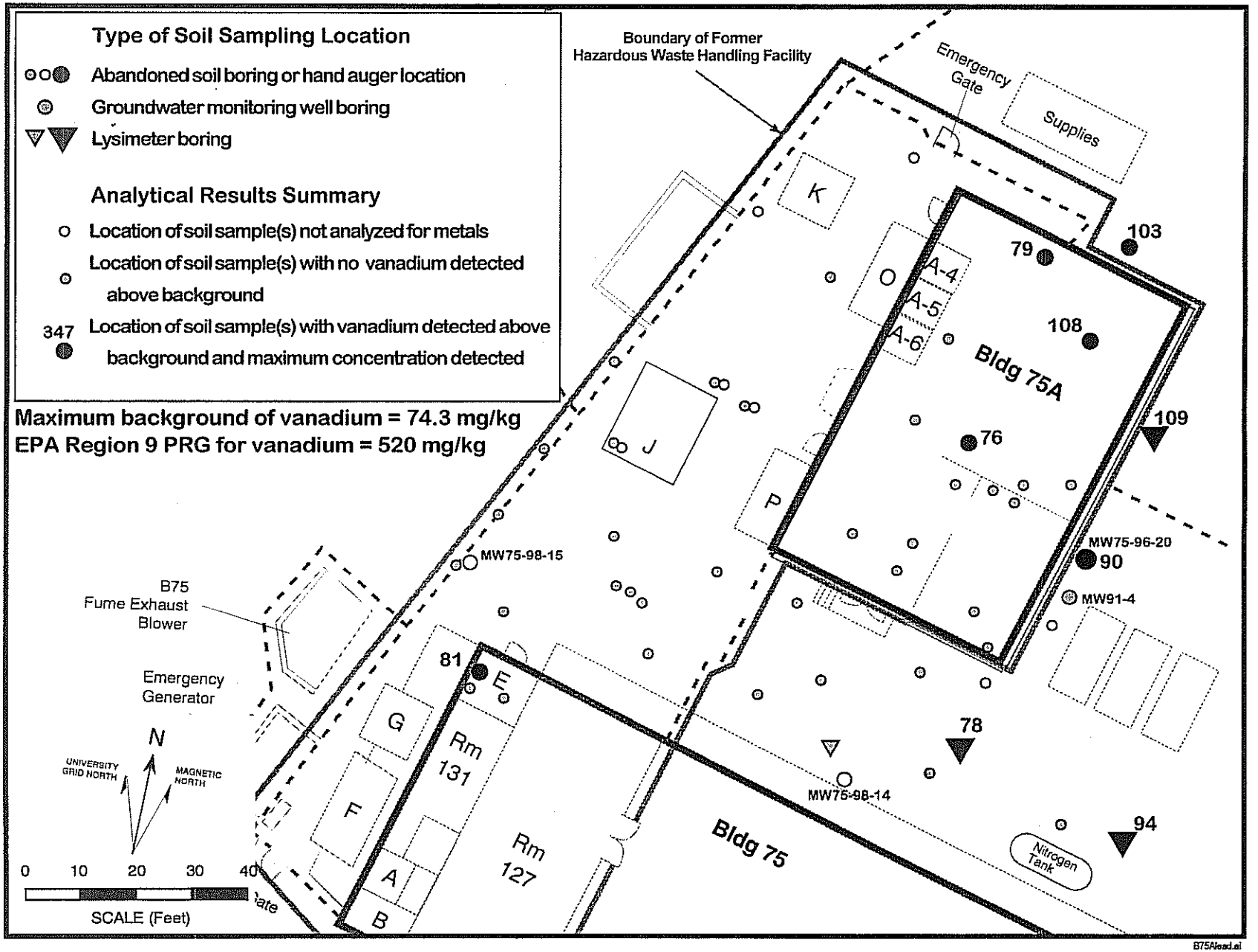
Copper in Soil, Building 75 Former Hazardous Waste Handling Facility



Lead in Soil, Building 75 Former Hazardous Waste Handling Facility



Nickel in Soil, Building 75 Former Hazardous Waste Handling Facility



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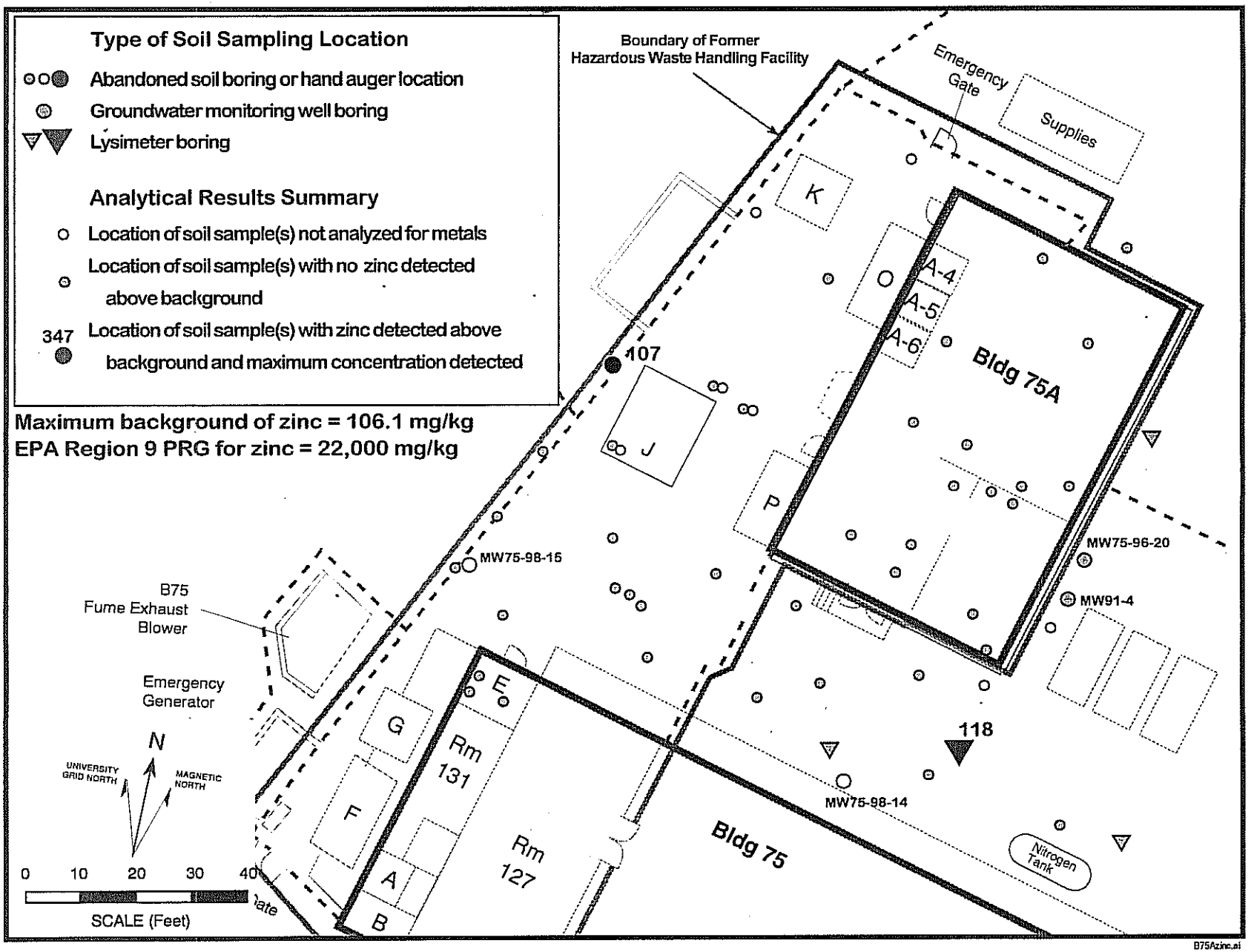
Vanadium in Soil, Building 75 Former Hazardous Waste Handling Facility



Zinc in Soil, Building 75 Former Hazardous Waste Handling Facility

E.O. Lawrence Berkeley National Laboratory
University of California
Environmental Restoration Program

United States Department of Energy

REQUEST FOR
NO FURTHER ACTION (NFA) STATUS
FOR
FORMER COOLING TOWERS SOUTHEAST OF BUILDING 51 (AOC 9-11)

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

March 2000

REQUEST FOR
NO FURTHER ACTION (NFA) STATUS
FOR
FORMER COOLING TOWERS SOUTHEAST OF BUILDING 51 (AOC 9-11)

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

A Joint Effort of
Environment, Health and Safety Division and
Earth Sciences Division
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

March 2000

This work was done at the Lawrence Berkeley Laboratory operated by the University of California for the U. S. Department of Energy under contract DE-AC03-76SF00098.

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LIST OF ABBREVIATIONS

AOC	Area of Concern
Berkeley Lab	Ernest Orlando Lawrence Berkeley National Laboratory
bgs	below ground surface
CAL-EPA	California Environmental Protection Agency
CAP	Corrective Action Program
CMS	Corrective Measures Studies
COPC	Constituent of Potential Concern
DCA	dichloroethane
DTSC	Cal-EPA Department of Toxic Substances Control
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
μg/L	micrograms per liter (10^{-6} grams per liter)
NFA	No Further Action
NFI	No Further Investigation
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RWQCB	Regional Water Quality Control Board
SVOCs	Semi-volatile organic compounds
SWMU	Solid Waste Management Unit
TCA	trichloroethane
THC	total hydrocarbons
USEPA	U. S. Environmental Protection Agency
VOCs	volatile organic compounds

SECTION 1

INTRODUCTION

1.1 PURPOSE

The purpose of this report is to document the environmental investigations conducted at the Former Cooling Towers Southeast of Building 51 (Area of Concern [AOC] 9-11) and request approval of No Further Action (NFA) status for AOC 9-11 under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP) at Lawrence Berkeley National Laboratory (Berkeley Lab). The California Environmental Protection Agency (CAL/EPA) Department of Toxic Substances Control (DTSC) is the lead regulatory agency for the CAP and has the authority to approve NFA status for this unit. If NFA status is approved, no additional soil sampling would be required and the unit will not be included in the site-wide risk assessment. However, groundwater monitoring would continue at the unit, in accordance with requirements of the Regional Water Quality Control Board (RWQCB).

1.2 CHRONOLOGY OF REGULATORY REVIEW OF AOC 9-11

Berkeley Lab previously submitted requests to the DTSC for approval of No Further Investigation (NFI) status for AOC 9-11 and provided responses to DTSC's comments on those requests. Following is the chronology of Berkeley Lab's previous submittals, DTSC's comments on the requests, and Berkeley Lab's responses to DTSC's comments.

- July 1998 — Berkeley Lab submitted a request to DTSC for No Further Action (NFA) or No Further Investigation (NFI) status approval for several solid waste management units (SWMUs) and AOCs, including AOC 9-11 (Berkeley Lab, 1998a).
- September 1998 — DTSC approved NFA and NFI status for all SWMUs and AOCs in the request report, except AOC 9-11 for which DTSC required further justification for Berkeley Lab's NFI status request (DTSC, 1998).

- September 1998 Berkeley Lab responded to DTSC's request for further justification on AOC 9-11 (Berkeley Lab, 1998b). Berkeley Lab's response contained a summary of results of groundwater investigations at the site.
- November 1998 The DTSC verbally requested that Berkeley Lab sample water from the drain lines that collect shallow groundwater immediately downgradient from the former containment basins.
- April 1999 Berkeley Lab submitted a second request for NFI status approval for AOC 9-11 (Berkeley Lab, 1999a), which included results of the drain line sampling requested by DTSC.
- May 1999 The DTSC provided comments on Berkeley Lab's April 20, 1999 request and requested clarification on several issues (DTSC, 1999a).
- June 1999 Berkeley Lab responded to the DTSC comments of May 1999 (Berkeley Lab, 1999b).
- September 1999 Based on Berkeley Lab's response to DTSC's May 1999 comments and a meeting held with DTSC on July 1, 1999, Berkeley Lab submitted an additional request for NFI status approval for AOC 9-11 (Berkeley Lab, 1999c).
- September 1999 DTSC provided comments to Berkeley Lab's September 1999 request (DTSC, 1999b).
- January 2000 Berkeley Lab submitted a workplan to DTSC (Berkeley Lab, 2000) for review and approval that contained responses to the DTSC's September 1999 comment letter and addressed their concerns. The workplan specified additional soil investigations at the unit and the installation of a new groundwater monitoring well.

1.3 SCOPE

This current NFA request summarizes the information contained in the previous NFI approval requests and provides the results of the soil and groundwater sampling that was specified in the January 2000 workplan (Berkeley Lab, 2000). The objectives of the investigations conducted in 2000 were to collect data to evaluate the presence of analytes previously detected in soil at AOC 9-11 and help assess the magnitude and extent of any contamination.

The data collected during the RCRA Facility Assessment (RFA) and during the RCRA Facility Investigation (RFI) prior to January 2000 are discussed in Section 3.2 of this report. Results of the investigations that were conducted in accordance with requirements specified in

Berkeley Lab's January 2000 workplan (Berkeley Lab, 2000) are discussed in Section 3.3. The rationale for requesting NFA status for AOC 9-11 is provided in Section 4.

SECTION 2

DESCRIPTION OF UNIT

2.1 SITE DESCRIPTION AND HISTORY

A map of Berkeley Lab showing the location of the AOC 9-11 is included as Figure 1. Maps of the southern Building 51 area showing the locations of the former cooling towers are included as Figure 2 and Figure 3. Water that was used to cool the Bevatron magnet ring inside Building 51 was routed to three cooling towers (CT-4, CT-5, and CT-6) located southeast of the building, prior to recirculation. About 1962, discharge water from cooling towers was redirected from the storm drain system to the sanitary sewers. Prior to 1983, the cooling tower cleaning activities may have released rinse water. The system was designed to catch any released water in drainholes of a subsurface drainage system that routed water to a sump located next to the CT-4 containment basin (Figure 3), which in turn discharged to the sanitary sewer. The Bevatron is no longer operational. Two of the towers have been removed and one inactive tower is still in place.

A sub-surface tile drain that collects groundwater from a wide area, including the area next to AOC 9-11, lies along the southern perimeter of Building 51 (the "Building 51 Drain" on Figure 2). A second sub-surface drain (the "Building 51 Spring Drain" on Figure 2) intersects a historical spring southwest of Building 51, that was mapped prior to construction of the building. Near the historical spring location, the two drain lines are within approximately 4 feet of each other, both vertically and horizontally. The drains discharge into a storm water catch basin located inside Building 51A (Figure 2). The water from the catch basin ultimately discharges to the storm drain outfall on North Fork Strawberry Creek (Figure 4).

2. 2 GEOLOGY AND HYDROGEOLOGY

2.2.1 Geology

The bedrock geology of the Building 51 and surrounding areas is shown on Figure 5. Rocks of the Orinda Formation underlie the location of the former cooling towers. The contact between the Orinda Formation and rocks of the older Great Valley Group is west of AOC 9-11, and dips moderately to the northeast. In the Building 51 area, the Orinda Formation consists mostly of fine-grained sediments that dip moderately to the north and northeast.

Geologic cross-sections at the former cooling tower site are shown on Figure 6 and Figure 7. The locations of the cross-sections are shown on Figure 3. Artificial fill, consisting primarily of silty, sandy, and gravelly clay increases in thickness from approximately 5 to 11 feet southeast of the former cooling towers to 20 feet at Building 51 toward the northwest. Interlayered claystone, siltstone, and sandstone of the Orinda Formation underlie the fill.

2.2.2 Hydrogeology

A water level elevation map of the Building 51 area based on water levels measured in groundwater monitoring wells screened near the water table is included as Figure 8. Groundwater flow at AOC 9-11 is northwestward toward North Fork Strawberry Creek. Groundwater levels measured in February 2000 are included on the geologic cross sections (Figure 6 and Figure 7). Depth to groundwater at the site was approximately 3 to 4 feet bgs at that time.

Based on results of slug tests conducted in monitoring wells, the Orinda Formation has the lowest values of hydraulic conductivity of any of the geologic formations at Berkeley Lab (approximately 10^{-7} to 10^{-9} meters per second).

SECTION 3

NATURE AND EXTENT OF CONTAMINATION

3.1 SCREENING PROCESS FOR NO FURTHER ACTION (NFA) STATUS

Soil sample analytical results were compared to background levels in order to evaluate what might constitute environmental contamination. For compounds that are not naturally occurring, such as many organic compounds, any detection of that compound is assumed to be contamination, unless other sources such as laboratory contamination of the sample can be documented. For naturally-occurring constituents such as metals, analytical results are compared to statistically-estimated background levels to identify with a certain degree of confidence which constituents are present at concentrations that represent contamination. Berkeley Lab used a statistical method (Berkeley Lab, 1995) to estimate the background concentrations of metals in soil. This method adopts the upper tolerance limit method as defined by USEPA (USEPA, 1989).

As approved by the DTSC, Berkeley Lab uses USEPA Region IX Preliminary Remediation Goals (PRGs) (USEPA, 1999) as a screening tool to help assess whether further action is required at a site (i.e. whether the unit will be included in the site wide risk assessment). DTSC PRGs (Cal-Modified PRGs) are used where Region IX PRGs either have not been established, or are greater than the DTSC values. To implement a conservative approach for site screening purposes, Berkeley Lab uses PRGs established for soil at residential sites instead of less-stringent PRGs defined for soil at industrial sites.

Where concentrations of contaminants in soil are within Berkeley Lab background levels or below PRGs for residential soil, the SWMU or AOC is recommended for NFA status. Where concentrations of contaminants in soil are above both Berkeley Lab background levels and PRGs for residential soil, the SWMU or AOC is recommended for NFI status. No further site

characterization will be required by DTSC for SWMUs and AOCs approved for either NFA or NFI status. SWMUs and AOCs approved for NFI status will be included in the risk assessment to be conducted as part of the Corrective Measures Studies (CMS) phase of the RCRA CAP. SWMUs and AOCs that are approved for NFA status will not be included in the CMS.

3.2 INVESTIGATIONS CONDUCTED PRIOR TO 2000 AT AOC 9-11

The results discussed in this section are based on environmental investigations conducted during the RFA and during the RFI prior to January 2000. These investigations included the collection of soil, groundwater, surface water, sediment, and drainline samples. Soil and groundwater samples were collected at locations most likely to have been impacted from any releases that may have occurred at the former cooling towers using an authoritative (judgement) sampling approach. To evaluate potential contaminant migration pathways from the former cooling tower area, water was sampled from the drain line ("Building 51 Drain") that collects shallow groundwater adjacent to the former containment basins. Surface water and sediment samples were also collected from the North Fork of Strawberry Creek, where the drain lines ultimately discharge, and analyzed for chemicals of potential concern from upgradient sources, including AOC 9-11.

The locations of the soil borings, groundwater monitoring wells, piezometers, and temporary groundwater sampling points discussed in this section are included on Figure 3. Surface water and sediment sampling locations and the location of the "Building 51 Drain" are shown on Figure 4. Analytical results are presented in Table 1 (soil organics and pH), Table 2 (soil metals), Table 3 (groundwater organics and metals), Tables 4a and 4b(surface water VOCs and metals), Tables 5a and 5b (sediment organics and metals), and Table 6 (subdrain water organics and hexavalent chromium).

3.2.1 Soil Sampling

<u>Sampling Locations</u>

During the RFA, a soil sample was collected from a depth of 9 feet below ground surface (bgs) (SS51S-07) to assess possible leakage from the cooling tower or sanitary sewer (Berkeley

Lab, 1992). The sample was analyzed for volatile organic compounds (VOCs) and Total Hydrocarbons (THC). Also during the RFA, soil samples were collected from two borings (51-92-2 and 51-92-3) drilled along the southeast side of the former cooling tower basins. Samples were analyzed for VOCs and metals. The shallowest sample at each location was also analyzed for semi-volatile organic compounds (SVOCs), and samples from 51-92-2 were analyzed for pH. Boring 51-92-2 was completed as a monitoring well (MW51-92-2) and boring 51-92-3 was completed as a series of five nested piezometers (PZ51-92-3).

In April 1996, soil samples were collected from two borings (SB51-96-19 and SB51-96-20) located next to surface drainholes adjacent to the former cooling tower basins CT-5 and CT-6, and from one boring (SB51-96-22) next to the sump adjacent to former cooling tower basin CT-4. Samples were analyzed for VOCs, metals, and pH. In September 1996, two soil samples were collected from SB51-96-20A (adjacent to SB51-96-20) at 1.1 and 2.1 feet bgs and analyzed for hexavalent chromium.

Analytical Results

Benzene (0.01 mg/kg) was detected in one soil sample collected at 15 feet in MW51-92-2. Trace concentrations (<0.2 mg/kg) of ethylbenzene, toluene, isopropylbenzene, and 1,1,1-trichloroethane (TCA) were detected at a depth of 9 feet in SS51S-07. THC (3.09 mg/kg) was also detected. Levels of pH measured at the site ranged from 8.18 to 9.00. No SVOCs were detected.

Seven metals were detected at concentrations above Berkeley Lab background levels: arsenic (1 sample), barium (1 sample), chromium (3 samples), cobalt (1 sample), lead (1 sample), nickel (1 sample), and thallium (1 sample). Except for one chromium and one thallium sample, all metal results were within approximately 10% of background levels. Detections of naturally-occurring metals at concentrations above a statistically determined background level are expected. Arsenic (maximum 21 mg/kg), chromium (maximum 270 mg/kg), and thallium (maximum 14 mg/kg) were detected at concentrations above both background levels and PRGs for residential soil in one sample each.

To further assess the elevated concentration (above background and the PRG) of chromium detected in SB51-96-20, two soil samples were collected from SB51-96-20A (adjacent to SB51-96-20) at 1.1 and 2.1 feet bgs and analyzed for hexavalent chromium. Hexavalent chromium was not detected.

Concentrations of organic analytes detected and concentrations of metals detected above both PRGs for residential soil and Berkeley Lab background levels for the samples collected prior to 2000 are included on the cross sections (Figures 9 and 10). Results of sampling conducted in January 2000 are also included on these figures for comparison purposes.

3.2.2 Groundwater Sampling

Sampling Locations

Groundwater samples have been collected from MW51-92-2 as part of quarterly monitoring since December 1992. In addition, groundwater samples were collected from the five nested piezometers (PZ51-92-3) in November 1993, and grab groundwater samples were collected from temporary sampling points SB51-96-20 or SB51-96-22 in April, September, and November in 1996, in December 1997, and in October 1999.

Analytical Results

Chloroform (2.1 μg/L) and 1,1-dichloroethane (1,1-DCA) (1.0 μg/L) were the only organic compounds detected in groundwater at the site. They were detected in one grab groundwater sample (April 1996) from SB51-96-22, located near the sump. No VOCs were detected in SB51-96-22 during subsequent sampling in November 1996.

Hexavalent chromium was detected at a maximum concentration of 93 μg/L (range of 3 μg/L to 93 μg/L) in grab samples collected from SB51-96-20. The Maximum Contaminant Level (MCL) for drinking water for total chromium (including hexavalent chromium) is 50 μg/L. Hexavalent chromium was not detected in the sample collected from SB51-96-20 in October 1999 nor has it been detected in samples from SB51-96-22 next to the sump. Cadmium was detected above its MCL for drinking water in one groundwater sample (5.7 μg/L in PZ51-92-3 in

November 1993; the MCL is 5 μg/L). No other metal has been detected in groundwater samples at a concentration above MCLs.

3.2.3 Surface Water and Sediment Sampling

Sampling Locations

As previously described, the storm drain system near AOC 9-11 discharges to North Fork Strawberry Creek. Surface water and sediment samples were collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 9-11. From April 1993 to April 1999, 9 surface water samples from North Fork Strawberry Creek were analyzed for CAM 17 metals and 15 for VOCs. During the same period, 11 sediment samples from North Fork Strawberry Creek were analyzed for CAM 17 metals and 2 for VOCs. In July 1999, surface water and sediment samples were collected from the North Fork Strawberry Creek erosion control basin and from North Fork Strawberry Creek at the site boundary (Figure 4) and analyzed for hexavalent chromium. These samples were collected in response to comments issued by the DTSC (DTSC, 1999a).

In November and December 1998, water samples were collected from the "Building 51 Drain" and the “Building 51 Spring Drain”. The samples were collected from the nearest accessible sampling location downflow from AOC 9-11, which is the catch basin inside Building 51A (Figure 2). The samples were analyzed for VOCs and hexavalent chromium.

Analytical Results

Surface Water Sampling

Of the three metals (arsenic, chromium, and thallium) detected at concentrations above both background levels and PRGs for residential soil in soil samples, only arsenic and chromium were detected in the surface water samples from North Fork Strawberry Creek. Arsenic and chromium were each detected in three of eleven surface water samples at a maximum concentration of 4.2 μg/L and 8.6 μg/L, respectively. The maximum concentrations of arsenic and chromium detected in the surface water samples are well below DHS Water Quality Criteria

(150 μg/L for arsenic and 210 μg/L for chromium) and drinking water Maximum Contaminant levels (MCLs).

Hexavalent chromium (4.2 μg/L) was detected in the surface water sample collected from North Fork Strawberry Creek at the boundary fence in July 1999, but was not detected in water collected upstream at the erosion control basin. The detected concentration is below the MCL for drinking water (50 μg/L) and the DHS Water Quality Criteria of 11 μg/L for protection of freshwater aquatic life. Except for one sample collected in May 1995 that showed a trace concentration (<1 μg/L) of 1,1,1-trichloroethane (TCA), no VOCs were detected. The MCL for 1,1,1-TCA is 200 μg/L.

The potential impact to the environment from contaminants detected in surface water will be evaluated in the ecological risk assessment.

Sediment Sampling

Of the three metals (arsenic, chromium, and thallium) detected at concentrations above both background levels and PRGs for residential soil in soil samples at AOC 9-11, only chromium and thallium were detected in sediment samples from North Fork Strawberry Creek at concentrations above Berkeley Lab background levels. Chromium (129 mg/kg maximum) and thallium (5.4 mg/kg) were detected above the background level in 1 of 11 samples each. The maximum concentrations detected are below the PRGs for residential soil.

A trace concentration of toluene (0.013 mg/kg) was the only VOC detected. Hexavalent chromium was not detected in either of the sediment samples collected at the same locations where surface water was sampled for hexavalent chromium.

The potential impact to the environment from contaminants detected in sediment will be evaluated in the ecological risk assessment.

Drainline Sampling

Various halogenated VOCs were detected in samples from both drain lines, and methyl tert-butyl ether (MTBE) was detected in one sample from the “Building 51 Drain” line. The

source(s) of these VOCs are unknown. Hexavalent chromium was detected in samples from both drain lines at a maximum concentration of 4 μg/L, which is well below the MCL for drinking water (50 μg/L). A potential source of the hexavalent chromium is the former cooling towers (AOC 9-11). The similar concentrations of hexavalent chromium and halogenated VOCs detected from both drain lines indicate that both lines intercept the same area of contaminated groundwater, or that there is cross-flow between the two drain lines. A groundwater monitoring well (MW51-99-1) was installed at the location of the historical spring to evaluate if the spring was a source area or migration pathway of contamination detected in the drainlines. No VOCs were detected in the groundwater sample collected from this well.

3.3 RESULTS OF SAMPLING SPECIFIED IN THE JANUARY 2000 WORKPLAN

The January 2000 Work Plan for Further Investigation of Contamination at Former Cooling Towers Southeast of Building 51 (AOC 9-11) (Berkeley Lab, 2000) established the procedures for evaluating the data previously collected at AOC 9-11 and assessing the extent of contamination. The work plan also provided the rationale for limiting the constituents of potential concern (COPCs) for further site investigation to arsenic, chromium, and thallium. In addition, to more thoroughly address the historical data collected at the site, the presence of VOCs previously detected in the soil and hexavalent chromium in the groundwater were included for assessment in the workplan.

3.3.1 Soil Sampling

Soil sampling results are included in Table 1 (organics) and Table 2 (metals). Soil sampling requirements specified in the January 2000 workplan and results of sampling were as follows:

Sampling Requirement January 2000 Work Plan (Berkeley Lab, 2000)	Results
<u>VOCs</u> To evaluate the potential presence and the extent of VOCs in the soil, samples will be collected at three depths from two soil borings, one drilled within 3 feet of SS51S-07 and one within 3 feet of MW 51-92-2 to assess whether VOCs are actually present. One sample will be collected at the same depth that contaminant(s) were detected previously and the other two will be collected 3 feet above and 3 feet below the target depth. The samples will be analyzed for VOCs by EPA Method 8260.	SS51-00-3 was drilled within 3 feet of the estimated location of SS51S-07. SB51-00-2 was drilled 3 feet from MW51-92-2. Three samples were collected from each boring at the elevations specified in the workplan. No VOCs were detected. Sampling locations are shown in cross section on Figure 10.
<u>Metals</u> *Arsenic* To evaluate the potential presence and investigate the extent of elevated arsenic concentrations at PZ51-92-3, two soil borings will be drilled within 3 feet of PZ51-92-3. Two soil samples will be collected from each borehole, one at 3 feet bgs and the other at 6 feet bgs.	SS51-00-1 and SB51-00-4 were drilled 2 feet and 3 feet, respectively, from PZ51-92-3. Two samples were collected from each boring at the elevations specified in the workplan. Arsenic was detected at a maximum concentration of 6.3 mg/kg. All concentrations detected were within the Berkeley Lab background level. Sampling locations and analytical results are shown in cross section on Figure 10.
Chromium To evaluate the potential presence and investigate the extent of elevated chromium concentrations near SB51-96-20, soil samples will be collected at depths of 1 and 5 feet at two locations within approximately 5 feet of SB51-96-20.	MW51-00-01 and SB51-96-20R were drilled 2 feet and 3 feet, respectively, from SB51-96-20. Two samples were collected from each boring at the elevations specified in the workplan. Chromium was detected at a maximum concentration of 99 mg/kg. All concentrations detected were within the Berkeley Lab background level. Sampling locations and analytical results are shown in cross section on Figure 9.
Thallium To evaluate the potential presence and investigate the extent of elevated thallium concentrations at PZ51-92-3, soil samples will be collected at depths of 10, 15, and 20 feet from one boring drilled within approximately 5 feet of PZ51-92-3.	SB51-00-01 was drilled 2 feet from PZ51-92-3. Three samples were collected from the boring at the elevations specified in the workplan. Thallium was not detected. Detection limits were below the Berkeley Lab maximum background level. Sampling locations and analytical results are shown in cross section on Figure 10.
If any of these samples contain metals above the Berkeley Lab background level, Berkeley Lab will assess whether the results are indicative of contamination and may collect additional samples to characterize the extent of potential contamination.	All detected concentrations of metals were within Berkeley Lab background levels.

3.3.2 Groundwater Sampling

Groundwater sampling results are included in Table 3. Groundwater sampling requirements specified in the January 2000 workplan and results of sampling were as follows:

Sampling Requirement January 2000 Work Plan (Berkeley Lab, 2000)	Results
A new groundwater monitoring well will be installed between the former cooling towers and the subdrain. The analysis of water sample from this well should help to evaluate potential sources of VOCs detected in the subdrain.	Groundwater monitoring well MW51-00-1 and temporary groundwater sampling point SB51-96-20R were installed between the former cooling towers and the subdrain. These two wells are immediately downgradient from former cooling tower basins CT-5 and CT-6 and together provide vertical characterization of groundwater quality (Figure 2 and Figure 6). No VOCs were detected in the sample collected from these wells, indicating that the former cooling towers are not the source of the VOCs detected in the subdrain.
Water samples from the other existing wells in the area of the former cooling towers will also be collected and tested for VOCs at the same time, to provide comparable results for evaluation.	Groundwater samples were collected from MW51-00-1, MW51-92-2, SB51-96-20R, SB51-96-22, and PZ51-92-3 (12') on February 22 or February 24, 2000 and analyzed for VOCs. No VOCs were detected, indicating that the former cooling towers are not the source of the VOCs detected in the subdrain.
To further evaluate the presence of hexavalent chromium in this area, a groundwater sample will be collected from a newly proposed monitoring well to be installed within 10 ft. of SB51-96-20. The other wells in the area of the former cooling towers will be sampled concurrently for hexavalent chromium and CAM 17 metals to provide comparable results for evaluation.	Groundwater samples were collected from MW51-00-1, MW51-92-2, SB51-96-20R, SB51-96-22, and PZ51-92-3 (12') on February 22 or February 24, 2000 and analyzed for hexavalent chromium and CAM 17 metals. Results are shown at the well locations on Figure 11. Hexavalent chromium was only detected in SB51-96-20R. Concentrations of metals (including hexavalent chromium) were below MCLs.
Cadmium was detected in one groundwater sample at a concentration slightly above the MCL (5.7 μg/L, MCL=5 μg/L) at a depth of 42 feet in multi-level well PZ51-92-3. Wells in the area of the former cooling towers will be sampled concurrently for CAM 17 metals to provide comparable results and help assess whether cadmium is present at an elevated concentration in the area of the former cooling towers.	Samples were collected from all levels of the multi-level well PZ51-92-3 on January 10, 2000 and analyzed for CAM 17 metals. Cadmium was not detected in any of the samples (<1 μg/L). In addition, cadmium was not detected in the samples collected from MW51-00-1, MW51-92-2, SB51-96-20R, SB51-96-22, and PZ51-92-3 (12') in February 2000. The results show that cadmium is not present at an elevated concentration in the groundwater in the area of the former cooling towers.

3.3.3 Surface Water Sampling

Surface water sampling results are included in Table 4a (VOCs) and Table 4b (metals). Surface Water sampling requirements specified in the January 2000 workplan and results of sampling were as follows:

Sampling Requirement January 2000 Work Plan (Berkeley Lab, 2000)	Results
Another water sample will be collected from North Fork Strawberry Creek and tested for metals to confirm the previous findings. (Of the three metals [arsenic, chromium, and thallium] identified as COPCs at AOC 9-11, only arsenic and chromium were detected in the previous surface water samples from North Fork Strawberry Creek. The maximum concentrations of arsenic and chromium detected were well below DHS Water Quality Criteria and MCLs.)	A surface water sample was collected from North Fork Strawberry Creek at the site boundary in January 2000 and analyzed for CAM 17 metals. Of the three metals (arsenic, chromium, and thallium) detected at concentrations above both background levels and PRGs for residential soil in previous soil samples collected at AOC 9-11, only chromium (2.5 μg/L) was detected in the surface water sample. The concentration of chromium detected is well below the DHS Water Quality Criteria (210 μg/L) and drinking water standard (MCL) of 50 μg/L. Results were consistent with the previous findings. A second sample collected at the site boundary in January 2000 was analyzed for hexavalent chromium. No hexavalent chromium was detected (<2 μg/L). Hexavalent chromium (4.2 μg/L) had been detected at the same location previously.
A water sample will be collected from North Fork Strawberry Creek and tested for VOCs to confirm the previous findings. (Except for one sample collected in May 1995 that showed a trace concentration [<1 μg/L] of 1,1,1-trichloroethane [TCA], no VOCs were detected.)	A surface water sample was collected from North Fork Strawberry Creek at the site boundary in January 2000 and analyzed for VOCs. No VOCs were detected. Results were consistent with the previous findings.

SECTION 4

RATIONALE FOR NFA RECOMMENDATION

4.1 INTRODUCTION

The Former Cooling Towers Southeast of Building 51 (AOC 9-11) is recommended for No Further Action status. The magnitude and extent of soil contamination, the impact of soil contamination on the groundwater, and the potential migration of contaminants to surface water have been evaluated. These criteria were discussed in Section 3 of this report and are summarized below. In addition, Berkeley Lab has provided responses to all DTSC comments on AOC 9-11.

4.2 RESPONSE TO DTSC COMMENTS

Berkeley Lab submitted a workplan to DTSC on January 10, 2000 (Berkeley Lab, 2000) to address concerns expressed by DTSC in their September 1999 comment letter (DTSC, 1999b). The workplan specified additional soil, groundwater, and surface water sampling for AOC 9-11 and the installation of a new groundwater monitoring well.

In response to DTSC's comments and in accordance with Berkeley Lab's responses to the comments the activities listed in the following table were completed. Those activities and the results were described in detail in Section 3 of this report.

Comment (DTSC, 1999b)	Action Completed
1. The request identifies soil, groundwater and possible surface contamination resulting from releases of arsenic, chromium, and thallium at AOC 9-11 but does not provide any information on the horizontal or vertical extent of this contamination for any of the mediums in question.	Additional soil samples were collected to evaluate the magnitude and extent of the elevated concentrations of arsenic, chromium, and thallium previously detected in the soil. An additional surface water sample was collected from North Fork Strawberry Creek and analyzed for metals. Groundwater samples were collected from 5 wells at AOC 9-11 and concurrently sampled for metals.
2. The request fails to establish actual paths of contamination to surface water if any.	Potential pathways of contamination to surface water were discussed in the January 2000 workplan and are discussed in this report. The storm drain system near AOC 9-11 discharges to North Fork Strawberry Creek. An additional surface water sample was collected from North Fork Strawberry Creek and analyzed for VOCs and metals.
3. Groundwater data reported for the contaminants identified as having been released come from some of the sampled wells, but not from others, and the data dates from various times in the past. This spotiness in the record makes it impossible to evaluate the data and to ascertain a clear contamination profile.	Concurrent samples were collected from the two monitoring wells, two groundwater sampling points, and piezometers located at AOC 9-11 and analyzed for CAM 17 metals, hexavalent chromium, and VOCs.

4.3 RECOMMENDATION FOR NFA STATUS

The initial list of Chemicals of Potential Concern (COPCs) for AOC 9-11 consisted of chromates, chromium, arsenic, zinc, and acids. Based on the information provided in the January 2000 workplan (Berkeley Lab, 2000) and in Section 3.2 of this report, and DTSC's comments of September 22, 1999 (DTSC, 1999b), the list of COPCs at AOC 9-11 was reduced to arsenic, chromium, and thallium. To more thoroughly address the historical data, Berkeley Lab also included evaluation of VOCs and hexavalent chromium in the groundwater in the workplan.

The following paragraphs summarize Berkeley Lab's justification for the NFA request:

<u>Soil Contamination</u>

Based on the results of sampling conducted in accordance with the January 2000 workplan (Berkeley Lab, 2000), there is no evidence of soil contamination at AOC 9-11.

Concentrations of arsenic, chromium, and thallium detected in soil were all within Berkeley Lab background levels. No VOCs were detected.

Magnitude and Extent of Groundwater Contamination

The horizontal and vertical extent of groundwater contamination have been addressed. Two groundwater monitoring wells, two temporary groundwater sampling points, and one piezometer in the area of AOC 9-11 were concurrently sampled for VOCs, CAM 17 metals, and hexavalent chromium in February 2000. No VOCs were detected. Concentrations of metals detected were below MCLs. Hexavalent chromium, which was only detected in SB51-96-20R, was the only contaminant identified in the groundwater. The detection only in SB51-96-20R indicates that the horizontal extent of the contamination is limited. SB51-96-20R is screened from approximately 5 to 15 feet bgs in the fill. Hexavalent chromium was not detected in adjacent (within 5 feet) monitoring well MW51-00-01, which is screened from 20 to 25 feet bgs in the Orinda Formation, indicating that the vertical extent of the contamination is limited.

Potential Migration of Contaminants to Surface Water and Sediment

The storm drain system near AOC 9-11 discharges to North Fork Strawberry Creek. Surface water and sediment samples have been collected from North Fork Strawberry Creek and analyzed for chemicals of potential concern from upgradient sources, including AOC 9-11. Based on the sampling conducted in 2000, the only COPC in soil or groundwater at AOC 9-11 is hexavalent chromium. Hexavalent chromium was detected (4.2 μg/L) in the surface water sample collected from North Fork Strawberry Creek at the boundary fence in July 1999, but was not detected in water collected upstream at the erosion control basin. The detected concentration is below the MCL for drinking water (50 μg/L) and the DHS Water Quality Criteria of 11 μg/L for protection of freshwater aquatic life. Hexavalent chromium was not detected in either of the sediment samples collected at the same surface water sampling locations. Furthermore, hexavalent chromium was not detected (<2 μg/L) in the surface water sample collected from North Fork Strawberry Creek in January 2000.

SECTION 5

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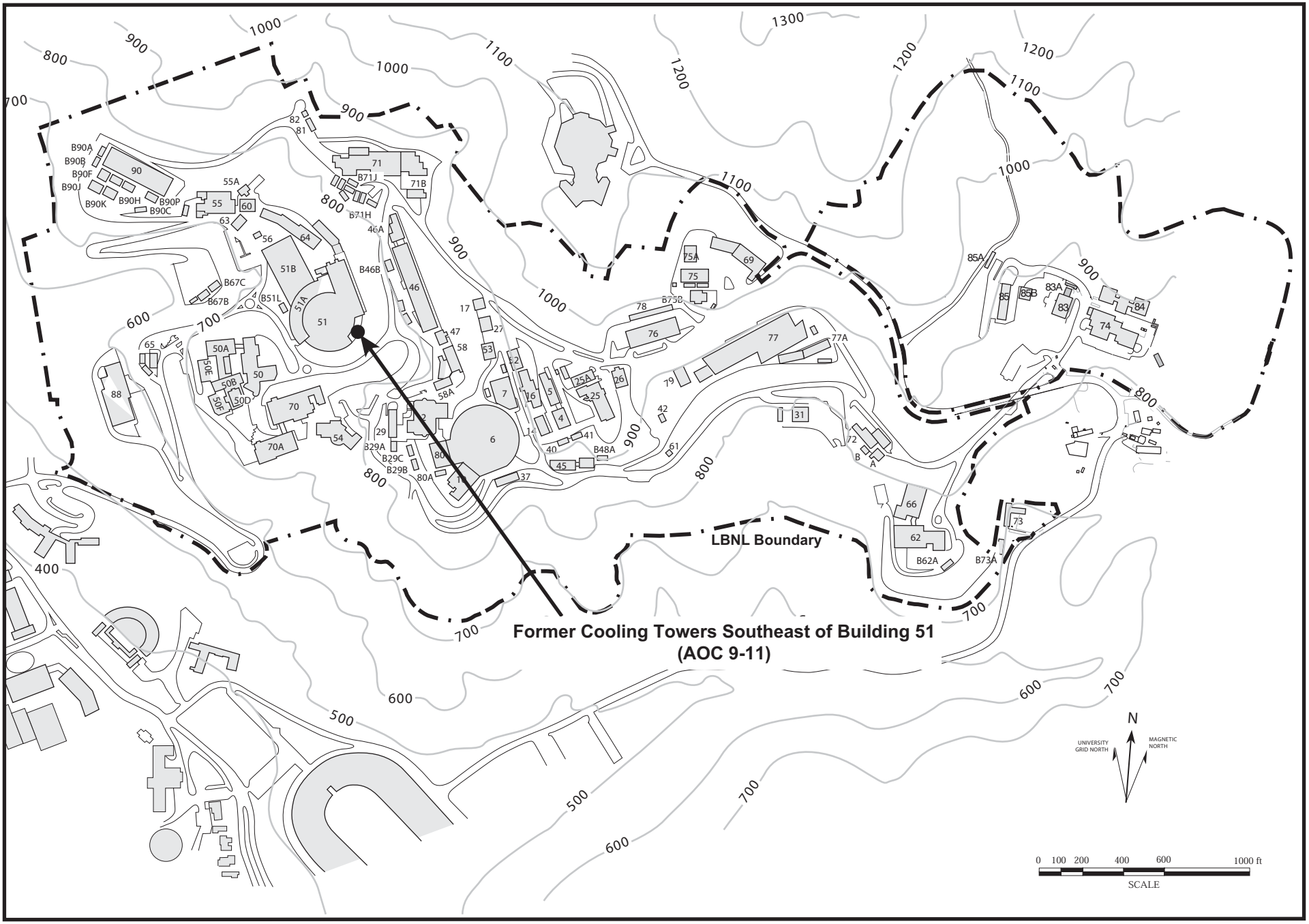


Figure 1. **Map of Lawrence Berkeley National Laboratory and Location of Former Cooling Towers Southeast of Building 51 (AOC 9-11).**

1-LocMap.ai
10/99

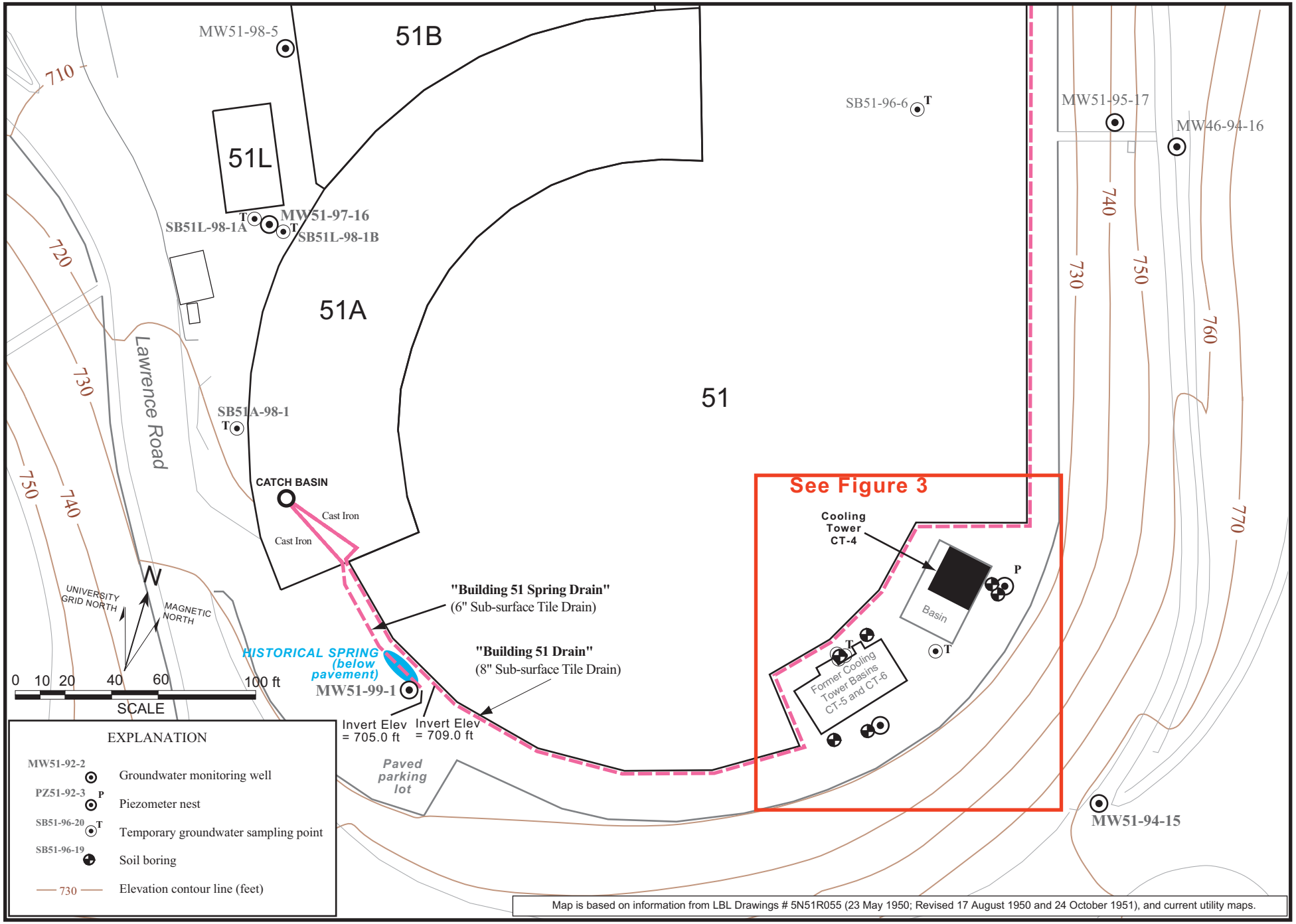


Figure 2. Map of the Southern Portion of the Building 51 Area.

2-B51.ai
3/00

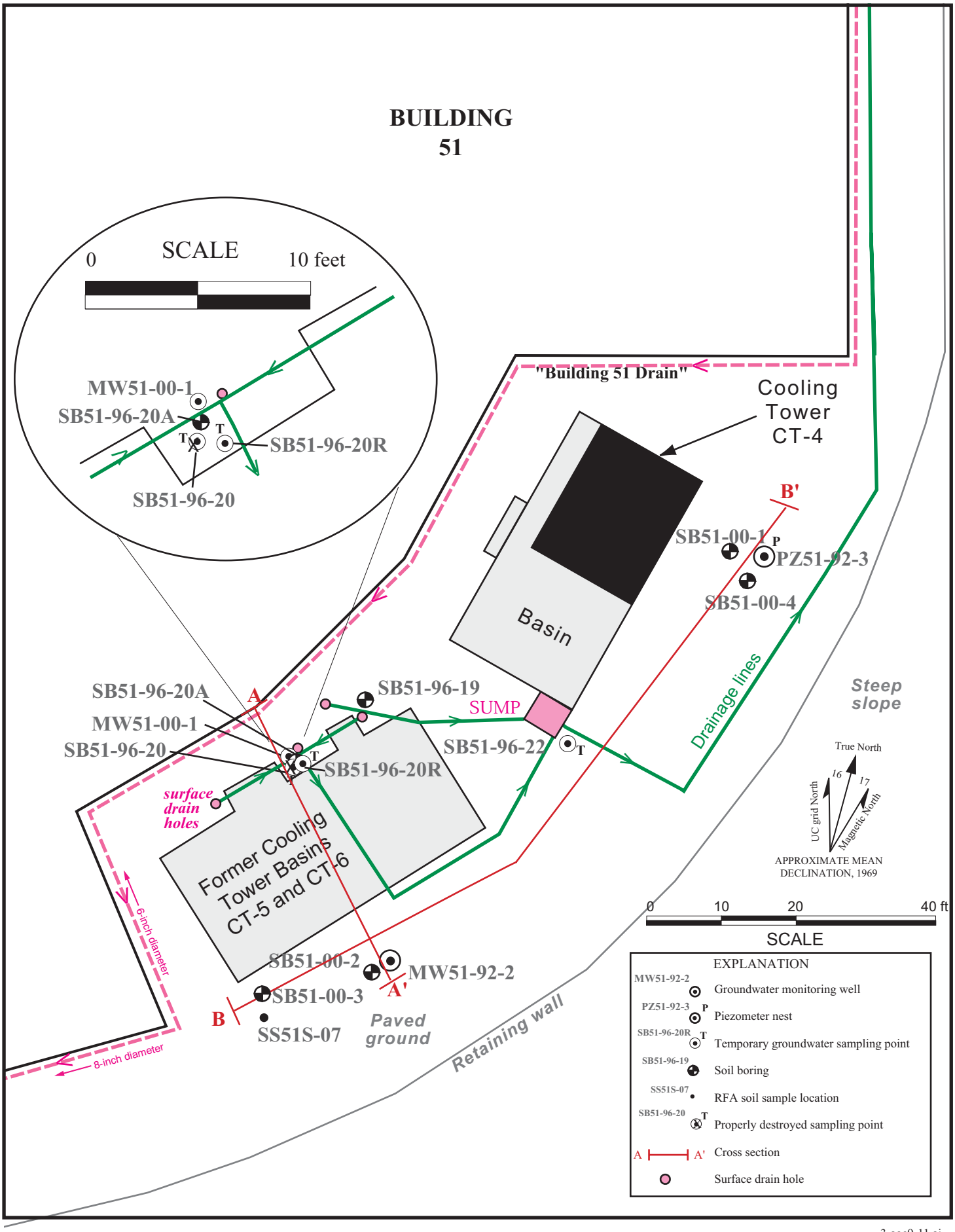
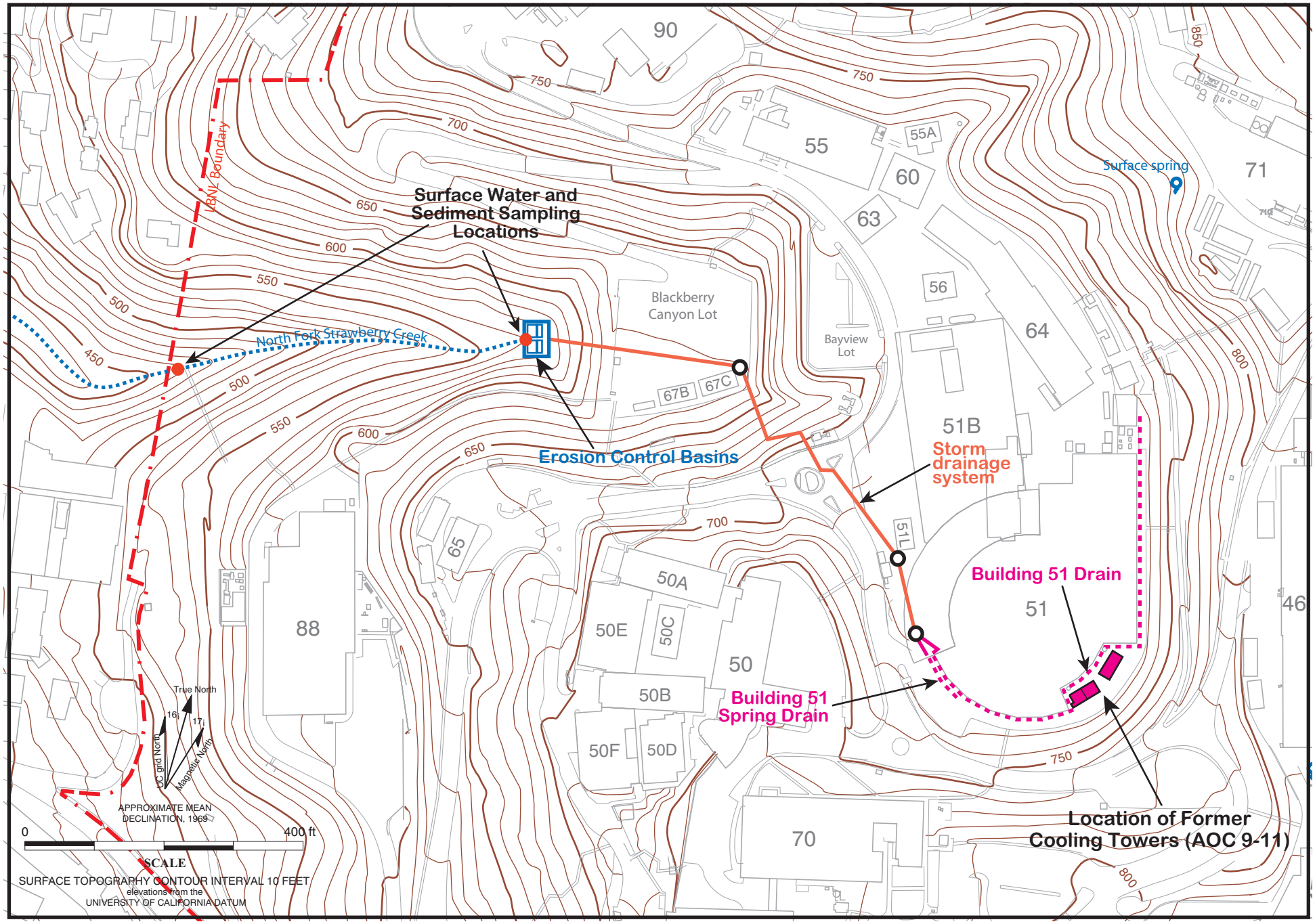


Figure 3. Site Map, Former Cooling Towers Southeast of Building 51 (AOC 9-11).

3-aoc9-11.ai
2/00



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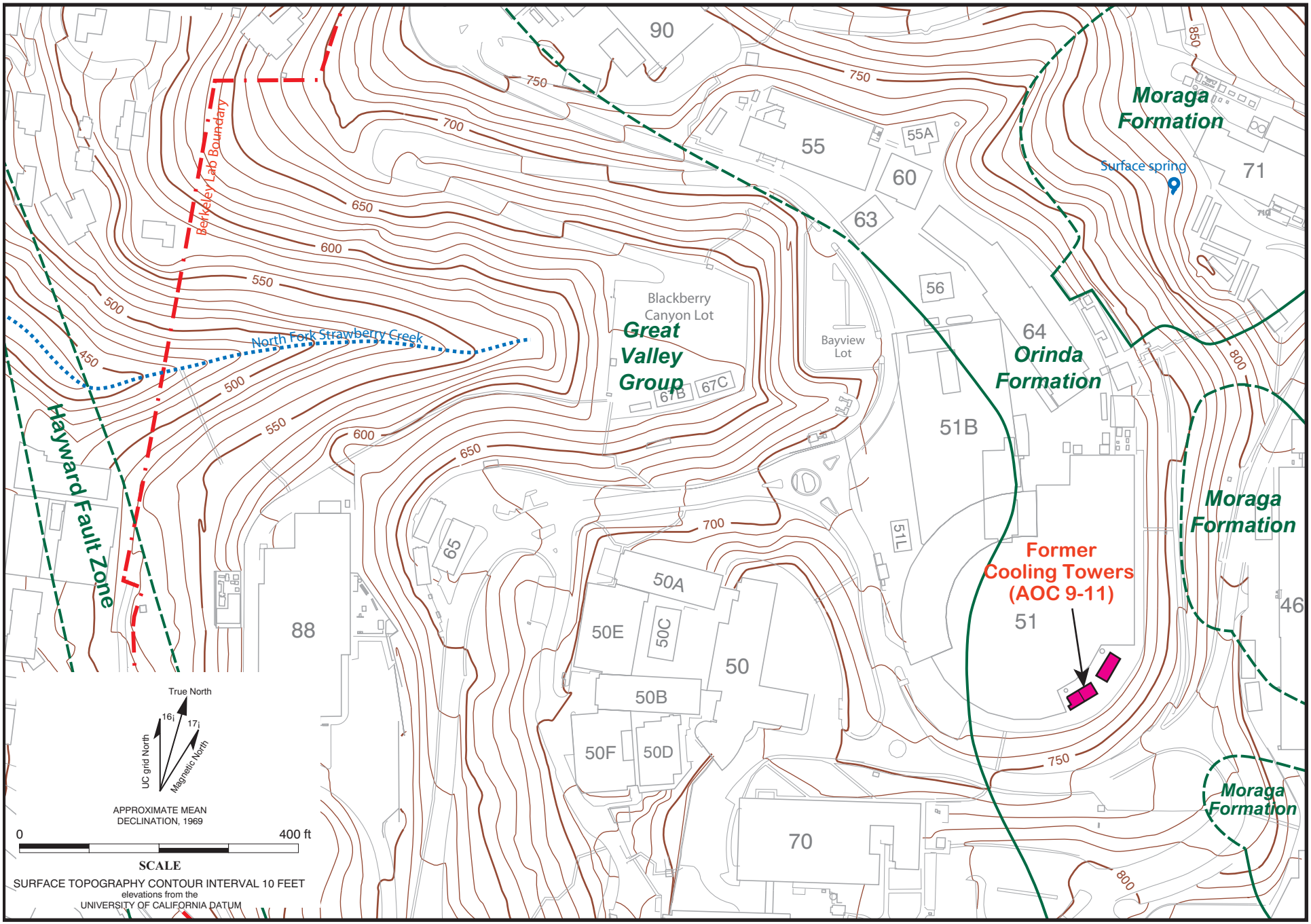
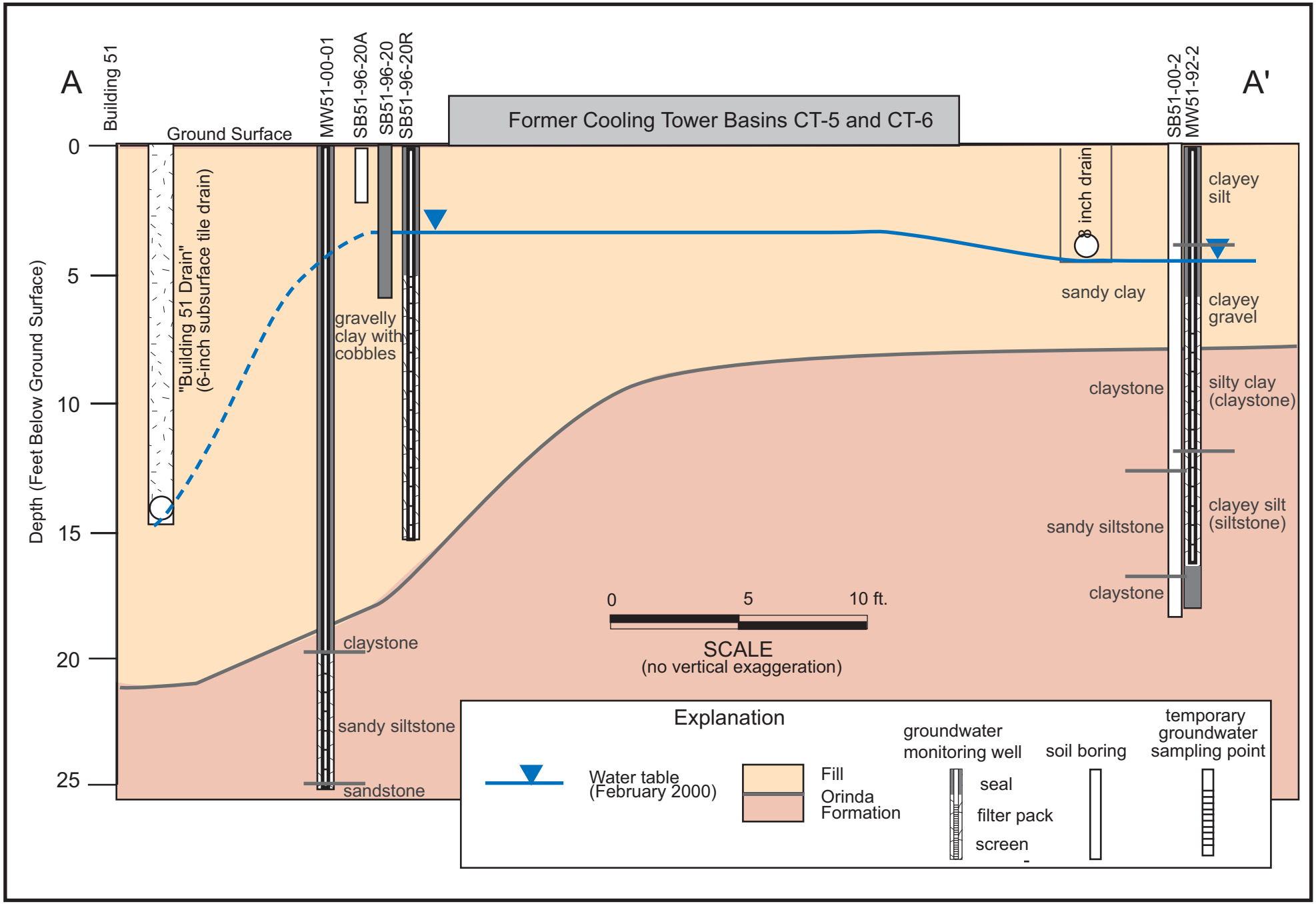


Figure 5. Bedrock Geology Map in the Vicinity of the Former Cooling Towers Southeast of Building 51 (AOC 9-11).

5-AOC9-11geol.ai
3/2000



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7-XsecAA.ai
10/99

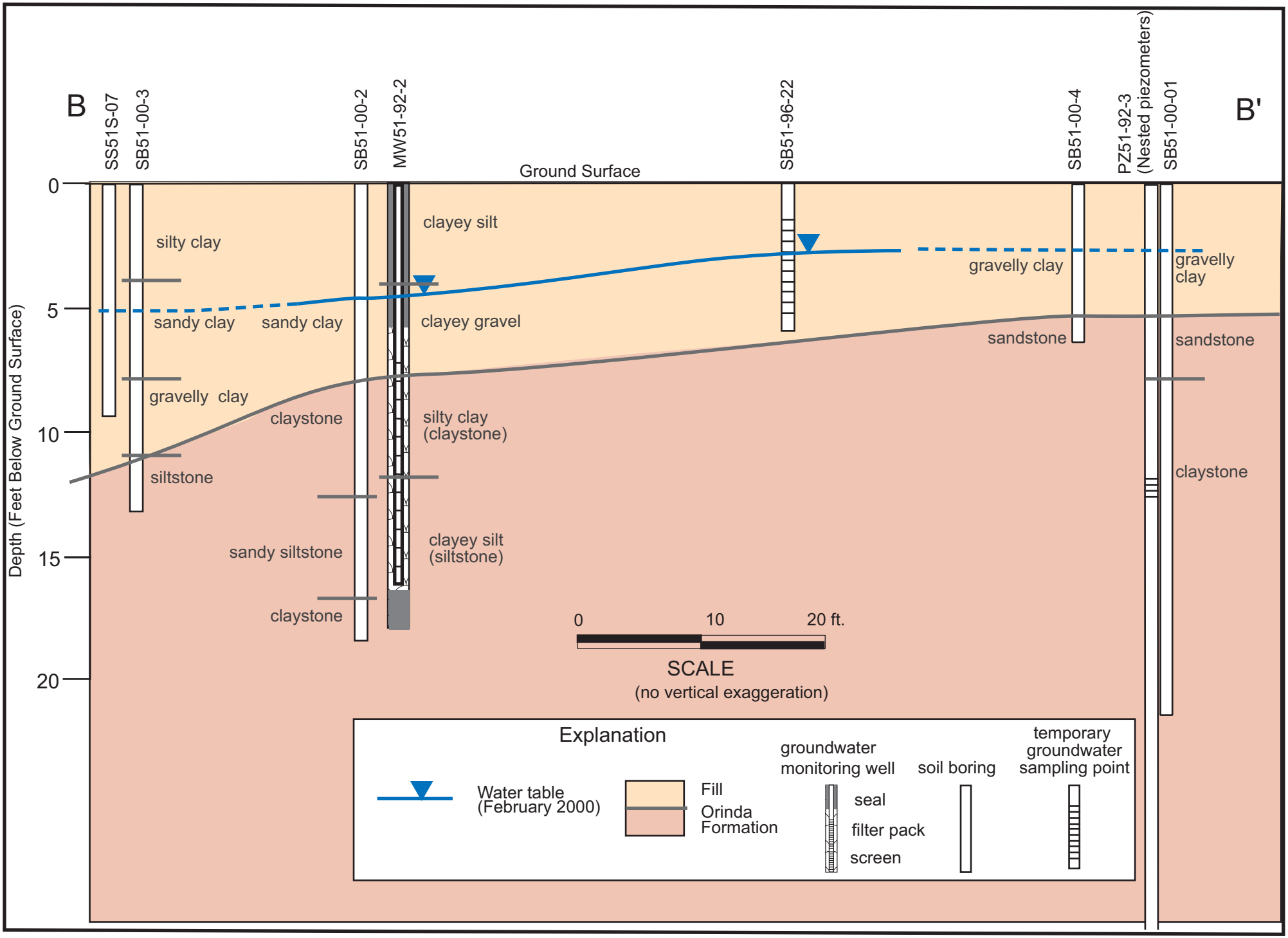
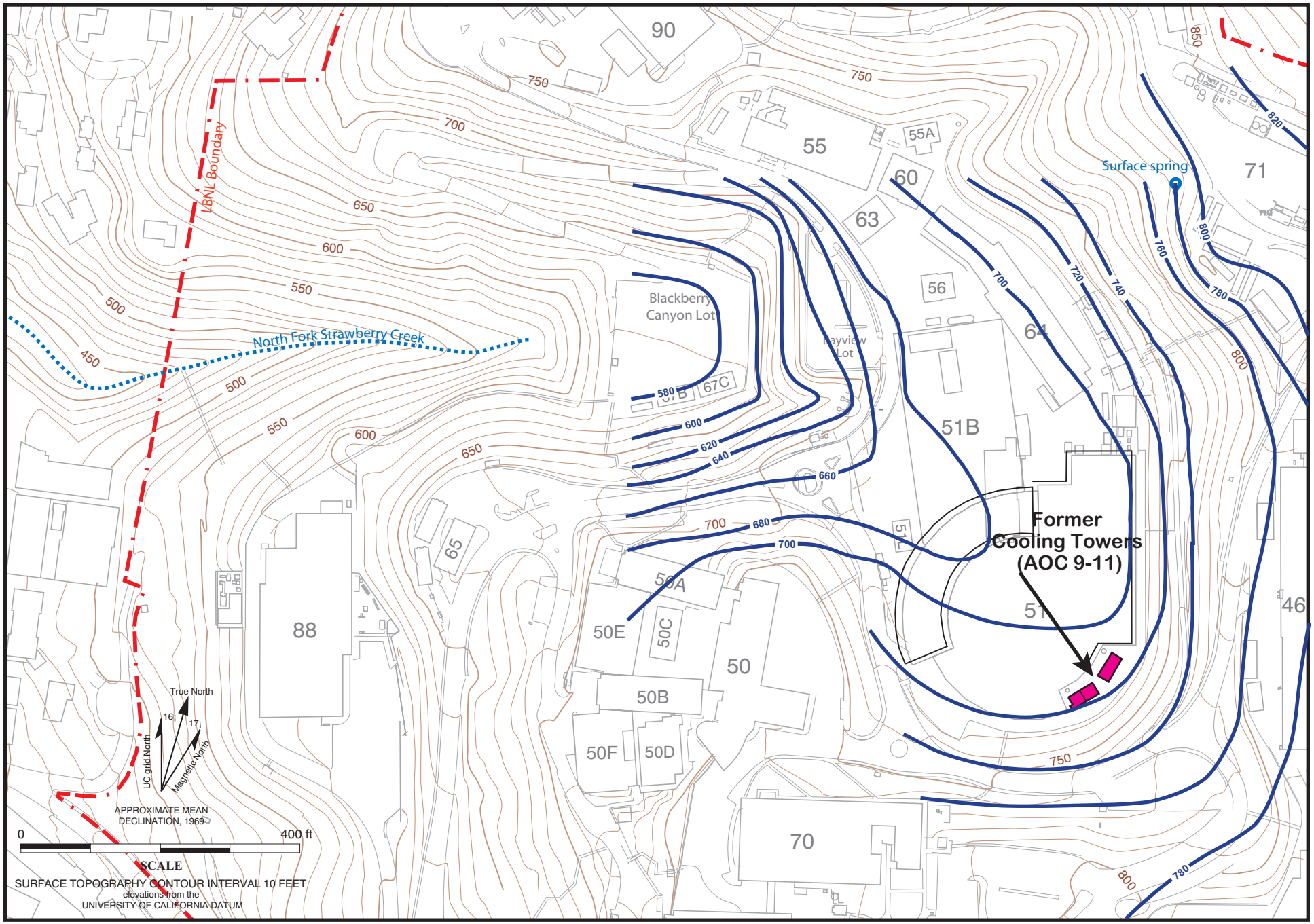


Figure 7. **Cross Section B-B' Showing Geology, Former Cooling Towers Southeast of Building 51 (AOC 9-11).**

7-XseB-B.ai
2/00



8-WLMap.ai
3-2000

Figure 8. Water Level Elevation Map (4th Quarter Fiscal Year 1999), Former Cooling Towers Southeast of Building 51 (AOC 9-11).

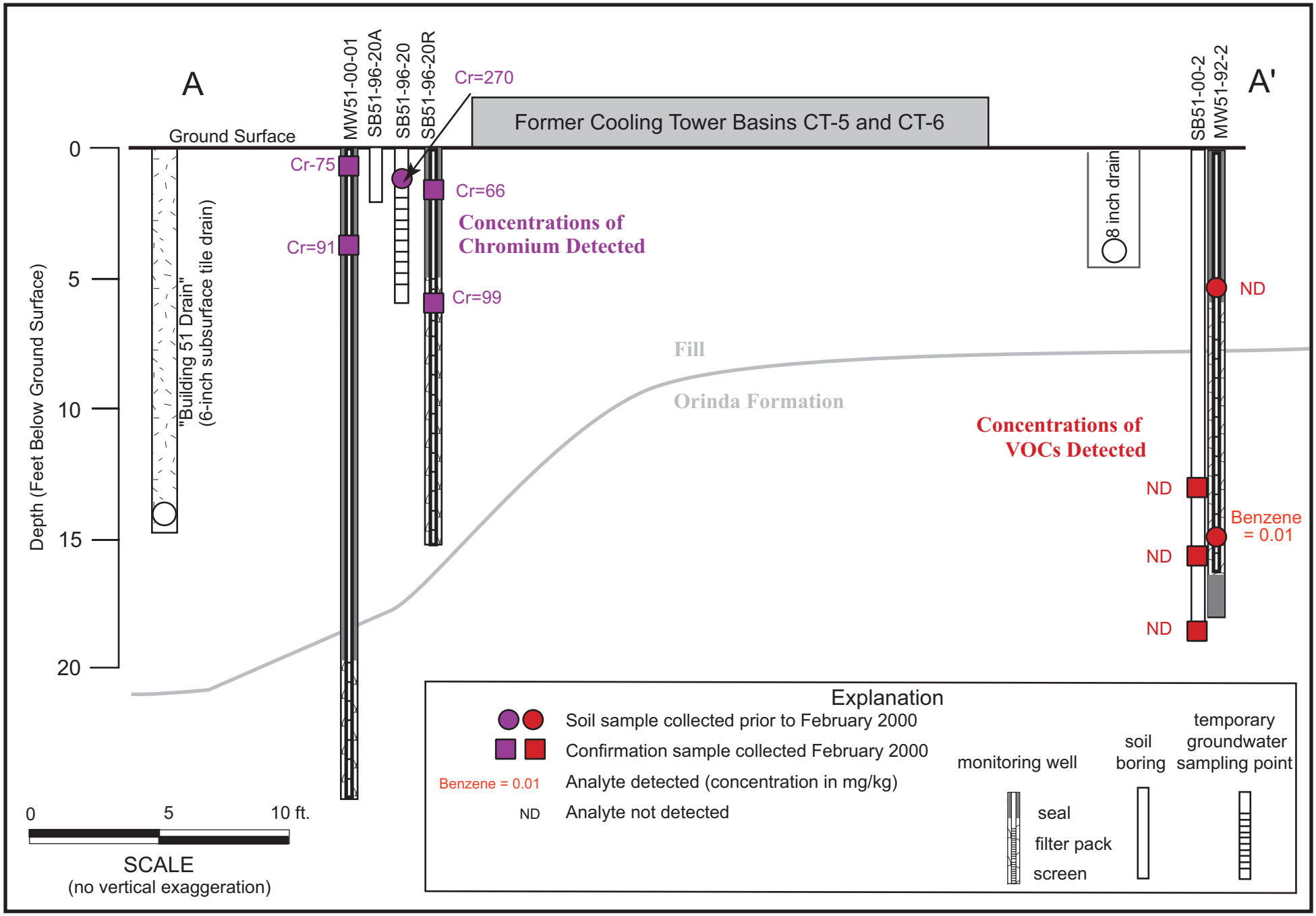


Figure 9. **Cross Section A-A' Showing Soil Sampling Results, Former Cooling Towers Southeast of Building 51 (AOC 9-11).**

9-XsecAA.ai
2/00

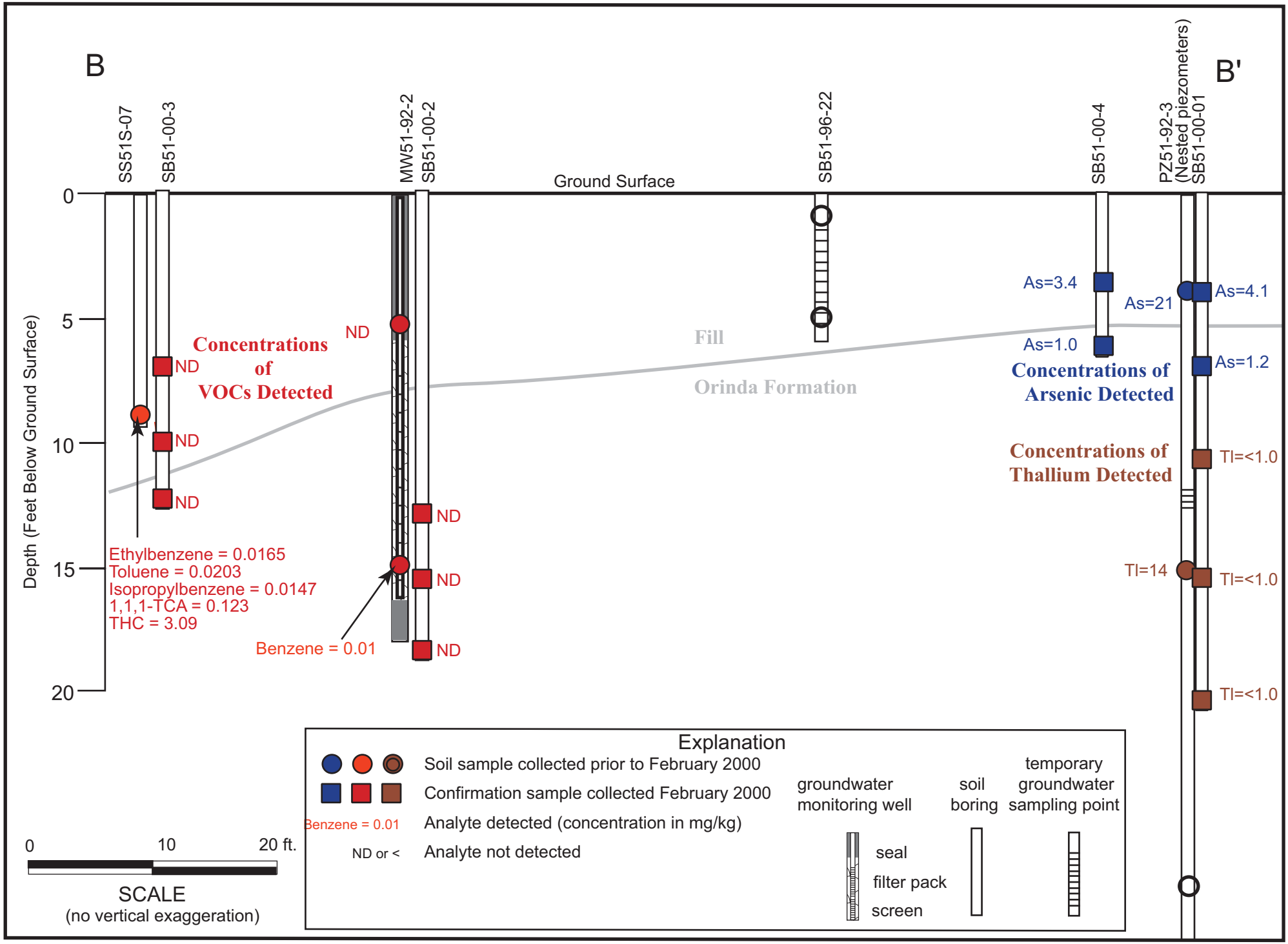
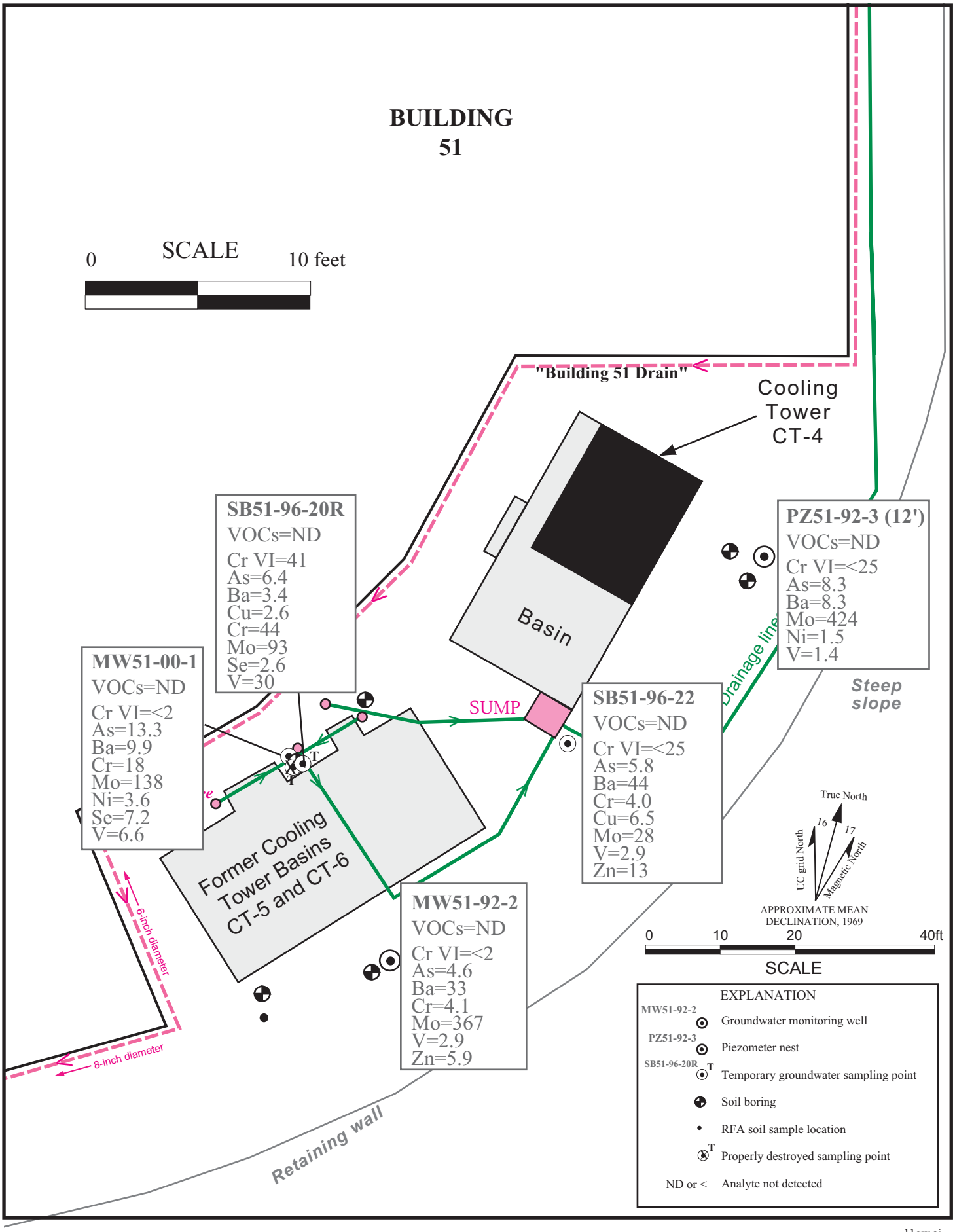


Figure 10. **Cross Section B-B' Showing Soil Sampling Results, Former Cooling Towers Southeast of Building 51 (AOC 9-11).**

10-XseB-B.ai
2/00



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11gw.ai
3/00

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Table 1
Soil Sampling Results for Organics and pH
Former Cooling Towers Southeast of Building 51 (AOC 9-11)

			Analyte	VOCs		SVOCs	Total Hydrocarbons	pH
			Method	8240	8260	8270		9040
Boring/Sample	Depth (feet bgs)	Date	Lab	mg/kg	mg/kg	mg/kg	mg/kg	S.U.
SS-51S-07	9	Aug-91	H	Ethylbenzene = 0.0165 Toluene = 0.0203 Isopropylbenzene = 0.0147 1,1,1-TCA = 0.123			3.09	
MW51-92-2	5	Mar-92	Q	ND		ND		
	15			Benzene = 0.01				
PZ51-92-3	4	Mar-92	Q	ND		ND		
	15			ND				
	28			ND				
	38			ND				
	49			ND				
	61			ND				
SB51-96-19	1	Apr-96	CLS		ND			9.00
	3				ND			8.53
	5				ND			8.18
SB51-96-20	1	Apr-96	CLS		ND			8.69
SB51-96-22	0.8	Apr-96	CLS		ND			8.75
	5				ND			8.89
SB51-00-2	12.4	Feb-00	BC		ND			
	15				ND			
	18				ND			
SB51-00-3	6.3	Feb-00	BC		ND			
	9.4				ND			
	12				ND			

BC = Analysis by BC Laboratories
CLS - Analysis by California Laboratory Services
H - Analysis by Hydro Geo Chem
Q - Analysis by Quanteq Laboratories

ND = Not Detected
= Not Analyzed

Table 2
Soil Sampling Results for Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)

		Metal	Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		LBNL Estimated Background Level	5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	7.6	74.3	106.1
		USEPA Region 9 PRGs	30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
		California Modified PRGs					9		0.2			130			150					
Boring/Sample	**Depth (feet bgs)**	**Date**	*All results given are in mg/kg*																	
MW51-92-2	5	Mar-92	<2	9.0	93	0.6	0.4	71		18	20	10	<0.2	<0.6	49	<2	<0.2	<3	61	54
	15		<2	9.0	330	0.8	0.2	89		14	33	12	<0.2	0.6	110	<2	<0.2	<3	44	67
PZ51-92-3	4	Mar-92	<2	**21**	110	0.7	0.3	77		16	22	10	<0.2	<0.6	81	<2	<0.2	<3	65	46
	15		<2	9.0	280	0.9	0.4	110		23	34	17	<0.2	1.1	120	<2	<0.2	**14**	56	87
	28		<2	14	300	0.9	0.5	100		13	32	14	<0.2	1.6	110	<2	<0.2	6.0	62	85
	38		<2	6.0	240	1.0	0.2	39		10	60	14	<0.2	1.4	40	<2	<0.2	<3	51	76
	49		<2	6.0	260	0.9	<0.2	35		11	22	14	<0.2	1.2	34	<4	<0.2	<3	33	56
	61		<2	14	280	0.7	0.2	34		14	26	13	<0.2	<0.6	54	2.0	0.4	<3	36	71
SB51-96-19	1	Apr-96	<5	11	130	0.39	1.6	64		14	18	12	0.061	<2.5	59	0.3	<1	<4	51	51
	3		<5	3.1	160	0.39	1.8	70		13	21	15	<0.05	<2.5	68	<0.5	<1	<4	58	54
	5		<5	3.9	160	0.36	1.6	76		18	18	12	<0.05	<2.5	74	0.5	<1	<4	63	48
SB51-96-20	1	Apr-96	<5	4.8	150	0.38	1.6	**270**		12	22	16	<0.05	<2.5	69	<0.5	<1	<4	49	56
SB51-96-20A	1.1	Sep-96							<0.2											
	2.1								<1.0											
SB51-96-22	0.8	Apr-96	<6	3.0	37	0.23	<0.5	49		8.0	25	4.6	0.06	<2.5	32	<0.5	<1	<4	37	46
	5		<6	2.6	35	0.20	<0.5	38		6.2	32	5.9	<0.05	<2.5	27	<0.5	<1	<4	31	58
SB51-96-20R	1.5	Feb-00						66												
	5.4							99												

Table 2 (Cont'd)
Soil Sampling Results for Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)

		Metal	Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		LBNL Estimated Background Level	5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	7.6	74.3	106.1
		USEPA Region 9 PRGs	30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
		California Modified PRGs					9		0.2			130			150					
Boring/Sample	**Depth (feet bgs)**	**Date**	*All results given are in mg/kg*																	
MW51-00-1	1	Feb-00						75												
	5							91												
SB51-00-1	3:3	Feb-00		4.1																
	6			1.2																
	10.1																	*<1*		
	15																	*<1*		
	20																	*<1*		
SB51-00-4	3	Feb-00		3.4																
	6			1.0																

	= Not analyzed
<5	= Not detected above quantitation limit
270	= Concentration (shown in boldface font) is above both background and PRG.

Table 3
Groundwater Sampling Results for Organics and Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)
Concentrations in µg/L

			Metals												
Sample Location	Sample Date	VOCs	Sb	As	Ba	Cd	Cr	CrVI	Cu	Pb	Mo	Ni	Se	V	Zn
		MCL:	6	50	1000	5	50	(a)	1000(b)	15(c)	none	100	50	none	5000(b)
SB51-96-20	Apr-96	ND	<50	7.2	21	<10	31		<10	<50	220	<50	<2	<20	<20
	Sep-96							3.0							
	Nov-96							26							
	Nov-96							45							
	Nov-96(S)							93							
	Dec-97							49							
	Dec-97(D)							56							
	Oct-99							<2.0							
SB51-96-20R	Feb-00	ND	<2	6.4	3.4	<2	44.1	41	2.6	<1	92.9	<1	2.6	30.2	<5
SB51-96-22	Apr-96	Chloroform = 2.1 1,1-DCA = 1.0	<50	3.7	<50	<40	<50		<50	<40	125	<50	<1	<50	<20
	Nov-96	ND													
	Dec-97							<10							
	Dec-97(D)							<10							
	Oct-99							<2.0							
	Feb-00	ND	<2	5.8	43.9	<2	4	<25	6.5	<1	27.6	<1	<2	2.9	13.4
MW51-92-2	Dec-92	ND	<2	43	<32.5	<33	3.9		4.7	<31	840	<8	9.3	<6.7	<38.5
	Mar-93	ND													
	Jun-93	ND	<10	50	60	<9	<7		<5.5	<43.5	970	<61	<1	<24.5	<16.5
	Aug-93	ND													
	Oct-93	ND													
	Feb-94	ND	<100	10	20	<10	<10		10	<50	610	<50	<10	<10	20
	Aug-94	All ND*													
	Feb-95	ND													
	May-95		<4	10	<100	<5	<10		<10	<5	350	<50	<2	<50	<10
	Sep-95	ND													
	Feb-96	ND	<50	11.7	<50	<40	<50		<50	<40	386	<50	<1	<50	<20
	Jun-96					<5									
	Aug-96	ND													
	Mar-97	ND													
	May-97		<4	9.0	<50	<5	<5		<5	<5	460	<50	<2	<5	<20
	Aug-97	ND													
	May-98	ND		11							404				
	May-99	ND		14.4							430				
	Jun-99							<2							
	Feb-00	ND	<2	4.6	33.2	<2	4.1	<2	<1	<1	367	<1	<2	2.9	5.9

Table 3 (Cont'd)
Groundwater Sampling Results for Organics and Metals
Former Cooling Towers Southeast of Building 51 (AOC 9-11)
Concentrations in µg/L

			Metals												
Sample Location	**Sample Date**	**VOCs**	**Sb**	**As**	**Ba**	**Cd**	**Cr**	**CrVI**	**Cu**	**Pb**	**Mo**	**Ni**	**Se**	**V**	**Zn**
		MCL:	**6**	50	1000	5	50	(a)	1000(b)	15(c)	none	100	50	none	5000(b)
PZ51-92-3-12 ft	Nov-93	ND													
	Jan-00		<1	8.6	5.9	<1	5.5		<1	<1	360	1.7	<2	4.2	<5
	Feb-00	ND	<2	8.3	8.3	<2	<1	<25	<1	<1	424	1.5	<2	1.4	<5
PZ51-92-3-32 ft	Nov-93	ND	<100	20	<100	<5	30		<10	<5	148	<50	2.6	<50	80
	Jan-00		4.1	6.9	21.7	<1	14.2		6.9	<1	75.5	<1	<2	5.0	<5
PZ51-92-3-42 ft	Nov-93	ND	<100	22	<100	5.7	27		<10	7.4	239	<50	5.2	<50	90
	Jan-00		<1	11.5	12.2	<1	5.6		<1	<1	344	2.3	<2	3.1	5.5
PZ51-92-3-52 ft	Nov-93	ND	<100	19	<100	<5	21		<10	5.2	282	<50	6.6	<50	63
	Jan-00		1.0	12.6	21.4	<1	7.2		1.3	<1	380	2.3	<2	4.2	8.1
PZ51-92-3-62 ft	Nov-93	ND	<100	18	<100	<5	14		<10	10.8	370	<50	<2	<50	61
	Jan-00		<1	22.7	56.1	<1	7.2		<1	<1	489	1.2	<2	3.1	7.5
MW51-00-1	Feb-00	ND	<2	13.3	9.9	<2	18		<1	<1	138	3.6	7.2	6.6	<5
			<4	8.6	<100	<0.2	<10	<2	<10	<5	120	<10	7.1	<10	<10

(S) = split sample
(D) = duplicate sample
ND = not detected above quantitation limit
< = not detected above quantitation limit
= not analyzed
* = No SVOCs detected (EPA Method 8270) and TPH-D <200 in Aug-94 samples.
(a) = same as for total chromium (50 ug/L)
(b) = secondary MCL
(c) = action level
Metals shown above are those detected in at least one sample at the site.
Metals not detected in any samples: beryllium, cobalt, mercury, silver, and thallium.

Table 4a
North Fork Strawberry Creek Surface Water Sampling Results
VOCs

Location	Date		8260 µg/L
North Fork Strawberry Creek	Feb-93	(L)	ND
	Feb-93 (a)	(L)	ND
	Apr-93	(L)	ND
	Aug-93	(L)	ND
		(L)	ND (D)
	Mar-94	(L)	ND
	Jul-94	(L)	ND
		(BC)	ND (D)
	Jan-95	(BC)	ND
	May-95	(BC)	**1,1,1-TCA=0.95**
		(BC)	**1,1,1-TCA=0.91 (D)**
	Jul-95	(L)	ND
	Jan-96	(L)	ND
	Apr-96 (b)	(L)	ND
	Apr-97	(L)	ND
	Jan-98	(L)	ND
	Apr-98	(L)	ND
	Apr-99	(L)	ND
	Jan-00	(L)	ND

(BC) - Analysis by BC Laboratories
(L) = Analysis by LBNL
(D) = Duplicate sample

ND = Not detected above quantitation limit

(a) = Women's Faculty Club on the U.C. Berkeley campus
(b) = Sample missed holding time for 8260 analysis

Table 4b
North Fork Strawberry Creek Surface Water Sampling Results
Metals
(All Concentrations in µg/L)

			Sb	As	Ba	Be	Cd	Cr	Cr6	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
		MCL:	6	50	1000	4	5	50		NS	1000 (a)	15 (b)	2	NS	100	50	100 (a)	2	NS	5000 (a)
LOCATION	LAB	DATE																		
North Fork Strawberry Creek	(C)	Aug-93	<20	<5	96	<1	<1	<10		<10	<5	<10	<1	15	<20	<10	7	<10	<10	93
			<20	<5	45	<1	<1	<10		<10	<5	<10	<1	<5	<20	<10	<5	<10	40	8
	(BC)	Jul-94	<100	<2	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
			<100	2	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	(BC)	Jul-95	<4	<2	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	(BC)	Jan-96	<4	2.4	<100	<10	<5	<10		<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	LBNL	Apr-96	<50	<2	<50	<5	<40	<50		<50	<50	<40	<0.20	<50	<50	<1	<50	<50	<50	<20
	LBNL	Apr-97	<4	<2	104	<4	<5	<5		<5	<5	<5	<0.20	<50	<50	<2	<5	<1	<5	<20
	LBNL	Jan-98	<1	<2	40.2	<1	<1	<5		<5	2.3	<1	<0.10	<5	<5	<2	<1	<1	4.3	8.8
	LBNL	Apr-98	<1	<2	48.7	<1	<1	1.0		<1	1.9	2.9	<0.20	1.4	<1	5.2	<1	<1	5.1	6.9
	LBNL	Apr-99	<1	4.2	76.9	<1	<1	8.6		<1	1.2	<1	<0.25	2.5	<1	4.5	<1	<1	15.9	9.3
	BC	Jul-99							4.2											
	BC	Jul-99							<2											
	LBNL	Jan-00	<1	<2	41.0	<1	<1	2.5		<1	4.6	<1	<0.10	1.6	1.5	<2	<1	<1	5.4	51.6
	BC	Jan-00							<2											

MCL: Maximum contaminant level for drinking water (determined by California DTSC)
(BC) = Analysis by BC Laboratories
(C) = Analysis by Chromalab
LBNL: Analysis by Lawrence Berkeley National Laboratory

(a): secondary MCL
(b): action level
NS: Not Specified

< = Not detected above quantitation limit
= Not analyzed

Table 5a
North Fork Strawberry Creek Sediment Sampling Results
Organics and Fuels

Location	Sample ID	Date	Lab	8240 mg/kg	TPH-Gas mg/kg	TPH-Diesel mg/kg
North Fork Strawberry Creek	SSBC-1/2A-0.4	Apr-93	Q	ND	49*	<0.2
	SSBC-3/4A-0.5			Toluene 0.013	<5*	<0.2

BC = Analysis by BC Laboratories
Q = Analysis by Quanteq
* = Oil detected

ND = Not detected above quantitation limit
< = Not detected above quantitation limit

Table 5b
North Fork Strawberry Creek Sediment Sampling Results
Metals
(Concentrations in mg/kg)

Location	Sample ID	Date	Lab	Sb	As	Ba	Be	Cd	Cr	Cr6	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
North Fork Strawberry Creek	SSBC-1/2A-0.4	Apr-93	Q	<2	3	140	<0.2	0.6	59		8.9	47	180	0.3	0.6	32	<2	3.5	<3	28	160
	SSBC-3/4A-0.5	Apr-93	Q	<2	5	79	<0.2	0.6	45		11	40	53	0.6	<0.6	38	<2	<0.2	<3	35	160
	SS-ERBAS-N-L-1-0	Jan-95	BC											<0.2							
	SS-ERBAS-N-U-1-0													<0.2							
	SS-ERBAS-S-U-1-0													<0.2							
	SS-ERBAS-S-L-1-0													<0.2							
	SS-ERBAS-S-U-2-0	Jul-95	BC	<5	2.6	334	<0.5	<0.5	36		6.8	28	17	<0.2	<2.5	26	<0.5	<1	5.4	31	130
	SS-ERBAS-S-U-3-0			<5	1.9	93	<0.5	0.57	42		6.5	38	73	<0.2	<2.5	29	<0.5	<1	<5	32	259
	SS-ERBAS-S-U-4-0			<5	2.0	52	<0.5	0.5	33		8.0	55	45	0.22	<2.5	27	<0.5	<1	<5	29	182
	SS-ERBAS-S-U-5-0			<5	2.5	47	<0.5	<0.5	79	<1	6.8	216	69	<0.2	<2.5	27	<0.5	<1	<5	32	314
	SS-Nfstraw-96-1A-0	Aug-96	BC	<10	3.5	98	<1	<1	129		7.1	19	17	<0.2	15	105	1.0	<2	<10	37	109
	SS-Nfstraw-96-2A-0			<10	4.7	83	<1	1.2	43		8.7	30	49	<0.2	<5	27	1.6	<2	<10	53	108
	SS-Nfstraw-96-3A-0			<10	9.2	1300	<1	2.5	21		13	44	21	<0.2	<5	181	2.6	<2	<10	48	148
	SS-Nfstraw-96-4A-0			<10	4.1	78	<1	<1	31		6.1	18	20	<0.2	<5	20	1.1	<2	<10	37	115
	SS-Nfstraw-96-5A-0			<10	4.2	81	<1	<1	29		7.3	26	19	<0.2	<5	22	1.0	<2	<10	49	144
North Fork Strawberry Creek Boundary/Fence Line	SS-NFStraw-FL-99-1-0	Jul-99	BC							<0.1											
North Fork Strawberry Creek Erosion Control Basin	SS-NFStraw-BSN-99-1-0									<0.1											

BC = Analysis by BC Laboratories
Q = Analysis by Quanteq

< = Not detected above quantitation limit
= Not analyzed

Table 6
Building 51 Drain Water Sampling Results
Organics and Hexavalent Chromium
Former Cooling Towers Southeast of Building 51 (AOC 9-11)
Concentrations in µg/L

Sample Location and Date	VOCs	CrVI
Building 51 Drain		
Nov-98	MTBE = 0.83	<2
Dec-98	PCE = 68.4 TCE = 26.9 cis-1,2-DCE = 11.2 1,1-DCA = 2.0	4

E.O. Lawrence Berkeley National Laboratory
University of California
Environmental Restoration Program

United States Department of Energy

REQUEST FOR NO FURTHER INVESTIGATION (NFI) STATUS

for

BUILDING 51 SANITARY SEWER AND DRAINAGE SYSTEM

(AOC 9-9)

for the

Lawrence Berkeley National Laboratory

ENVIRONMENTAL RESTORATION PROGRAM

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A Joint Effort of
Environment, Health and Safety Division, and
Earth Sciences Division,
Lawrence Berkeley National Laboratory
University of California
Berkeley, California 94720

April 2000

This work was done at the Lawrence Berkeley Laboratory operated by the University of California for the U. S. Department of Energy under contract DE-AC03-76SF00098.

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LIST OF ABBREVIATIONS

AOC	Area of Concern
Berkeley Lab	Lawrence Berkeley National Laboratory
Cal/EPA	State of California Environmental Protection Agency
CAP	Corrective Action Program
CMS	Corrective Measures Study
COPCs	Chemicals of Potential Concern
DCA	dichloroethane
DCE	dichloroethene
DTSC	Department of Toxic Substances Control (Cal-EPA)
EBMUD	East Bay Municipal Utilities District
GAC	granular activated carbon
ICMs	Interim Corrective Measures
MCLs	Maximum Contaminant Limits
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
NFA	No Further Action
NFI	No Further Investigation
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene (perchloroethylene)
PRGs	preliminary remediation goals
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
SVOCs	semi-volatile organic compounds
SWMU	solid waste management unit
TCA	trichloroethane
TCE	trichloroethene
TPH	Total Petroleum Hydrocarbons
USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds

SECTION 1

INTRODUCTION

1.1 PURPOSE

The purpose of this report is to document the environmental investigations conducted at the Building 51 Sanitary Sewer and Drainage System (Area of Concern [AOC] 9-9), and request approval of No Further Investigation (NFI) status for AOC 9-9 under the Resource Conservation Recovery Act (RCRA) Corrective Action Program (CAP) at Lawrence Berkeley National Laboratory (Berkeley Lab). The California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) is the lead regulatory agency for the CAP and has the authority to approve NFI status for this unit. If NFI status is approved, no additional site characterization will be required; however, the unit will still be included in the site-wide risk assessment. A map of Berkeley Lab showing the location of AOC 9-9 is included as Figure 1.

1.2 CHRONOLOGY OF REGULATORY REVIEW OF AOC 9-9

Berkeley Lab previously submitted a request to the DTSC for approval of NFI status for AOC 9-9 in January 1999 (Berkeley Lab, 1999a). Following is the chronology of Berkeley Lab's previous submittal, DTSC's comments on the request, and Berkeley Lab's responses to comments.

- January 1999 — Berkeley Lab submitted a request for No Further Action (NFA) or NFI Status for selected Solid Waste Management Units (SWMUs) and AOCs, including AOC 9-9 (Berkeley Lab, 1999a).
- April 1999 — DTSC provided comments on Berkeley Lab's request in a Notice of Deficiency (DTSC, 1999a).
- May 1999 — Berkeley Lab responded to the comments in the Notice of Deficiency (Berkeley Lab, 1999b). Berkeley Lab stated that additional site characterization work for AOC 9-9 would be proposed in a workplan that would be submitted to DTSC for review and approval.

- December 1999 Berkeley Lab submitted a workplan to DTSC for further investigation of the Building 51 Sanitary Sewer and Drainage System (Berkeley Lab, 1999c)

- February 2000 DTSC approved Berkeley Lab's workplan (DTSC, 2000).

1.3 SCOPE

Several concurrent investigations and Interim Measures (IMs) were conducted at AOC 9-9 between November 1990 and February 2000. The objectives of these activities were:

- To identify the source of contamination and contaminant migration pathways
- To evaluate the magnitude and extent of contamination
- To reduce the potential impact to soil and groundwater
- To remove accessible soil with concentrations of polychlorinated biphenyls (PCBs) above 1 mg/kg (the United States Environmental Protection Agency's [USEPA]) self-implementing cleanup level ("walk away" level) for soil in high occupancy areas (USEPA 1998).

The history of the site and the geology and hydrogeology are described in Section 2 of this current NFI request. The environmental investigations and (IMs) that have been conducted at the site are summarized in Section 3. The summary includes information contained in the January 1999 NFI approval request (Berkeley Lab, 1999a) and the December 1999 workplan (Berkeley Lab, 1999c). In addition, the results of the environmental activities conducted in accordance with the December 1999 workplan are reported in Section 3. The rationale for requesting NFI status for AOC 9-9 is provided in Section 4.

SECTION 2

DESCRIPTION OF UNIT

2.1 SITE DESCRIPTION AND HISTORY

A variety of oil-containing equipment was operated and/or stored in the Motor Generator Room of Building 51 (the Bevatron) and its basement, including oil pumps, capacitors, and transformers. There were also two oil pumps in the basement that delivered oil to the motor generators on the main floor.

The configuration of the subfloor drainage system for the Building 51 Motor Generator Room basement is shown on Figure 2. The system consists of a terra cotta subdrain approximately 1.5 feet below the basement floor and a parallel cast iron pipe at a depth of 4 to 5 feet. The cast iron pipe is part of a larger drainage system that collects water from the Building 51 complex and empties into a discharge sump located at the north end of the Motor Generator Room basement. Several wells and subdrains are used to dewater the hillside immediately east of Building 51. This dewatering system discharges to the filter sump at the south end of the Motor Generator Room basement. Water from the filter sump is conveyed through the cast iron pipe to the discharge sump. The underground utility drawings for Building 51 indicate that the terra cotta drain and the cast iron pipe are not connected. However, a connection was discovered at the north end of the basement in 1999, when the two drain lines were exposed.

During most of its history, the effluent from the discharge sump was discharged to the sanitary sewer. However, prior to 1962, and for a period between 1994 and 1996, when contaminants were not detected in the effluent, the sump contents emptied to the storm drain system that discharges to North Fork Strawberry Creek. Currently, the effluent from the discharge sump is treated by a granular activated carbon (GAC) system and discharged to the sanitary sewer under Berkeley Lab's East Bay Municipal Utility District (EBMUD) discharge permit.

On November 12, 1990 during a routine inspection, Berkeley Lab personnel observed that water in the filter sump was covered with black oil that was found to contain PCBs. Based on this occurrence, the DTSC RCRA Facility Assessment (RFA) (DTSC, 1991) identified the Building 51 PCB Spill Sumps and Drainage system as AOC #1. The Berkeley Lab RFA (Berkeley Lab, 1992) identified the filter sump as Solid Waste Management Unit (SWMU) 9-6. Berkeley Lab later designated the impacted section of the drainage line and the discharge sump as AOC 9-9, which is the subject of this NFI request. DTSC has approved NFI status for SWMU 9-6 (DTSC, 1999b), based on a previous request (Berkeley Lab, 1999d).

2.2 GEOLOGY AND HYDROGEOLOGY

The bedrock geology of the Building 51 area is shown on Figure 3. Depth to bedrock is approximately 1.5 to 2 feet below the top of the concrete floor in the Motor Generator Room basement. The bedrock is composed of interbedded silty claystone, clayey siltstone, and sandy siltstone of the Orinda Formation. The rock is generally intensely fractured, friable, of low hardness, and little weathered. The basement is located approximately 75 feet east of the geological contact between the Orinda Formation and the Great Valley Group, which underlies the Orinda Formation.

As observed in test pits in the Motor Generator Room basement, depth to groundwater varies from approximately 2 to 5 feet beneath the floor. A water level elevation map of the Building 51 area is shown on Figure 3, and indicates that groundwater flows generally westward. However, it is likely that local groundwater flow directions beneath the basement may be deflected towards the permeable backfill surrounding the drain lines.

The Orinda Formation has a hydraulic conductivity of 10^{-7} to 10^{-9} meters per second, based on lab-wide slug tests performed in monitoring wells. This is the lowest range of hydraulic conductivities measured at Berkeley Lab.

SECTION 3

ENVIRONMENTAL ACTIVITIES

3.1 SCREENING PROCESS FOR NFA OR NFI STATUS

To evaluate which soil sample data might represent environmental contamination, sample analytical results are compared to background levels of chemicals. For compounds that are not naturally occurring, such as many organic compounds, background levels are assumed to be zero, and any detected concentration is assumed to represent contamination, unless potential sample contamination (e.g., laboratory contamination) can be documented. For naturally-occurring constituents such as metals, analytical results are compared to statistically-estimated maximum background levels to identify, to a specified degree of confidence, which constituents are present at concentrations that represent contamination. These statistically-estimated maximum background levels were developed for Berkeley Lab by applying the upper tolerance limit method (USEPA, 1989) to general metals sampling data collected at Berkeley Lab (Berkeley Lab, 1995).

As approved by the DTSC, Berkeley Lab uses USEPA Region IX Preliminary Remediation Goals (PRGs) (USEPA, 1999) as a screening tool to help assess whether further action is required at a site (i.e., whether the unit will be included in the site-wide risk assessment). DTSC PRGs (Cal-Modified PRGs) are used where Region IX PRGs either have not been established, or are greater than the DTSC values. As a conservative measure, PRGs for soil *at residential sites* are used in lieu of the less-stringent PRGs for soil *at industrial sites*.

SWMUs or AOCs where sufficient sampling data have been collected to characterize the magnitude and extent of any contamination and soil contaminant concentrations are less than Berkeley Lab maximum background levels or below PRGs for residential soil are recommended for no further action (NFA) status. If, however, soil contaminant concentrations are greater than both Berkeley Lab maximum background levels and PRGs for residential soil, the unit is recommended for no further investigation (NFI) status.

No further site characterization is required by DTSC for SWMUs and AOCs approved for either NFA or NFI status, and units that are approved for NFA status will not be included in the Corrective Measures Studies (CMS) phase of the RCRA CAP. However, SWMUs and AOCs approved for NFI status will be included in the site wide risk assessment to be conducted as part of the CMS.

3.2 SUMP AND DRAINLINE SAMPLING AND WATER TREATMENT

Investigation and IM activities for AOC 9-9 were initiated in November 1990, when PCB-containing oil was found in the filter sump. Samples collected from the filter sump at that time contained PCBs at maximum concentrations of 110 μg/L (water), 110 mg/kg (oil product), and 3,700 mg/kg (sludge) (Kaldveer Associates, 1991). The oil apparently originated from blown capacitors stored in the basement.

A subsequent survey (Kaldveer Associates, 1991) indicated that lines draining into the filter sump (Lines J and K) and lines downstream from the filter sump (lines A, B, and parts of C, D, and F) contained an oil product. Oil contamination was not detected in the remainder of the building's drain system that was accessible to inspection. The system was flushed, and more than 1,300 gallons of contaminated water were removed, containerized and disposed.

Beginning in November 1990, effluent from the discharge sump was pumped to a GAC system for treatment. Treated effluent from this system was used as makeup water for the Building 51 cooling towers. Eight water samples were collected from the treatment system influent line between March to November 1993. Three of the samples were analyzed for VOCs and five for PCBs. Neither VOCs nor PCBs were detected; therefore, water treatment was discontinued. The floor drains in the building were sealed and the effluent from the discharge sump rerouted to the storm drain.

In May 1996, PCBs and oil & grease were detected in sediment samples collected from the filter and discharge sumps. Based on these results, water treatment was resumed, and treatment system effluent was routed to the sanitary sewer. Results of sampling sediment and water in the sumps and drain line are included in Table 1a (organic compounds) and Table 1b (metals).

3.3 INITIAL EVALUATION OF CONTAMINATION AND POTENTIAL RELEASE ROUTES

An Addendum to the RCRA Facility Investigation Workplan (Phase III) for investigation of the Building 51 (Bevatron) complex was submitted to the regulatory agencies in March 1996 (Berkeley Lab, 1996). The addendum proposed sampling to evaluate whether potential releases from the building's interior drain lines had impacted surrounding soils. In accordance with the addendum, the following borings were drilled and sampled.

Locations of Initial Borings in Motor Generator Room Basement

Boring Number	Location
SB51-96-5	Adjacent to discharge sump
SB51-96-6	Adjacent to the filter sump
SB51-96-7 to SB51-96-10	Adjacent to drain line
SB51-96-11	Adjacent to the former oil pump location on west side of basement
SB51-96-12	Adjacent to the drain line and former oil pump location on the east side of basement

The locations of these borings are shown on Figure 4. The soil analytical results are included in Table 2a (organics) and Table 2b (metals). Total petroleum hydrocarbons (TPH) in the range of motor oil and oil & grease were detected in most samples (11,000 mg/kg maximum concentration). PCBs were detected in SB51-96-12 (3.0 mg/kg maximum) and SB51-96-8 (23 mg/kg maximum) adjacent to the northern section of the drain line. No VOCs were detected.

Three of the soil borings (SB51-96-6, SB51-96-8, and SB51-96-12) were converted to temporary groundwater sampling points. Analytes detected in groundwater samples collected from SB51-96-8 and SB51-96-12 in April 1996 included PCBs and oil & grease (Table 4).

Also in accordance with the March 1996 addendum, Test Pit 1 was excavated at a location where a video survey had indicated blockage of the cast iron drain line. The purpose of the test pit was to verify the locations and depths of the terra cotta and cast iron drain lines, and investigate whether the area of blockage was as a source of releases of contaminants to the environment. The location of the test pit is shown on Figure 4. A plan view and cross section of Test Pit 1 showing the configuration of the drain lines and sampling locations and results is

presented on Figure 5. Soil analytical results are included in Table 2a (organics) and Table 2b (metals). No contaminants were detected in soil samples collected from the bedrock, including samples collected adjacent to the cast iron pipe. The sample (SS-51MRPit-96-6) collected from soil immediately beneath the terra cotta drain contained PCBs (0.61 mg/kg) and TPH in the range of motor oil (170 mg/kg). Samples of black chips from the underside of the concrete (SS-51-MRPit-96-3) contained PCBs (1 mg/kg of Aroclor-1260). The Aroclor-1260 contamination is apparently the result of a thin layer of oil that was applied as a moisture barrier on top of the base rock.

3.4 SOURCE INVESTIGATIONS

Test Pit 2 November 1996

In November 1996, Test Pit 2 was excavated along the drain lines between the two former oil pumps (Figure 4). The purpose of the test pit was to evaluate whether the former oil pumps or drain lines in this area could be the source of the PCBs and oil & grease detected in groundwater samples from boring SB51-96-12. Four soil samples (SS-51MRP2-1 through SS-51MRP2-4) and one sample of product seeping into the east side of the pit (SS-51MRP2-PROD) were collected.

PCBs were detected in a sample collected from the oil layer forming an apparent moisture barrier immediately beneath the concrete floor. PCBs, oil & grease, and TPH in the range of motor oil were detected in the soil sample (SS-51MRP2-4) collected below the terra cotta drain (Figure 6, Table 2a). No VOCs were detected. The product seeping into the pit contained PCBs and hydraulic/motor oil (Table 3). Based on the analytical results and inspection of the cast iron pipe, the source of the contamination did not appear to be in the area of this Test Pit 2.

Test Pit 3 1997 and 1998

A second Addendum to the RCRA Facility Investigation Workplan (Phase III) was submitted to the regulatory agencies in January 1997 (Berkeley Lab, 1997). This addendum specified that a third test pit be excavated along the drain lines north of Test Pit 2, near

temporary groundwater sampling point SB51-96-8, in the area of maximum detected soil and groundwater PCB concentrations (Figure 4). The purpose of this test pit was to help evaluate the source and assess the extent of the contamination previously detected in the soil and groundwater.

Test Pit 3 was excavated in stages starting in April 1997. During the initial excavation of the pit only composite samples were collected from excavated soil for disposal purposes. Analytical results from these samples were comparable to concentrations detected in the previous two test pits.

The pit was deepened to 7.5 feet in July 1998 in order to expose the terra cotta and cast iron drain lines for inspection and allow the collection of soil samples beneath drainlines. Water and product (oil or sludge) were observed seeping into the test pit at several locations. A sample of the product contained PCBs, TPH in the range of hydraulic/motor oil, and several polynuclear aromatic hydrocarbons (PAHs) (Table 3).

Soil samples (SS-51MRPit3-98-1 through SS-51MRPit3-98-10) were collected from the walls and floor of the excavation. A plan view and cross sections of Test Pit 3 showing the drain line configurations and soil sample results are presented on Figure 7a, Figure 7b, and Figure 7c. Soil samples (SS-51MRPit3-98-1 through SS-51MRPit3-98-10) contained PCBs up to 14 mg/kg and TPH in the range of hydraulic/motor oil up to 4,600 mg/kg (Table 2a). No mercury was detected (Table 2b).

Borings SB51-98-1 to SB51-98-9 February and June 1998

In February and June 1998, soil samples were collected from soil borings (SB51-98-1 through SB51-98-9) in the Motor Generator Room basement (Figure 4). The purpose of these borings was to characterize soil contamination both adjacent to and away from the drain lines, and provide additional information on the source of the contamination. TPH in the range of hydraulic/motor oil and crude/waste oil was detected at a maximum concentration of 2,000 mg/kg (Figure 8, Table 2a). Two PCB compounds were detected: Aroclor-1242 was detected in several samples, with the maximum concentration (0.29 mg/kg) found adjacent to the drain line at the north end of the basement; Aroclor-1260 was detected in the oil layer forming an apparent

moisture barrier immediately beneath the concrete floor. No VOCs were detected. Mercury (0.89 mg/kg) was only detected in one sample (Table 2b). Concentrations of PCBs generally decreased with distance from the drain line, indicating that the drain line was the source of the contamination.

Former Oil Pumps April 1999

The locations of the former oil pumps are shown on Figure 2. In April 1999, two samples of oil from the western oil pump (located west of Test Pit 2) were analyzed for PCBs. PCBs were not detected (Table 3). When the abandoned eastern oil pump (located east of Test Pit 2) was removed, the concrete pad under the pump was observed to be heavily stained with oil. The concrete pad was therefore removed and soil samples were collected from ten borings (51MRP4-SB1 through 51MRP4-SB10) under the former pad location (the planned location for Test Pit 4). The locations of the borings are shown on Figure 4 and Figure 9. Soil samples collected from the borings contained TPH in the range of hydraulic motor oil or diesel up to 28,000 mg/kg and PCBs up to 0.54 mg/kg (Table 2a, Figure 9). PCBs were detected in only 4 of 29 samples. The sampling was conducted to investigate whether the oil pump could have been a source of the PCB contamination detected in soil and groundwater beneath the basement. The results indicated that the oil pumps were not the source of the contamination.

Area of Wall Stains April 1999

On April 28, 1999, two wipe samples (51MR-99WALLWIPE-1 and -2) were collected from the oil-stained concrete basement wall east of Test Pit 3. The staining was observed below holes in the wall that had previously held electrical conduits. The sampling was conducted to assess if this oil could have been the source of the PCB contamination detected in the soil and groundwater. PCBs were not detected, indicating that this was not the source. TPH in the range of crude/waste oil was detected (Table 3).

Test Pit 3 1999 and 2000 Source Identification

Several rounds of confirmation sampling and enlargement of Test Pit 3 were conducted between June 1999 and February 2000. Sumps were installed for dewatering the excavation. A soil sample (SS-51MRP3-99-1-7.3) was collected at one of the sump locations in June 1999.

Methylene chloride was the only VOC detected (0.015 mg/kg) (Table 2a and Figure 11). Aroclor-1242 was detected at a concentration of 0.26 mg/kg.

The pit was extended 10 feet toward the north in July 1999 to further investigate the source of the contamination. After the pit was extended, oil was observed seeping into the pit around the backfill of the cast iron pipe on the north wall of the excavation (Photograph 1).

In August 1999, the excavation was extended to the north wall of the basement (Photograph 2 and Photograph 3) to attempt to locate the source of the seep. Near the north wall, the shallow terra cotta tile drain was observed to extend downward and connect to the cast iron pipe (Photographs 3 and 4). The connection is illustrated in cross section on Figure 10. This configuration, which was not indicated on utility drawings, explains the mechanism for the release of the PCBs. In the past, when the pump in the discharge sump was not operating or was being repaired, the water level could rise in the sump. Contaminated water could then back up in the cast iron pipe and, from there, into the terra cotta drain. Since the terra cotta drain is not a solid pipe, any PCB-contaminated water that backed up into the terra cotta drain could be released to the surrounding coarse-grained backfill material around the drain lines.

3.5 MAGNITUDE AND EXTENT OF CONTAMINATION

In December 1999 a workplan was submitted to the regulatory agencies that included provisions for both the evaluation of the magnitude and extent of contamination in the walls and beneath the floor of Test Pit 3 and for the excavation of Test Pit 5 to assess contamination in the soil around the discharge sump (Berkeley Lab, 1999c).

Test Pit 3 Floor and Wall Samples

Soil samples were collected at 21 locations in the walls (SS-51MRP3-99-W1 through SS-51MRP3-99-W21 and SS-51MRP3-99-FW9) and 5 locations beneath the floor (SS-51MRP3-99-F1 through SS-51MRP3-99-F5) of Test Pit 3. One PCB compound (Aroclor-1242), TPH (primarily in the range of hydraulic/motor oil), and thirteen PAH compounds were detected in the soil samples (Table 2a). The detected PAH compounds included benzo(a)pyrene, which was

detected slightly above its PRG in two samples. VOCs were not detected. Mercury was not detected (<0.2 mg/kg) (Table 2b).

Concentrations of PCBs detected in the east and west walls of the pit decreased with depth into the walls (distance from the drain lines), except for one location to the west of the drain line (SS-51MRP3-99-W20 on Figures 11). SS-51MRP3-99-W20 is near the connection of the cast iron pipe and terra cotta drain, the apparent source area for the contamination. This area of soil contamination was excavated when Test Pit 3 was subsequently extended to the west wall of the basement. The results were further evidence that the drain lines were the source of the release.

Test Pit 5 Floor and Wall Sampling

Removal of the concrete floor adjacent to the discharge sump and excavation of Test Pit 5 (Figure 4) started in August 1999. A 2-inch diameter hole was observed on the underside of the cast iron drain line when it was exposed in the excavation; however, no visual evidence of oil seepage was observed on the pit walls or floor. The hole in the pipe was repaired.

Soil samples were collected at eight locations in the walls (SS-51MRP5-99-W1 through SS-51MRP5-99-W8) and three locations beneath the floor (SS-51MRP5-99-F1 through SS-51MRP5-99-F3) of Test Pit 5. A number of the soil samples contained PCBs (Aroclor-1242), TPH in the range of hydraulic/motor oil, PAH compounds, and VOCs (Table 2a). Detected VOC concentrations were all less than PRGs, while one PAH compound (benzo(a)pyrene) was detected in one sample at a concentration slightly greater than its PRG. Mercury was not detected (Table 2b). Concentrations of PCBs were less than 1 mg/kg, except for one location that was subsequently excavated. The lateral and vertical distribution of PCBs detected in the test pit are shown on Figures 13 and 14.

Test Pit 2 Area

No confirmation samples were collected from the walls of Test Pit 2 prior to backfilling of the excavation, therefore additional sampling was conducted in February 2000 to ascertain whether contaminants were present adjacent to the backfilled pit. No additional samples were needed along the east wall of test Pit 2 because it was coincident with the west wall of Test Pit 4.

To evaluate the magnitude and extent of contamination immediately west of former Test Pit 2, soil samples were collected from soil borings SB51-MRP2-WW-1A, -2, -2A, -3, and -4 (Figure 4). PCBs (Aroclor-1242) were detected (0.017 mg/kg) in one sample (Table 2a, Figure 9). No PAHs were detected.

3.6 GROUNDWATER SAMPLING

Soil borings SB51-96-6, SB51-96-8, SB51-96-12, SB51-98-1, SB51-98-3, SB51-98-4, SB51-98-5, SB51-98-6, and SB51-98-7 were converted to temporary groundwater sampling points. Except for one detection of Aroclor 1260, Aroclor 1242 has been the only PCB detected in the groundwater (Table 4). In April 1999, groundwater samples were collected from the available temporary groundwater sampling points in the Motor Generator Room basement and three groundwater monitoring wells outside Building 51, including MW51-96-15 downgradient from the Motor Generator Room (Figure 15). PCBs (0.37 µg/L) were only detected at SB51-98-4.

A noteworthy observation is that no PCBs were detected in SB51-98-6. This monitoring point is adjacent to well SB51-96-8, where the maximum concentration of PCBs had been detected in the groundwater prior to excavation of Test Pit 3. Well SB51-96-8 and the surrounding PCB-contaminated soil were removed when Test Pit 3 was excavated. Therefore, based on the April 1999 sampling results, it appears that excavation of PCB contaminated soil from Test Pit 3 has resulted in a marked decrease in PCB concentrations in the groundwater.

Other contaminants detected in groundwater include oil & grease, crude waste oil, and several VOCs (Table 4). Several VOCs [trichloroethene (TCE), cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, and vinyl chloride] have been detected at concentrations greater than drinking water standards (MCLs). However, since VOCs were detected in only a small fraction of the soil samples collected beneath the Motor Generator Room Basement, AOC 9-9 is interpreted to not be the source of the VOCs detected in the groundwater. Concentrations of VOCs detected in groundwater samples in this area have been below or slightly above drinking water MCLs since 1997. The source of these contaminants is probably the Building 51/64 Groundwater Plume.

3.7 POTENTIAL MIGRATION OF CONTAMINATION TO SURFACE WATERS

As discussed in Section 2.1, the discharge sump has in the past (primarily prior to 1962) been connected to the Berkeley Lab storm drain system. Effluent from the storm drain system near Building 51 is routed to the erosion control basins on North Fork Strawberry Creek, located approximately 700 feet northwest of Building 51 (Figure 16). This is the only known potential migration pathway of contamination from the drainage system to surface waters. North Fork Strawberry Creek is also in the downgradient direction for the groundwater from the Building 51 area. Surface water and sediment samples were collected from North Fork Strawberry Creek between April 1993 and January 2000 and analyzed for contaminants of potential concern from upgradient sources, including AOC 9-9.

Surface water and sediment samples contained no detectable PCBs or PAHs (Table 5a and Table 6a). The only organic analytes detected in surface water were a trace concentration (<1 μg/L) of 1,1,1-trichloroethane (TCA) and diethyl phthalate, which were each detected in one surface water sample at concentrations less than MCLs (Table 5a). No mercury was detected.

The only organic analytes detected in sediment were toluene and oil (Table 5b and Table 6b). Each of these constituents was found in one sediment sample. Toluene was detected at a concentration less than both the USEPA sediment screening level and the PRG. Mercury was detected in one sediment sample at a concentration within Berkeley Lab soil background levels.

The potential impact to the environment from the contaminants detected in surface water and sediment will be evaluated in the ecological risk assessment.

3.8 INTERIM MEASURES (IMs)

Interim Measures (IMs) have been conducted in the basement to reduce the potential impact of contaminants to groundwater and surface water. IMs have included:

- cleaning the drain lines and sumps
- excavating contaminated soil and backfill
- treating the contaminated drain line effluent.

Cleaning the Drain Lines and Sumps

In June and August 1999, the sediment and sludge were removed from the filter and discharge sumps. The interior of each sump was then cleaned with a high-pressure water jet and steam and the cast iron drain line connecting them was cleaned with high-pressure water. A subsequent video survey of the pipe indicated no remaining oil contamination. More than 2000 gallons of contaminated wastewater were generated during these operations and recovered for offsite disposal using a vacuum truck. Photographs of the cleaning operations are shown on Photographs 5, 6, 7 and 8.

The connection of the cast iron pipe to the terra cotta drain line was sealed and the elbow section of the cast iron pipe was replaced with a new section that provides a cleanout access.

Excavating Contaminated Soil and Backfill

Proposed action levels for interim soil removal were included in Berkeley Lab's December 1999 workplan. For VOCs, PAHs, and mercury the proposed action level was the PRG for residential soil. For PCBs, the proposed action level was the USEPA self-implementing cleanup level (1 mg/kg) for soil in high occupancy (i.e., residential) areas (USEPA, 1998).

Test Pit 3

In accordance with Berkeley Lab's December 1999 workplan (Berkeley Lab, 1999c), accessible soil in Test Pit 3 with concentrations of PCBs above USEPA's self-implementing cleanup level for soil in high occupancy areas (1 mg/kg) (USEPA 1998) was removed. The initial excavation was extended to the east, based on analytical results from wall samples and to the west to the Motor Generator Room Basement wall (Figure 11).

In February 2000, additional soil was excavated at a depth of approximately 4 feet under the west wall of Test Pit 3, at the location of the October 1999 wall samples SS-51MRP3-99-W11A and B. This was the location where a product seep was observed when the pit was opened in 1998, and was the only remaining location where the October 1999 samples indicated that PCBs were present at concentrations greater than 1 mg/kg (7.0 mg/kg and 6.6 mg/kg). After removing this additional soil, PCBs were detected at a concentration of 2.2 mg/kg in a sample

collected from the back of the excavated area. The area of this sample was also excavated. In order to evaluate the final extent of the contamination, soil samples were collected at 2 and 4 feet below the floor surface from boring SB51-MRP3-WW-11D, approximately 2 feet west of SS-51MRP3-00-W11C. No PCBs were detected. The locations of the samples are shown on Figure 11. Concentrations of analytes detected are included in Table 2a.

Test Pit 5

In accordance with Berkeley Lab's December 1999 workplan (Berkeley Lab, 1999c), soil in Test Pit 5 with concentrations of PCBs above 1 mg/kg was removed. The planned excavation area was enlarged near the northwest corner, because a shallow sample (SS-51MRP5-99-W3A) taken from the excavation wall contained 1.9 mg/kg PCBs (Figure13).

Test Pit 4

TPH in the range of hydraulic/motor oil had been detected at a maximum concentration of 28,000 mg/kg (soil boring 51MRP4-SB1-1.2 on Figure 9 and Table 2) in soil borings drilled at the planned location of Test Pit 4. Therefore, in January and February 2000, Test Pit 4 was excavated to a depth of approximately 4 feet below the basement floor. Confirmation samples were collected beneath the floor (SS-51-MRP4-00-F1 through SS-51-MRP4-00-F3) and along the walls (SS-51-MRP4-00-W1 through SS-51-MRP4-00-W3) of the excavation. PCBs (0.028 mg/kg) were detected in only one wall sample. (Figure 17 and Table 2a). TPH in the range of hydraulic/motor oil was detected at maximum concentration of 310 mg/kg. No VOCs were detected.

Treating The Contaminated Drain Line Effluent

The effluent from the discharge sump is treated by a GAC system and discharged to the sanitary sewer under Berkeley Lab's EBMUD discharge permit.

SECTION 4

RATIONALE FOR NFI RECOMMENDATION

4.1 INTRODUCTION

The Building 51 Sanitary Sewer and Drainage System (AOC 9-9) is recommended for No Further Investigation (NFI) status for the following reasons.

- A source for the contamination has been located.
- The magnitude and extent of soil contamination has been evaluated.
- The impact of soil contamination on the groundwater has been evaluated.
- The potential migration of contaminants to surface water and sediment has been evaluated.
- Interim Measures have been implemented to protect human health and the environment.

These criteria were discussed in Section 3 of this report and are summarized below. AOC 9-9 is recommended for NFI status rather than NFA status since PCBs and PAHs were detected in soil at concentrations above PRGs for residential soil.

4.2 RECOMMENDATION FOR NFI STATUS

The Constituents of Potential Concern identified for AOC 9-9 in the December 1999 workplan (Berkeley Lab, 1999c) were VOCs, PAHs, mercury, PCBs, and TPH/oil & grease. Due to the fact that TPH and oil & grease are analytical measures of chemical mixtures containing variable amounts of individual constituents, potential toxic effects for particular levels of TPH or oil & grease cannot be quantified. For this reason, PRGs have not been established for either measure. However, PRGs have been established for specific VOCs and PAHs that are chemical components of TPH and total oil and grease. Therefore, the Chemicals of Potential Concern (COPCs) in this NFI request are VOCs, PAHs, mercury, and PCBs, and do not include either TPH or oil & grease.

The following paragraphs discuss the COPCs and summarize Berkeley Lab's justification for this NFI request:

Source Identification

The source of the contamination was identified as releases from the terra cotta drain line that occurred when contaminated water backed up from the cast iron drain line into the terra cotta drain. The backup of water and subsequent release could occur when the pump in the discharge sump was not operating. The connection between the cast iron drain line and terra cotta drain has been sealed to prevent a future release.

Magnitude and Extent of Contamination

The magnitude and extent of contamination have been evaluated. PCB analysis was conducted on 186 soil samples collected from beneath the Motor Generator Room basement. The following table summarizes the analytical results and concentrations of PCBs remaining in place.

Summary of PCBs Detected in Soil

	PCB Aroclor			
	1242	**1248**	**1254**	**1260**
Number of detections	65	1	2	8
Maximum concentration detected	23 mg/kg	0.94 mg/kg	3.6 mg/kg	1.1 mg/kg
Number of detections above 1 mg/kg	19	0	1	1
Maximum detected concentration remaining in place	1.0 mg/kg	<0.01 mg/kg	0.084 mg/kg	1.1 mg/kg
Number of sample locations where concentrations above 1 mg/kg remain in place	0	0	0	1

Concentrations of PCBs remaining in place are shown on Figure 18 through Figure 21 for various depth ranges. Concentrations of PCBs detected in material that has been excavated are included on the overlays for the figures. The extent of contamination to the west of the Motor Generator Room basement is limited by the western concrete basement wall, which extends to a depth of approximately 4 feet below the basement floor.

Concentrations of PCBs detected above 1 mg/kg remain in place at one sample location:

- 1.1 mg/kg Aroclor 1260 at a depth of 2 feet in SB51-98-2. PCBs were not detected in deeper samples collected in SB51-98-2 (5 and 6.5 feet). The Aroclor-1260 contamination is apparently the result of a thin layer of oil that was applied as a moisture barrier on top of the base rock.

Seventy soil samples were analyzed for PAHs. Benzo(a)pyrene was detected at concentrations slightly above the PRG in only two floor samples from Test Pit 3 (0.074 mg/kg maximum) and one floor sample from Test Pit 5 (0.082 mg/kg) (Table 2a). These samples were collected 7 to 8 feet below the floor. The PRG for residential soil for benzo(a)pyrene is (0.056 mg/kg).

One hundred forty one soil samples collected beneath the Motor Generator Room basement were analyzed for VOCs (Table 2a). VOCs were detected in only 16 of the soil samples, 14 of which were collected from Test Pit 5. All detected concentrations were below PRGs for residential soil.

Mercury analysis was conducted on 123 soil samples collected beneath the Motor Generator Room basement (Table 2b). Mercury (0.82 mg/kg and 0.89 mg/kg) was detected in only two samples. The detected concentrations were above Berkeley Lab background levels but below the PRG for residential soil. Both samples were collected from areas that have been excavated.

Groundwater Contamination

Groundwater contamination has been evaluated and is discussed in Section 3.5. PCBs, oil & grease, crude/waste oil, and VOCs have been detected (Table 4). Based on the April 1999 sampling results, it appears that excavation of PCB contaminated soil from Test Pit 3 has resulted in a marked decrease in PCB concentrations in the groundwater.

Requirements for groundwater monitoring in the basement of the Motor Generator Room will be assessed. At least one of the temporary groundwater sampling points downgradient from Test Pit 3 will be converted to a permanent groundwater monitoring well.

Potential Migration to Surface Water and Sediment

Potential migration to surface water and sediment has been evaluated and was discussed in Section 3.6. Neither PCBs nor PAHs have been detected in surface water or sediment samples collected from North Fork Strawberry Creek (Table 5a and Table 6a). Mercury, which was detected in one sediment sample, was within Berkeley Lab soil background levels. The potential impact to the environment from contaminants detected in surface and sediment will be evaluated in the ecological risk assessment.

Interim Measures

Interim Measures have been conducted in the basement to reduce the potential impact of contaminants to groundwater and to protect human health and the environment. The contaminated sediment and sludge were removed from the filter and discharge sumps. The sumps and the cast iron drain line were cleaned. A subsequent video survey of the pipe indicated no remaining oil contamination. The effluent from the discharge sump is treated by a GAC system and discharged to the sanitary sewer.

Approximately 70-cubic yards of contaminated soil and backfill were excavated. The objective of the IMs were to remove contaminated soil with concentrations of PCBs above the USEPA self-implementing cleanup level (i.e., the “walk away” level) of 1 mg/kg for soil in high occupancy (residential) areas and soil with concentrations of other COPCs above PRGs. This was accomplished except for one limited location where detected concentrations of PCBs remaining in place are slightly above 1 mg/kg and three locations where benzo(a)pyrene was detected at concentrations just above the PRG for residential soil.

The IM cleanup levels were conservative, since the remediated contaminants were only present in soil and backfill below an 8-inch-thick concrete floor in the basement of a laboratory building.

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Figure 21. PCBs Remaining in Soil at Depths of 6 to 8.5 Feet Below Motor Generator Room Basement Floor, Building 51 Sanitary Sewer and Drainage System (AOC 9-9).

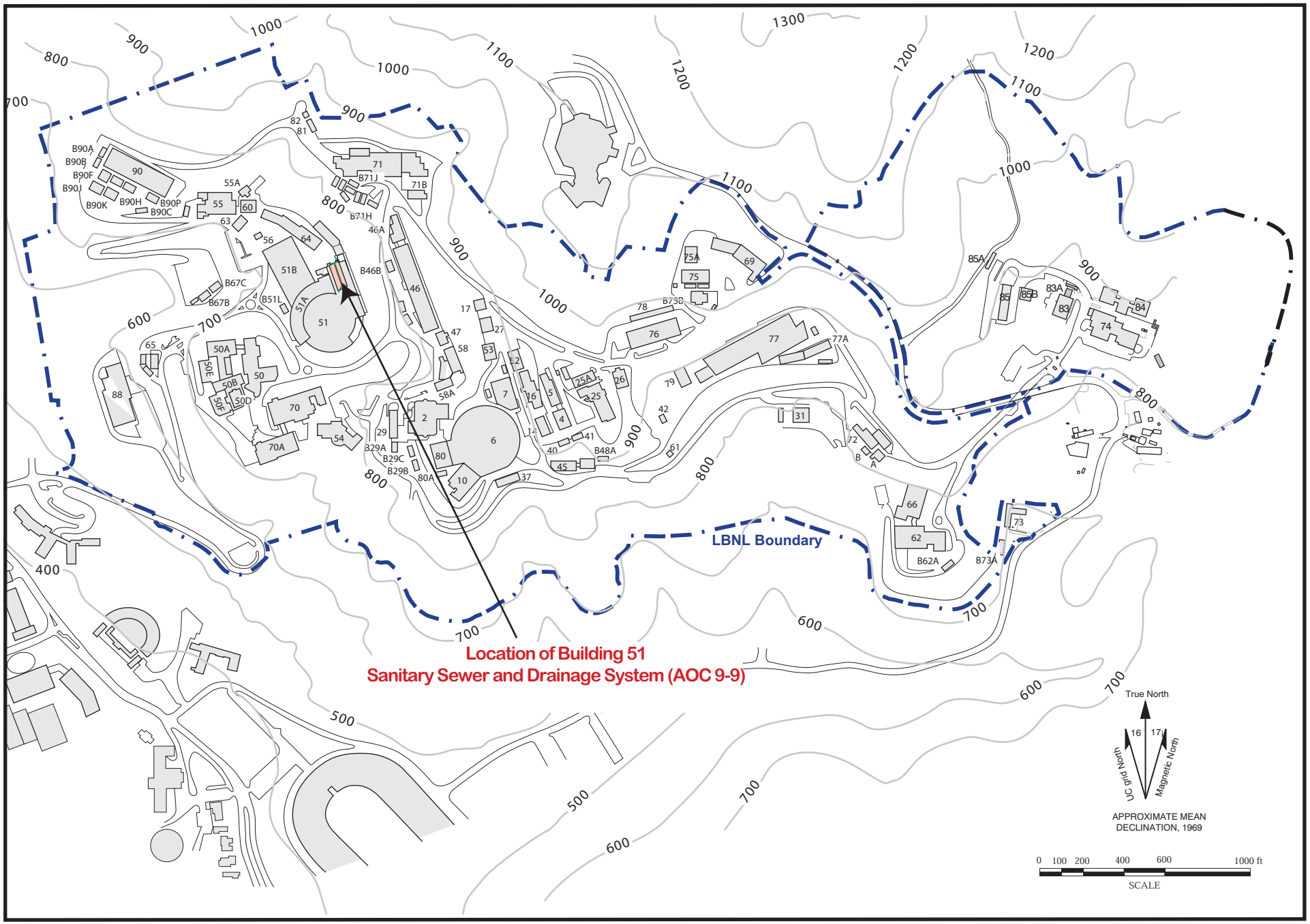

Figure 1. **Location Map, Site of Building 51 Sanitary Sewer and Drainage System in Motor Generator Room Basement (AOC 9-9), Lawrence Berkeley National Laboratory.**

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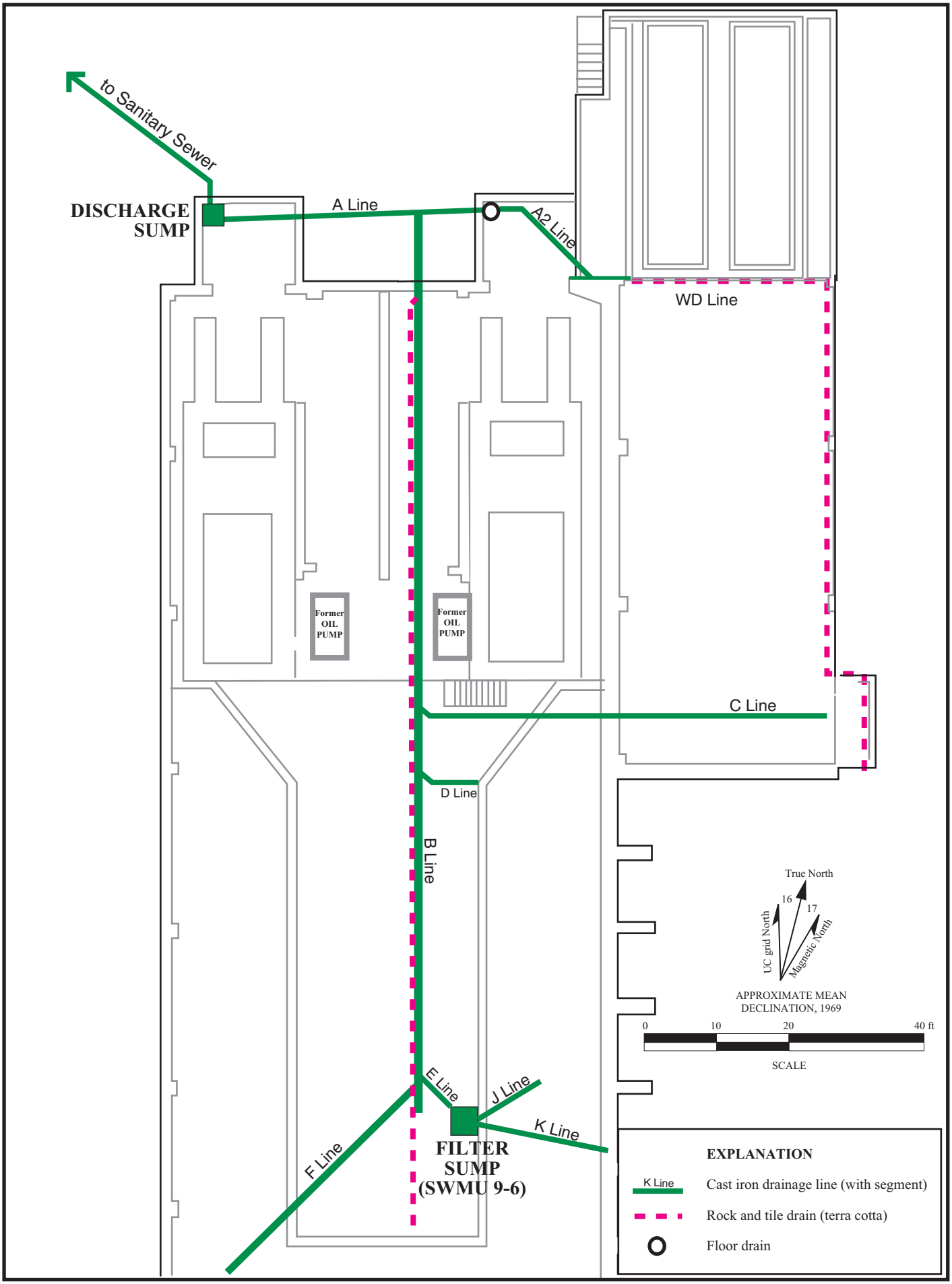

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Figure 2. Plan View of Building 51 Motor Generator Room Basement Showing Location of Drainage Lines.

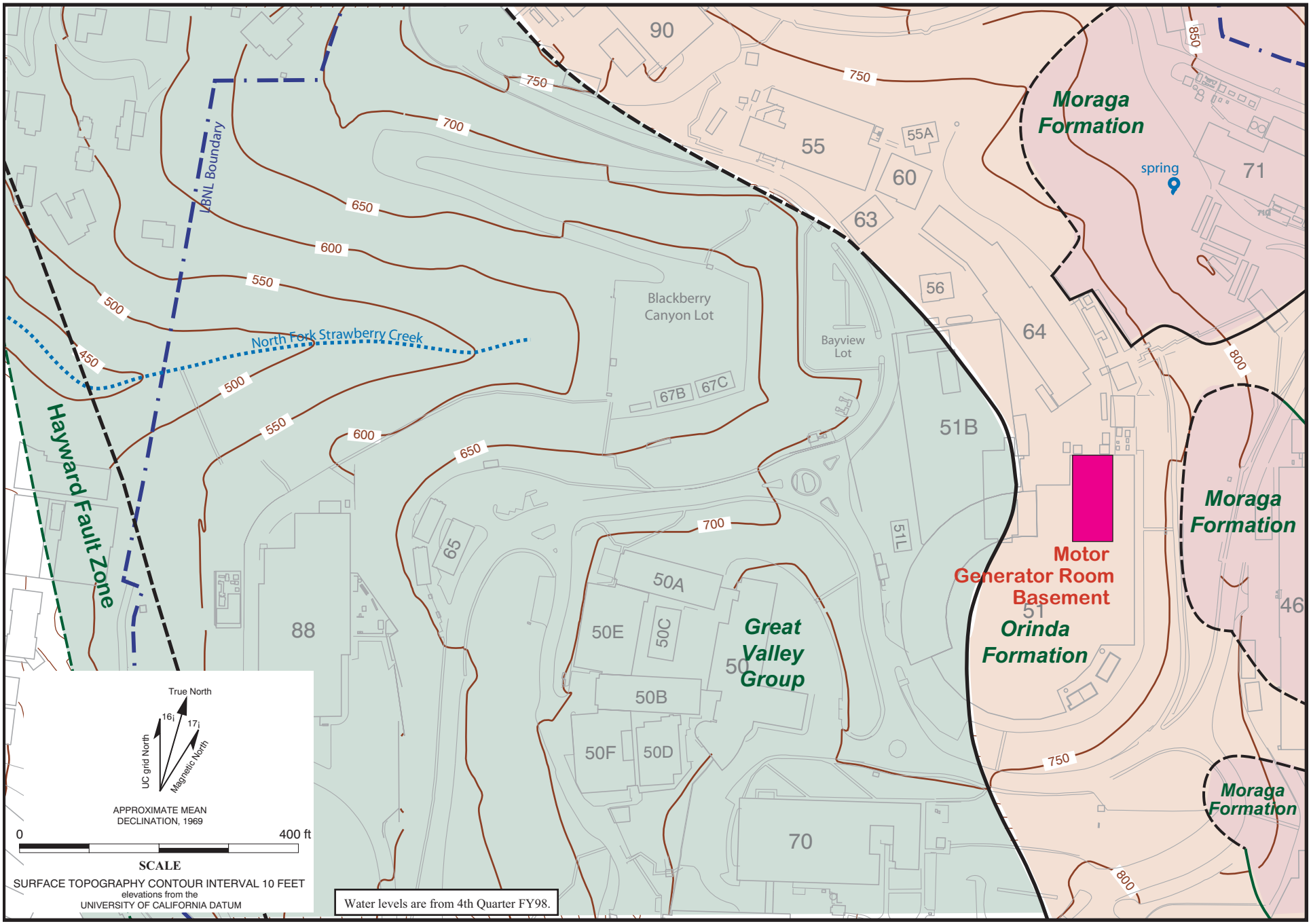

Figure 3. Bedrock Geology Map, Building 51/64 Area.

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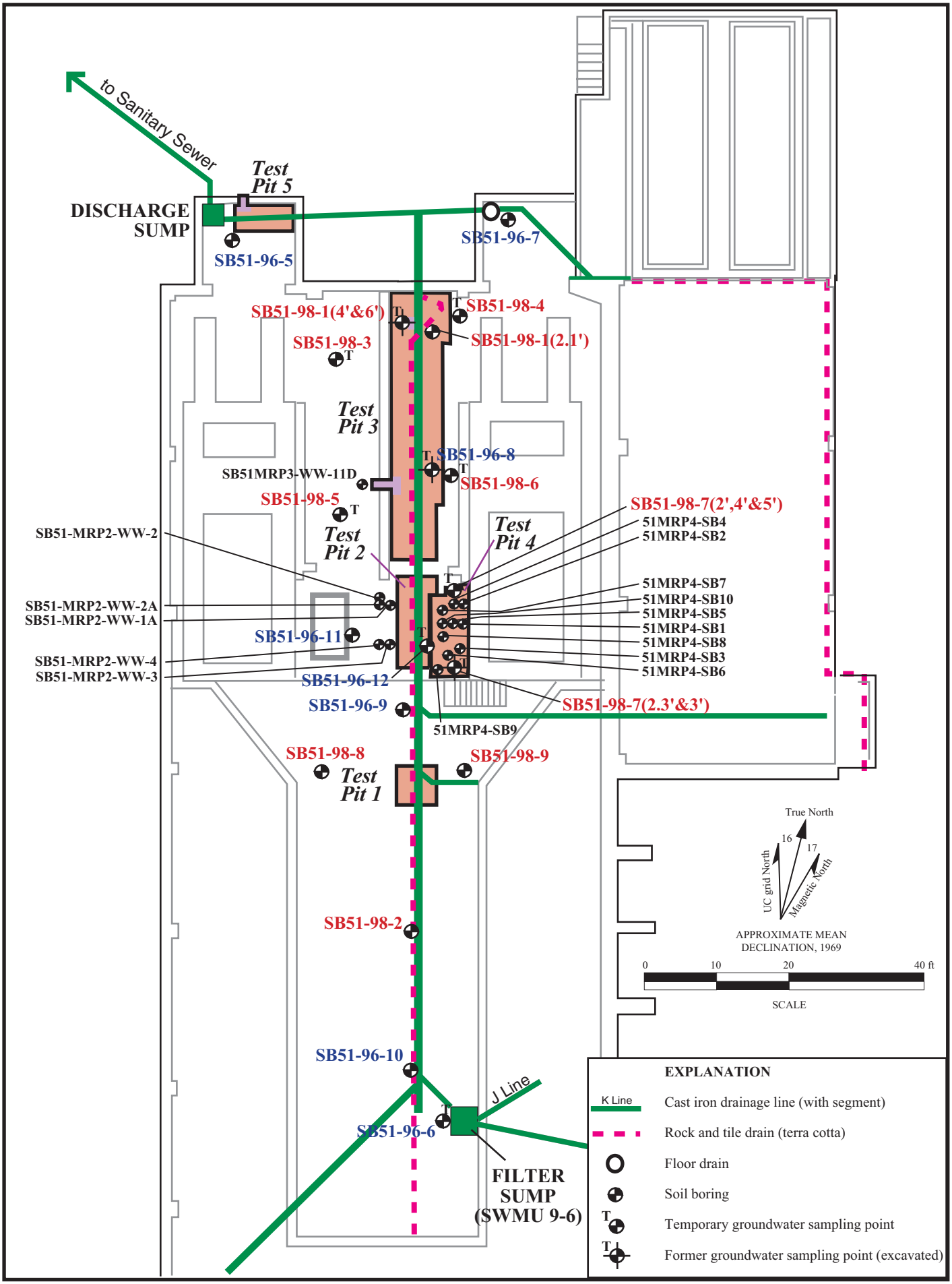

Figure 4. **Plan View of Building 51 Motor Generator Room Basement with Locations of Soil Borings and Test Pits.**

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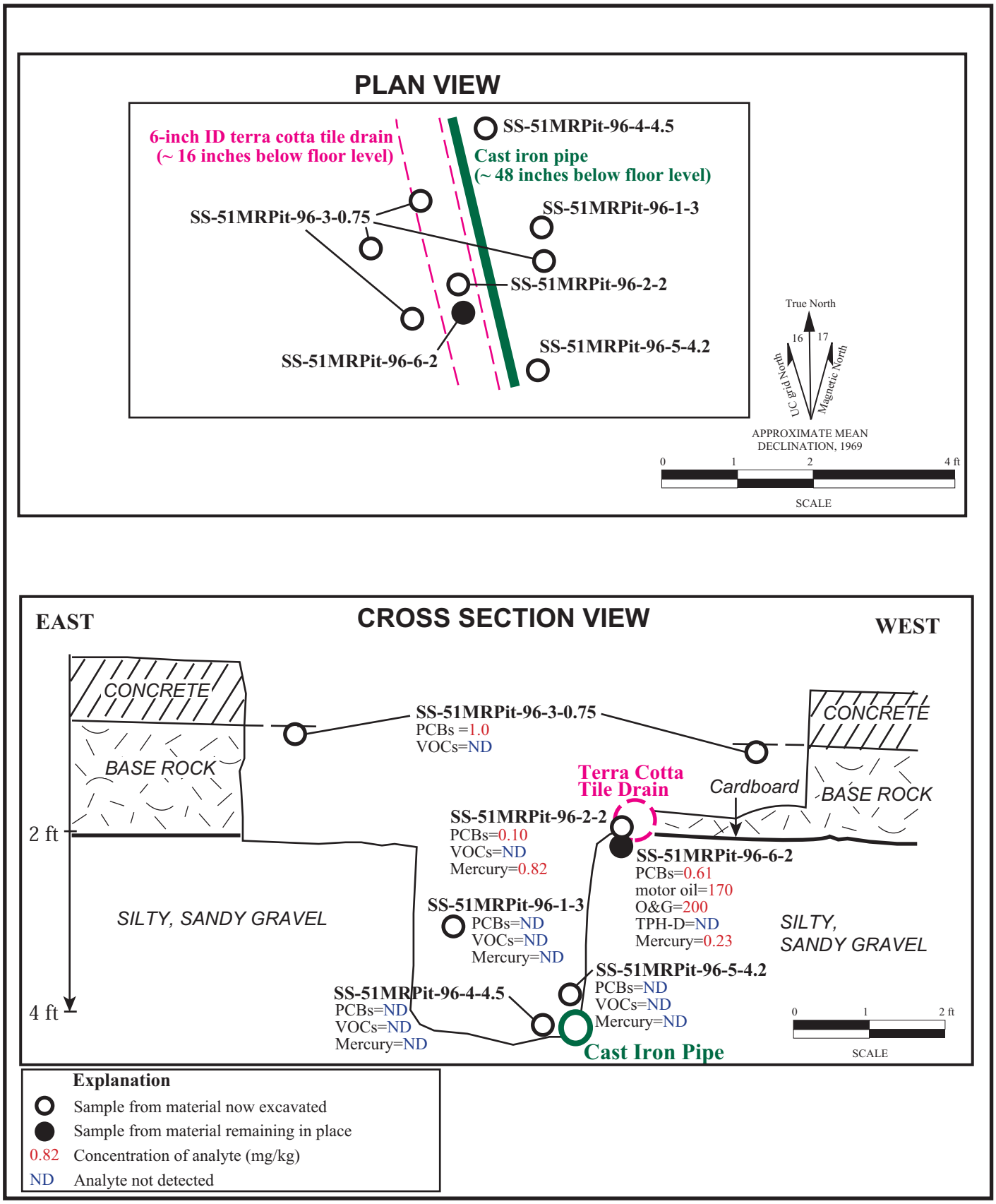

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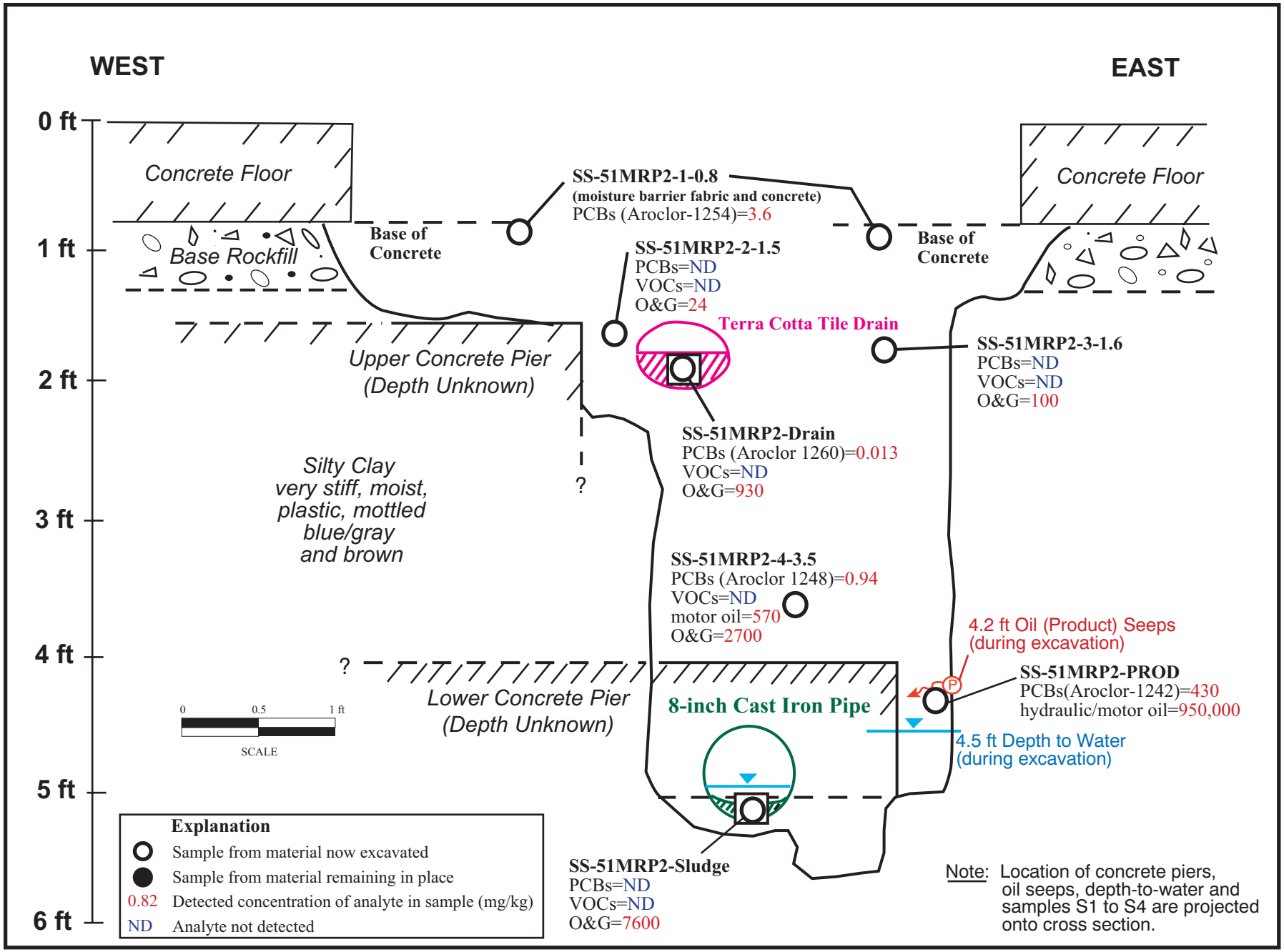
Figure 5. Map and Cross Section of Test Pit 1 Showing Locations of Soil Samples and Concentrations of Analytes Detected (mg/kg).



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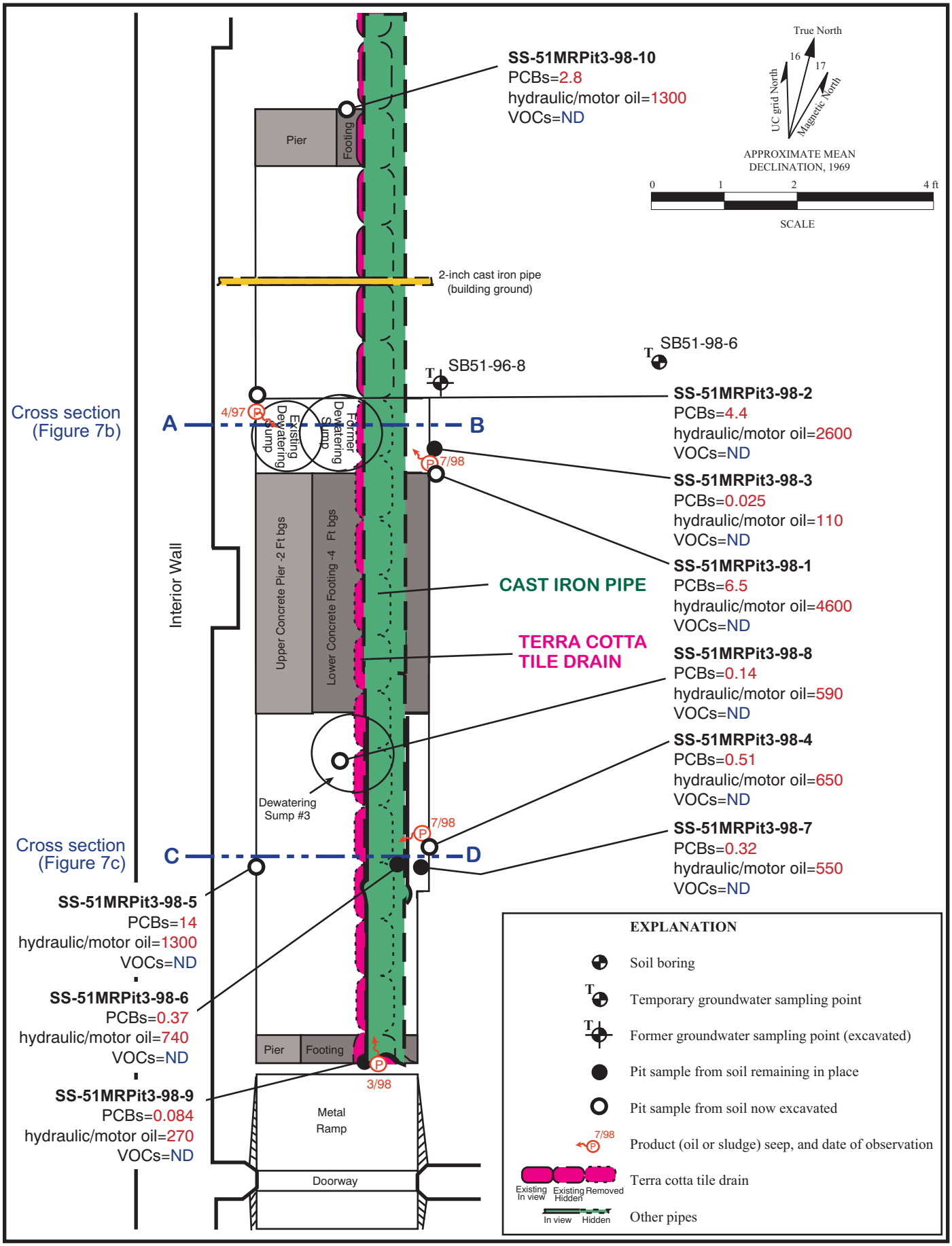

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Figure 7a. **Map of Test Pit 3 (July 1998) Showing Locations of Soil Samples and Concentrations of Analytes Detected (mg/kg).**

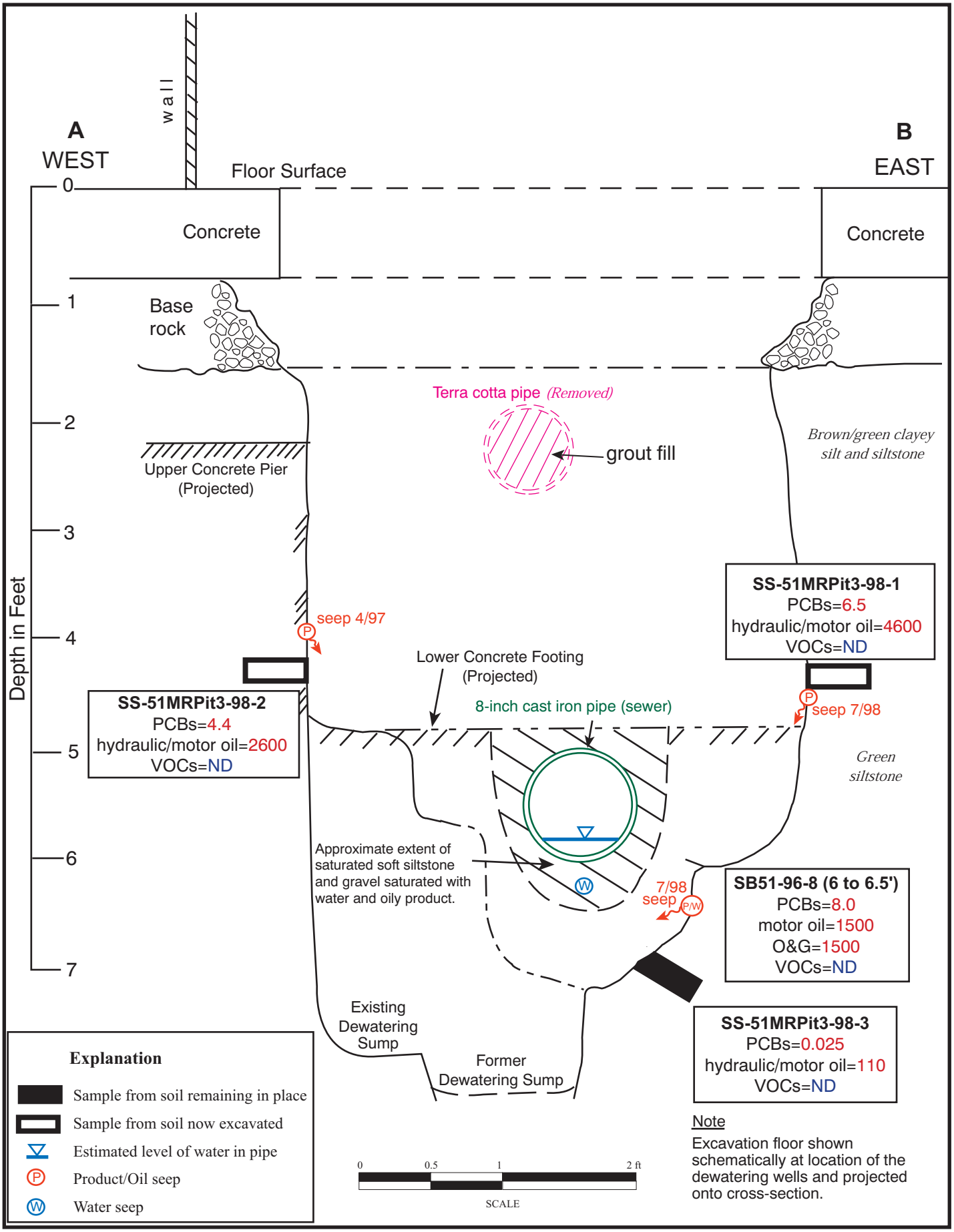

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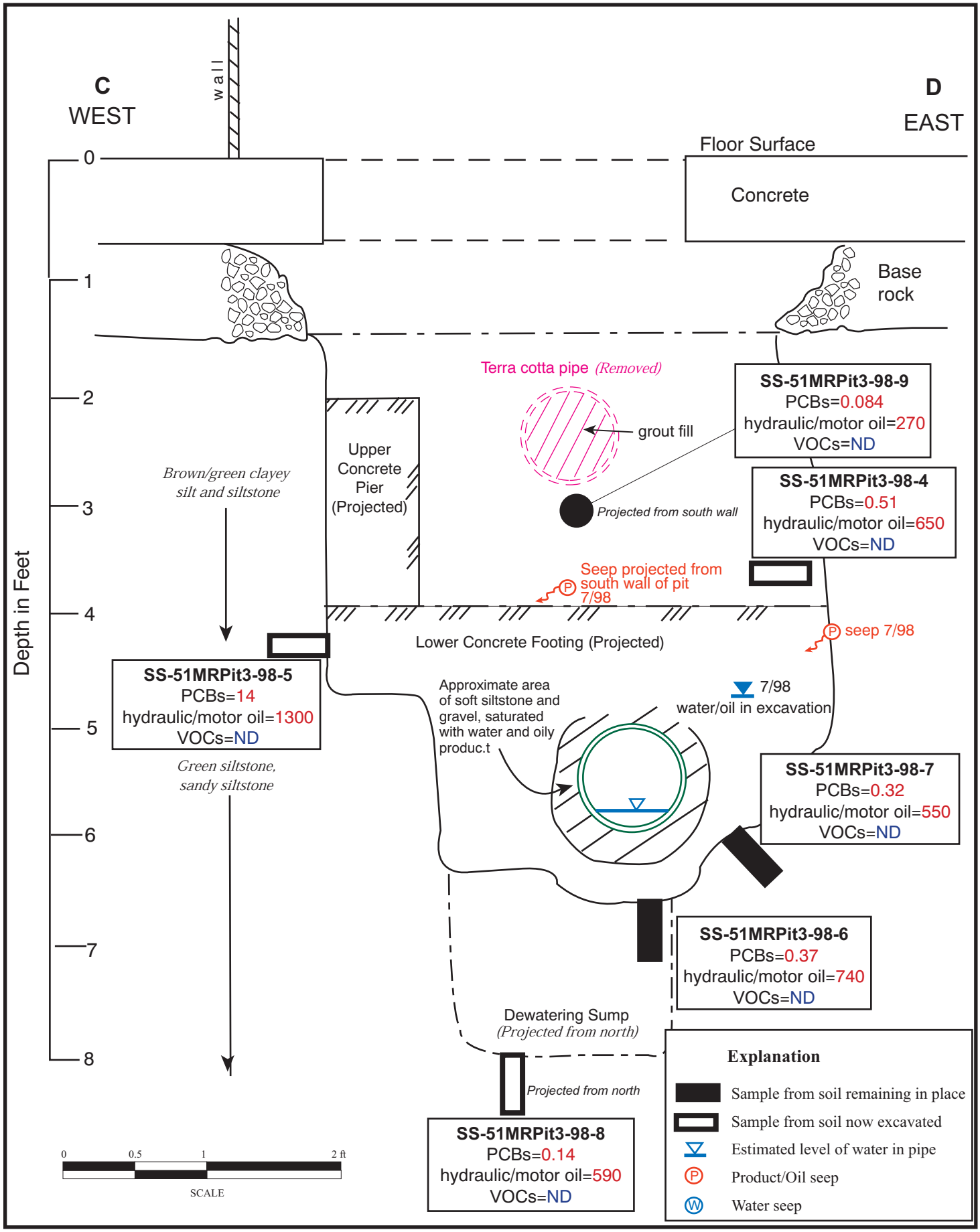
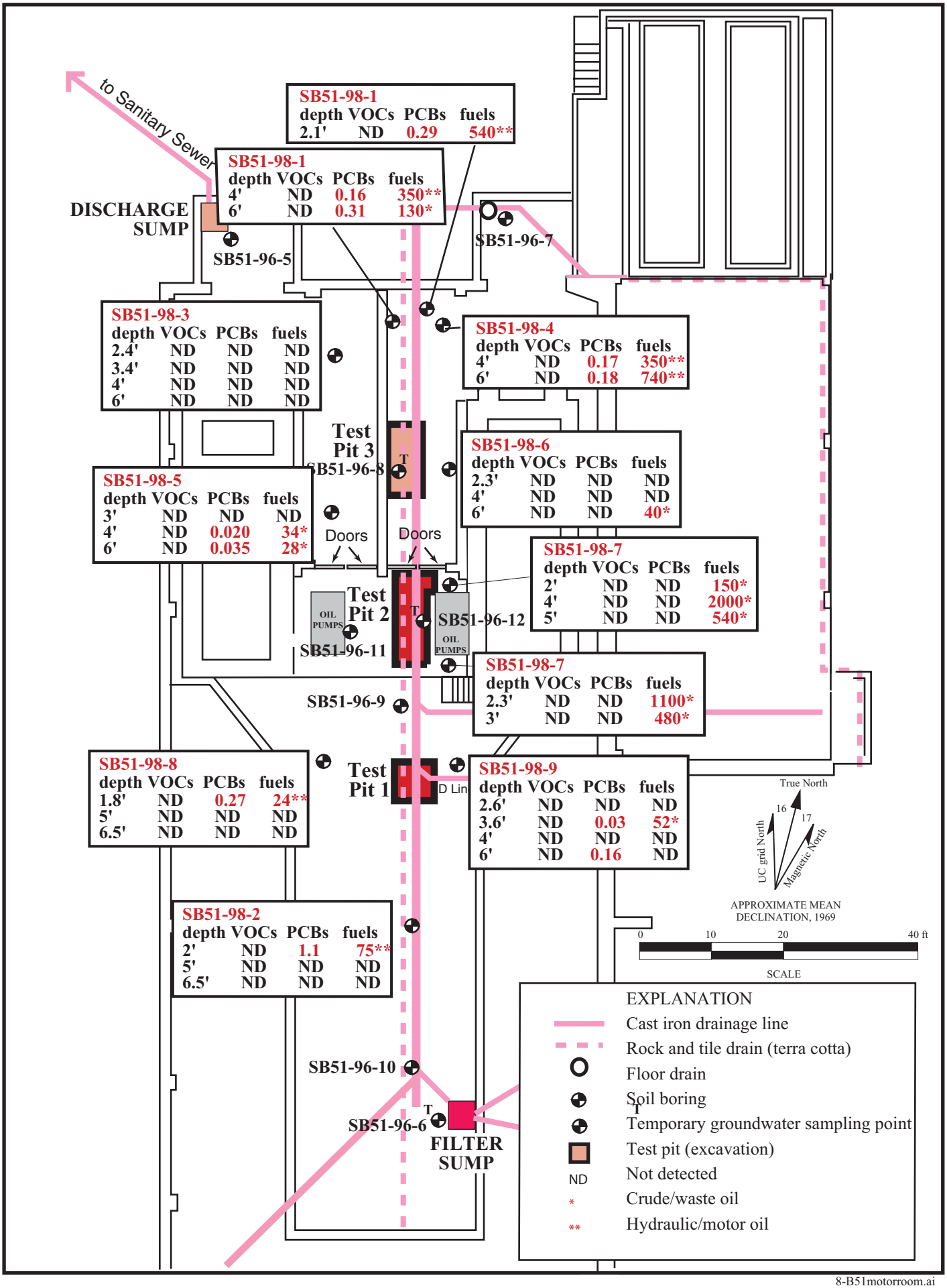
Figure 7b. **Cross-Section A-B (Test Pit 3 July 1998) Showing Locations of Soil Samples and Concentrations of Analytes Detected (mg/kg).**



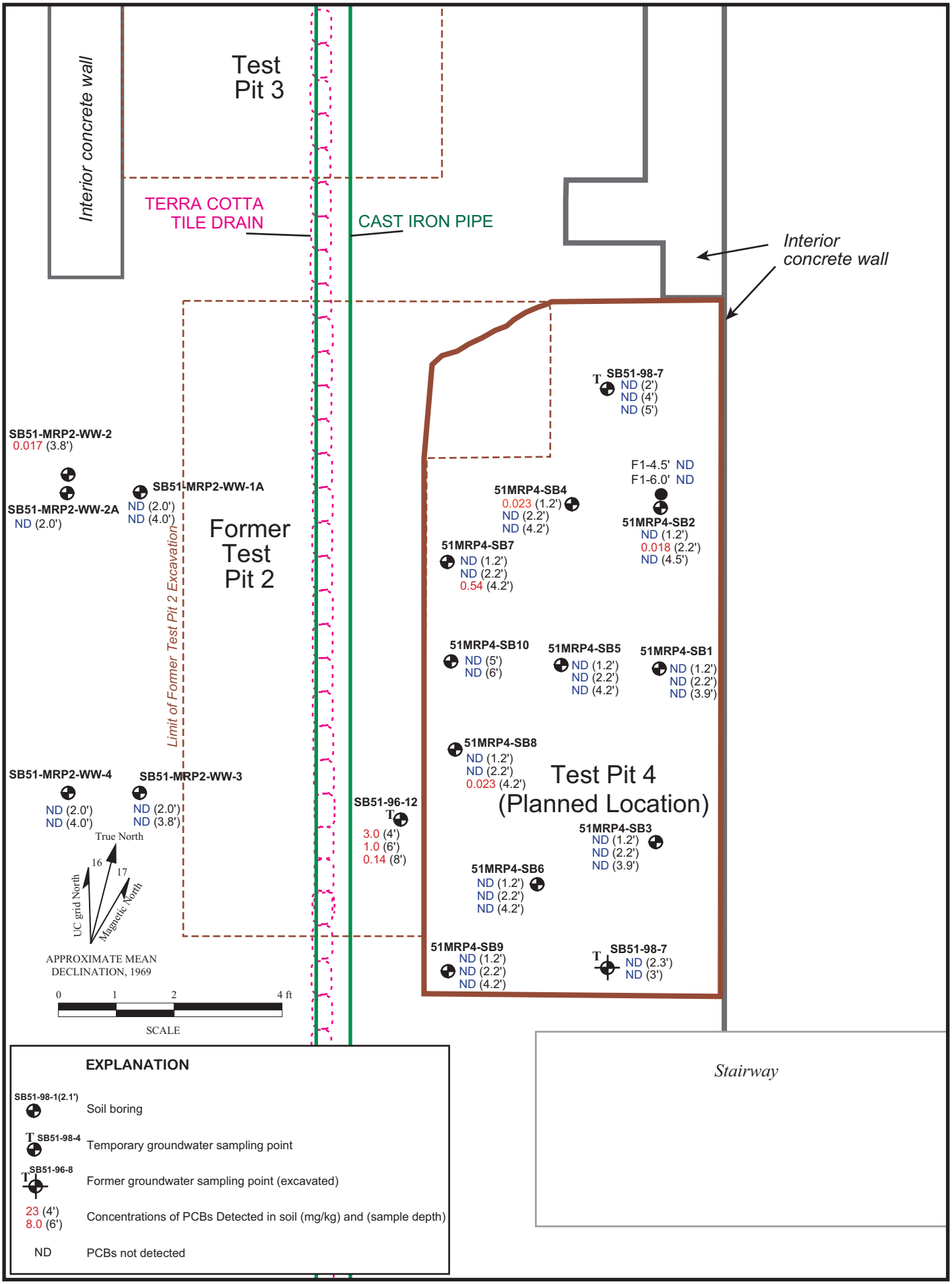
7c-Pit3SectionCD.ai
03/00

Figure 7c. **Cross-Section C-D (Test Pit 3 july 1998) Showing Locations of Soil Samples and Concentrations of Analytes Detected (mg/kg).**



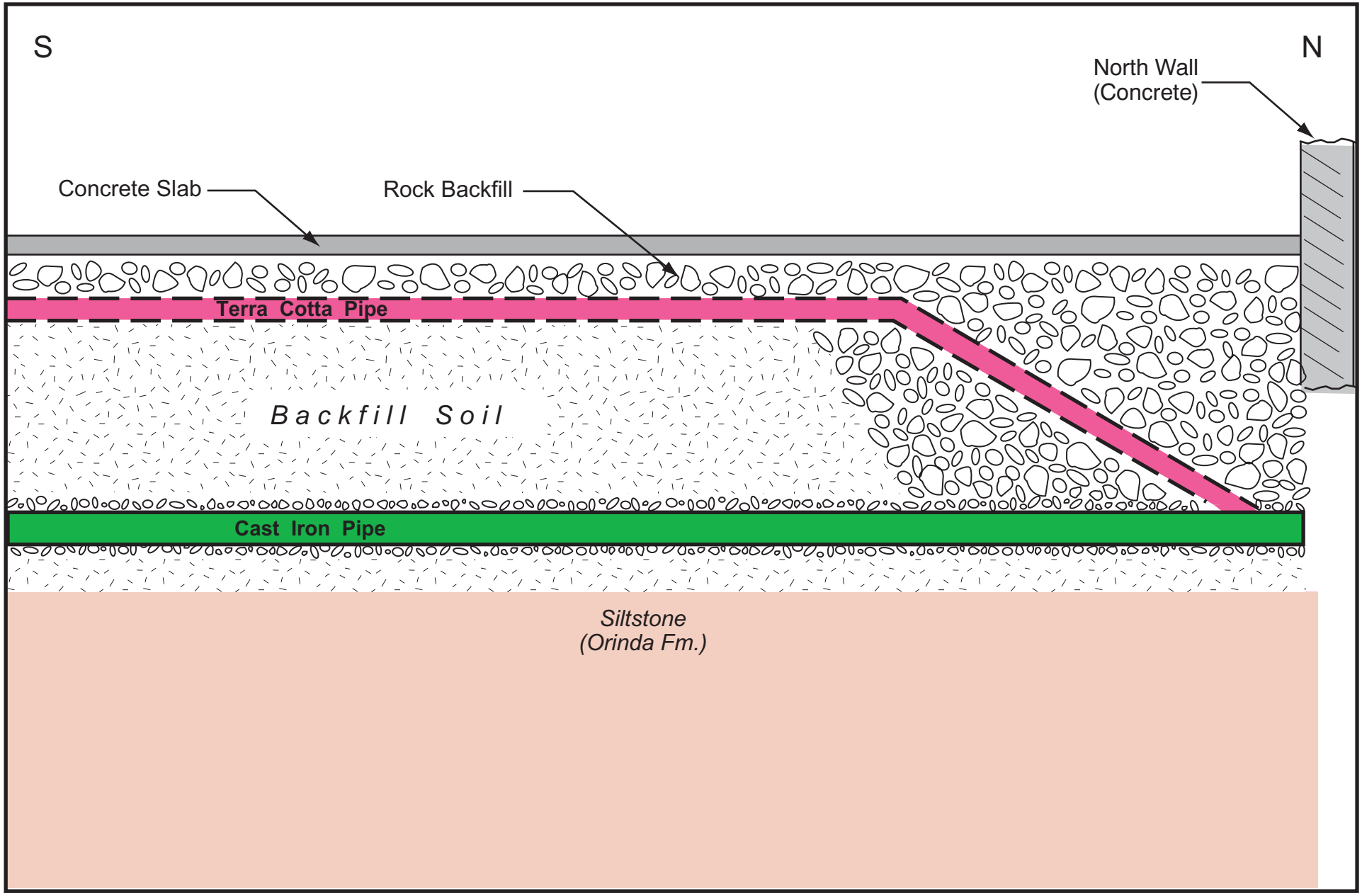
8-B51motorroom.ai
4/00

Figure 8. Locations of Soil Borings SB51-98-1 through SB51-98-9 and Concentrations of Contaminants Detected (mg/kg), Building 51 Motor Generator Room



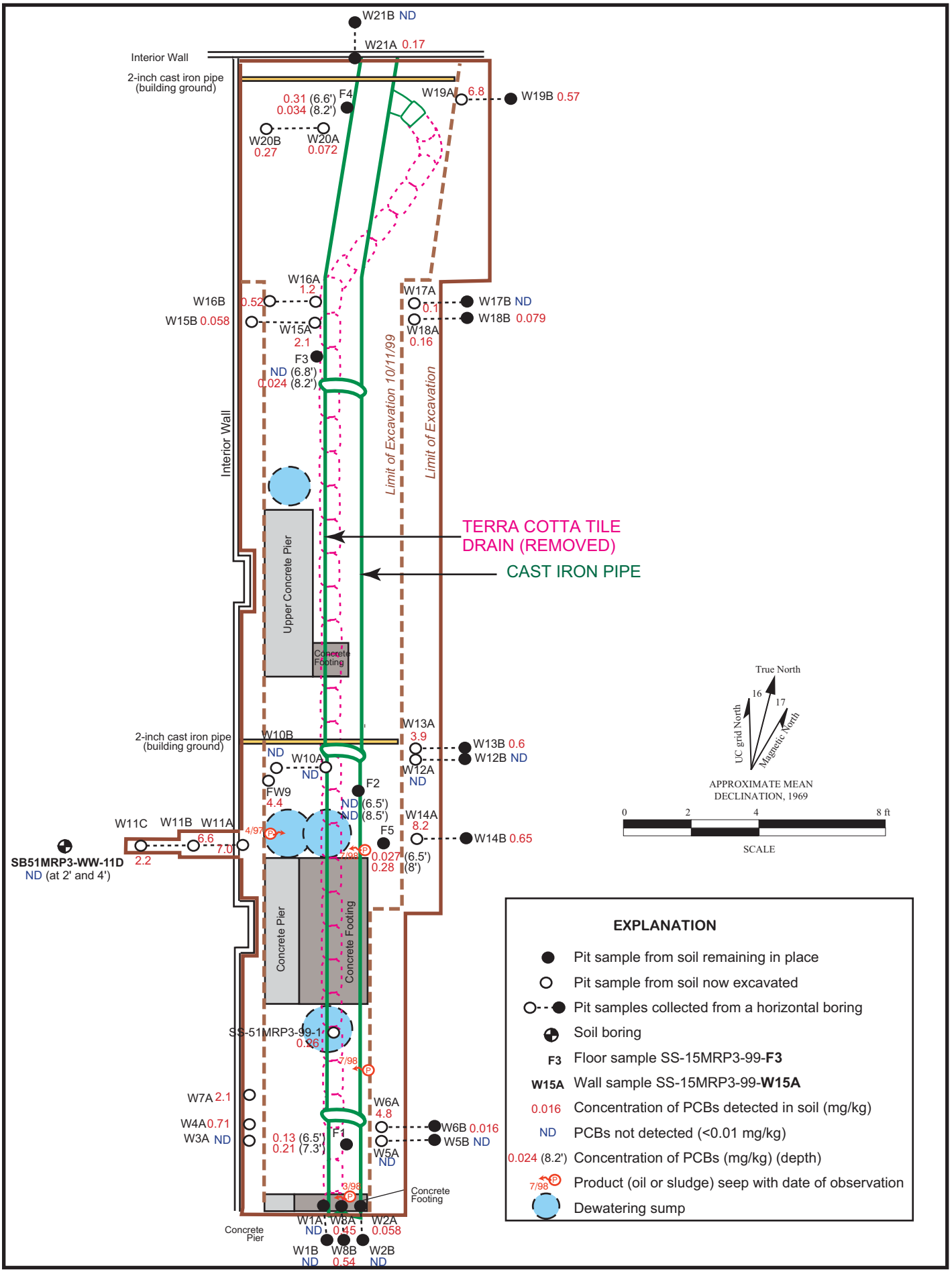
9R1-Pit4PCBsPlan.ai
04/00

Figure 9. Plan View of Proposed Test Pit 4 Showing Concentrations of PCBs Detected (mg/kg) in Soil Borings.



10-Pit3Pipes.ai
03/00

Figure 10. Diagrammatic View of Connection of Cast Iron Pipe and Terra Cotta Tile Drain at North End of test Pit 3 .



11-Pit3resultsPCBsPlan.ai
4/00

Figure 11. Concentrations of PCBs Detected (mg/kg) in 1999 and 2000 Samples, Test Pit 3 (Plan View).

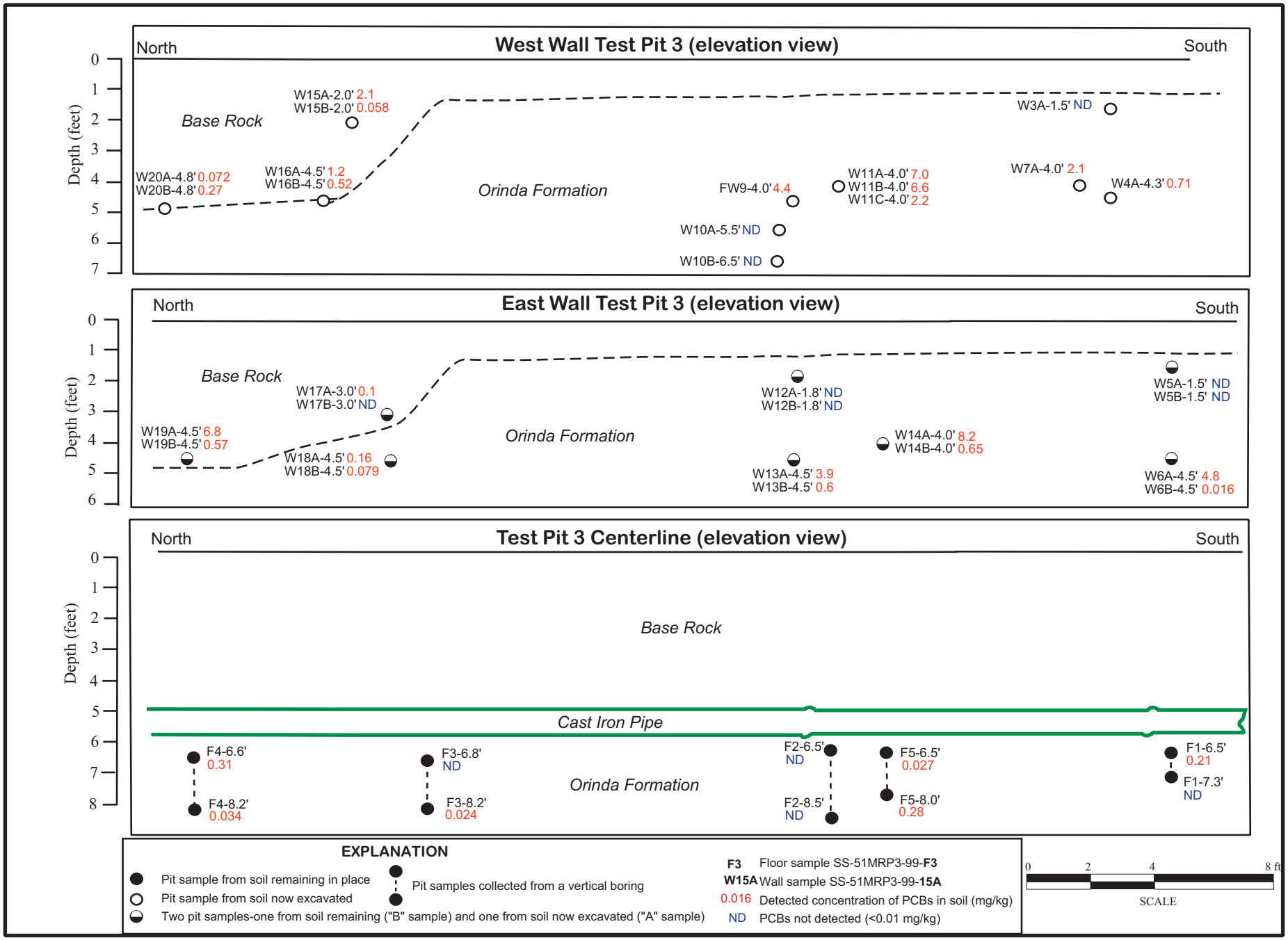
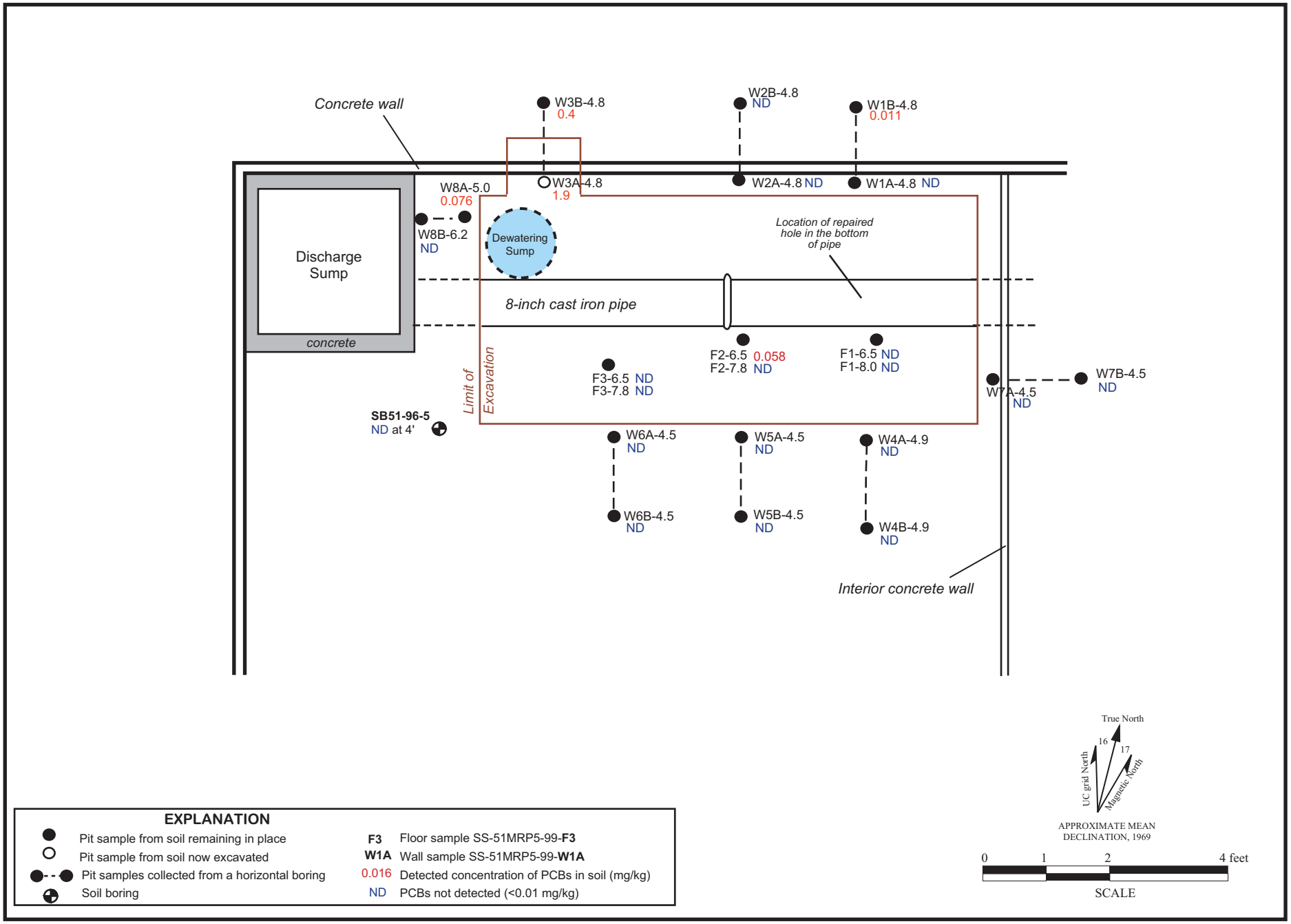


Figure 12. Concentrations of PCBs Detected in Soil Samples Collected in October 1999 (mg/kg), Test Pit 3.

12i-Pit3wallPCBs.ai
03/00



13-Pit5PCBsPlan.ai
03/00

Figure 13. Plan View of Test Pit 5 With Concentrations of PCBs Detected (mg/kg) in Soil Samples.

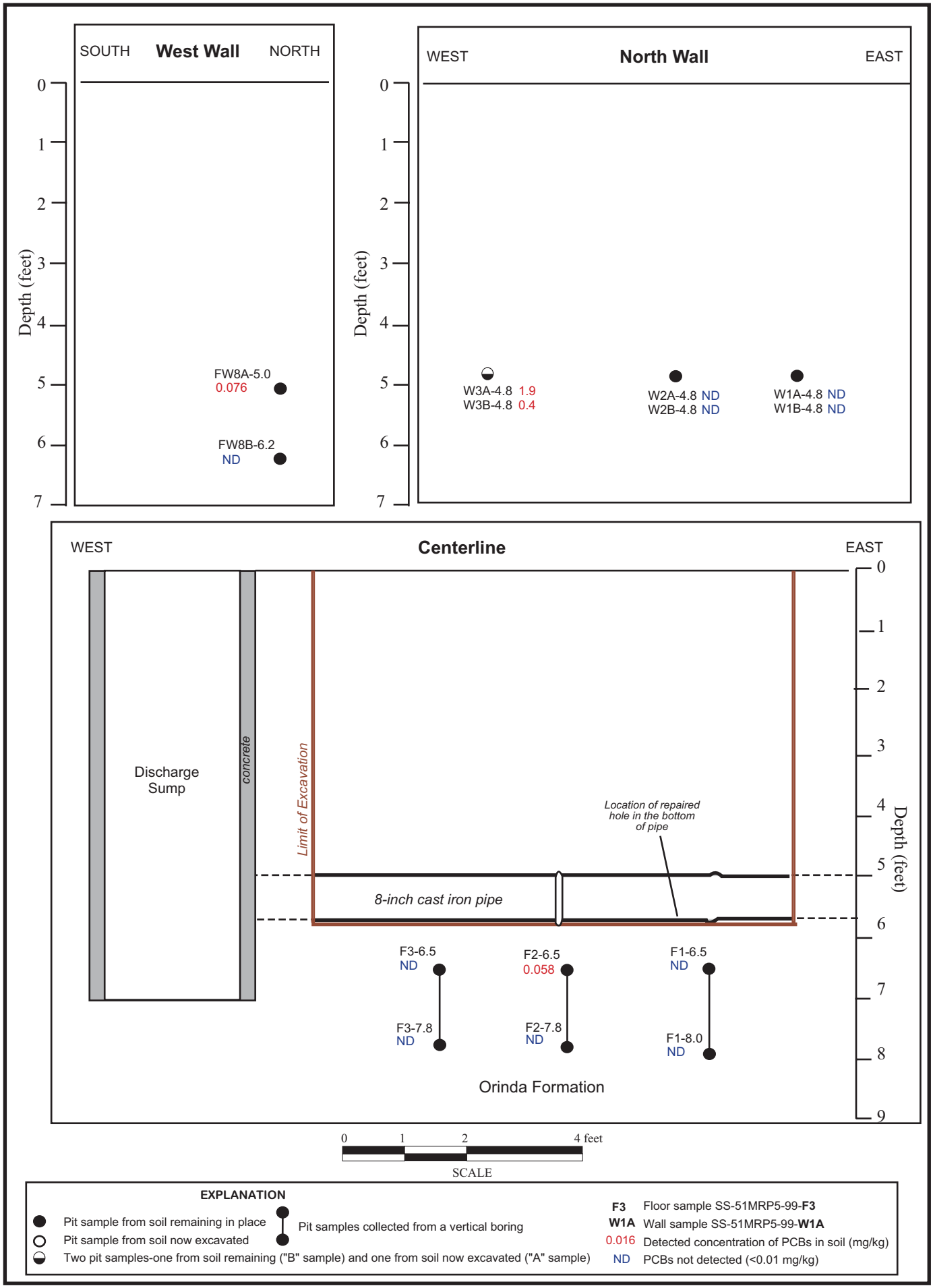


Figure 14. Elevation Views of Test Pit 5 With Concentrations of PCBs Detected (mg/kg).

14-Pit5wallPCBs.ai
03/00

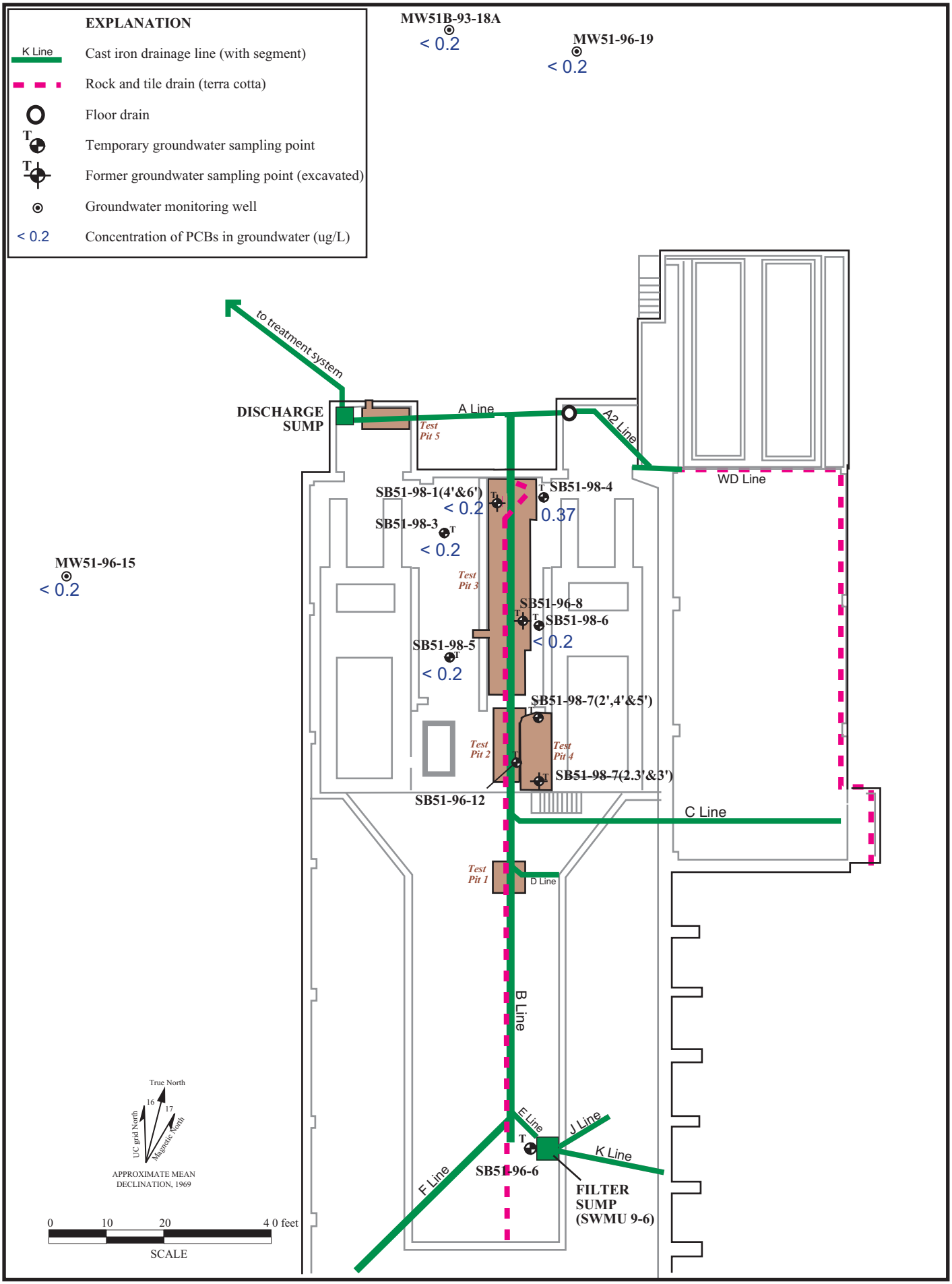


Figure 15. Results of PCBs in Groundwater (ug/L) in the Area of the Building 51 Motor Generator Room Basement - April 1999.

15-B51PCBsGW.ai
03/00

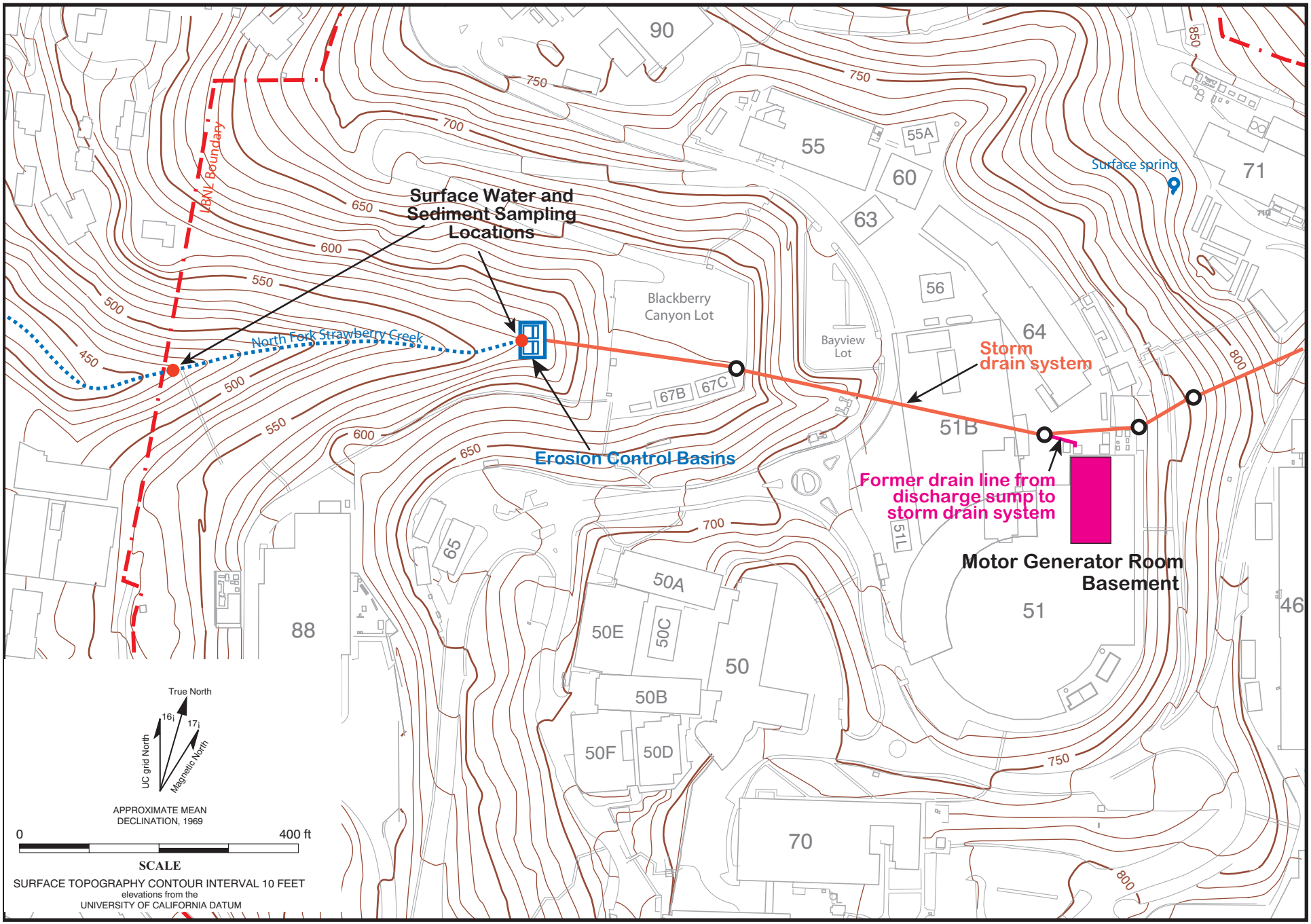
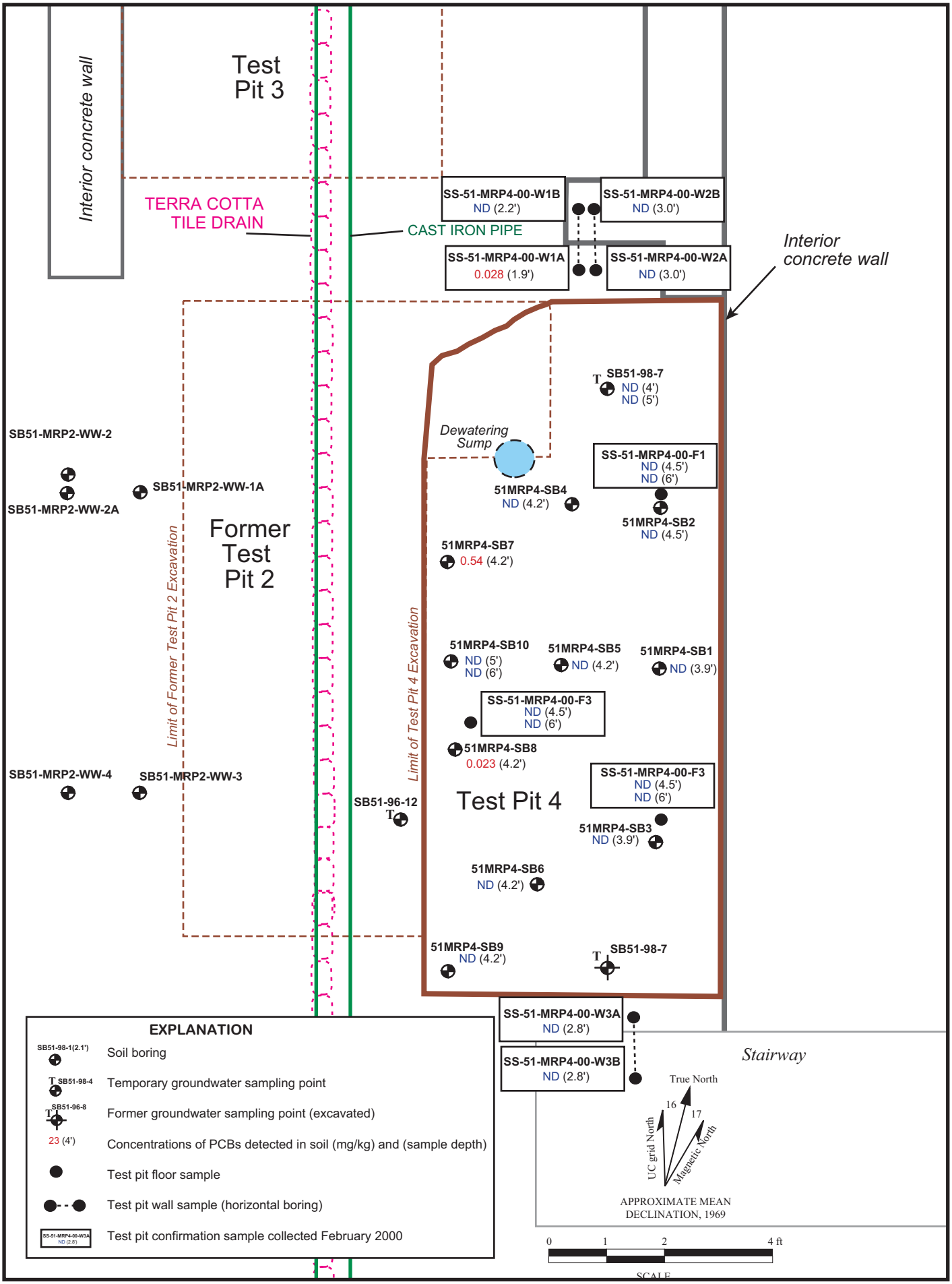


Figure 16. Potential Migration Pathway for Contamination to Surface Water from Building 51 Drainage System (AOC 9-9) and Surface Water and Sediment Sampling Locations.

16-B51SurfWtr.ai
03/00



17-Pit4PCBsPlan.ai
03/00

Figure 17. Plan View of Test Pit 4 Showing Concentrations of PCBs Detected in Confirmation Samples (mg/kg)

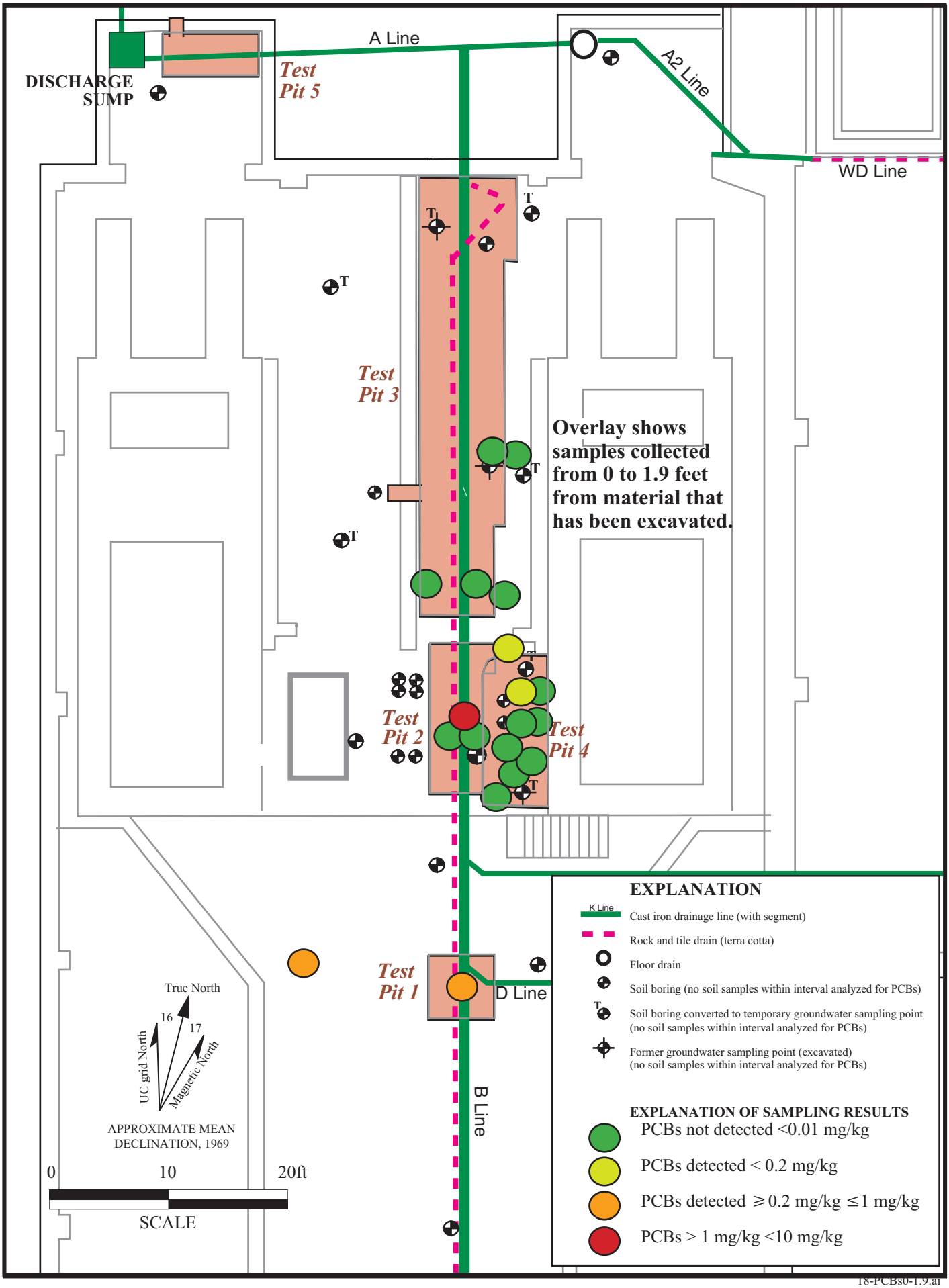
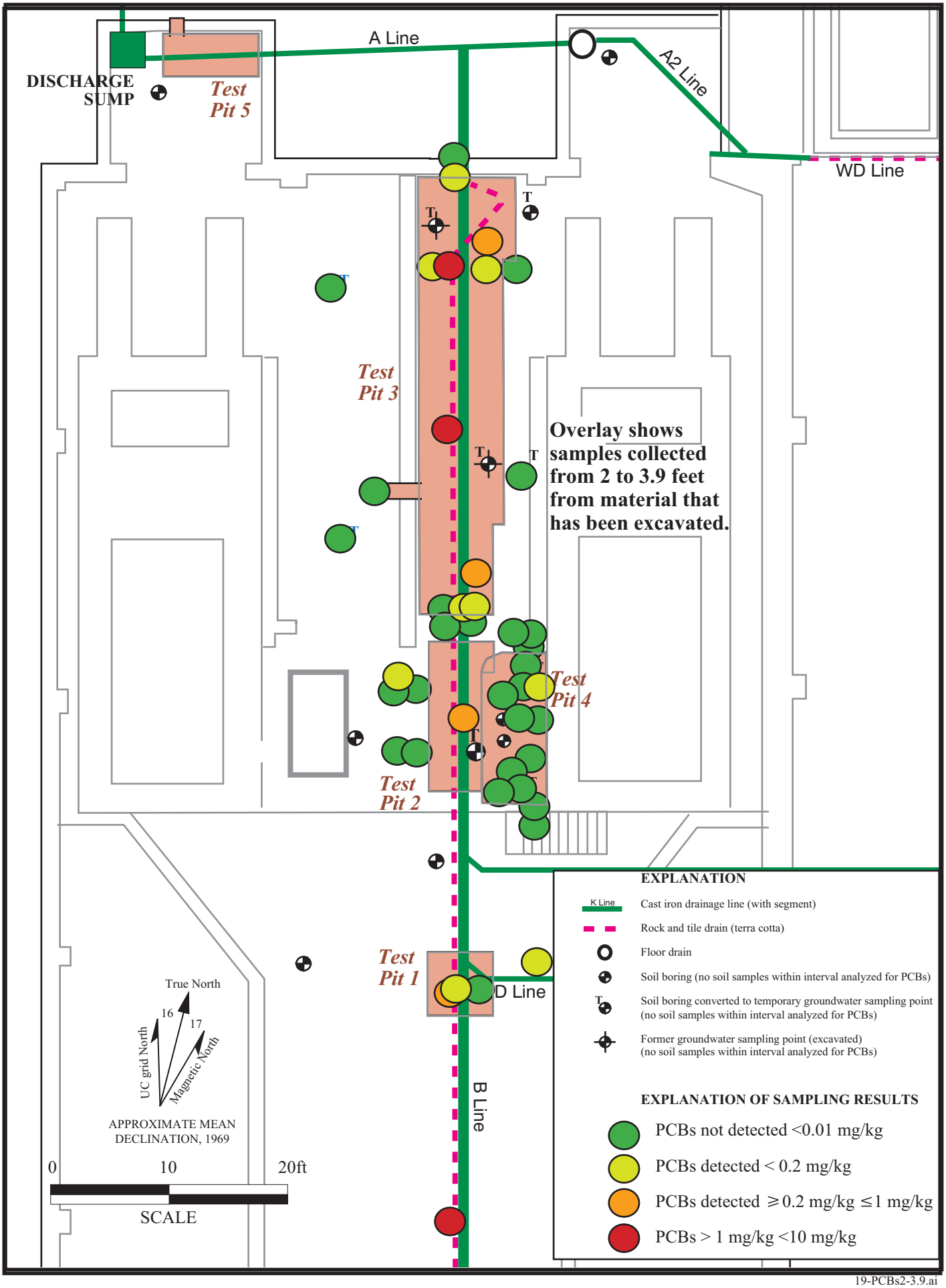
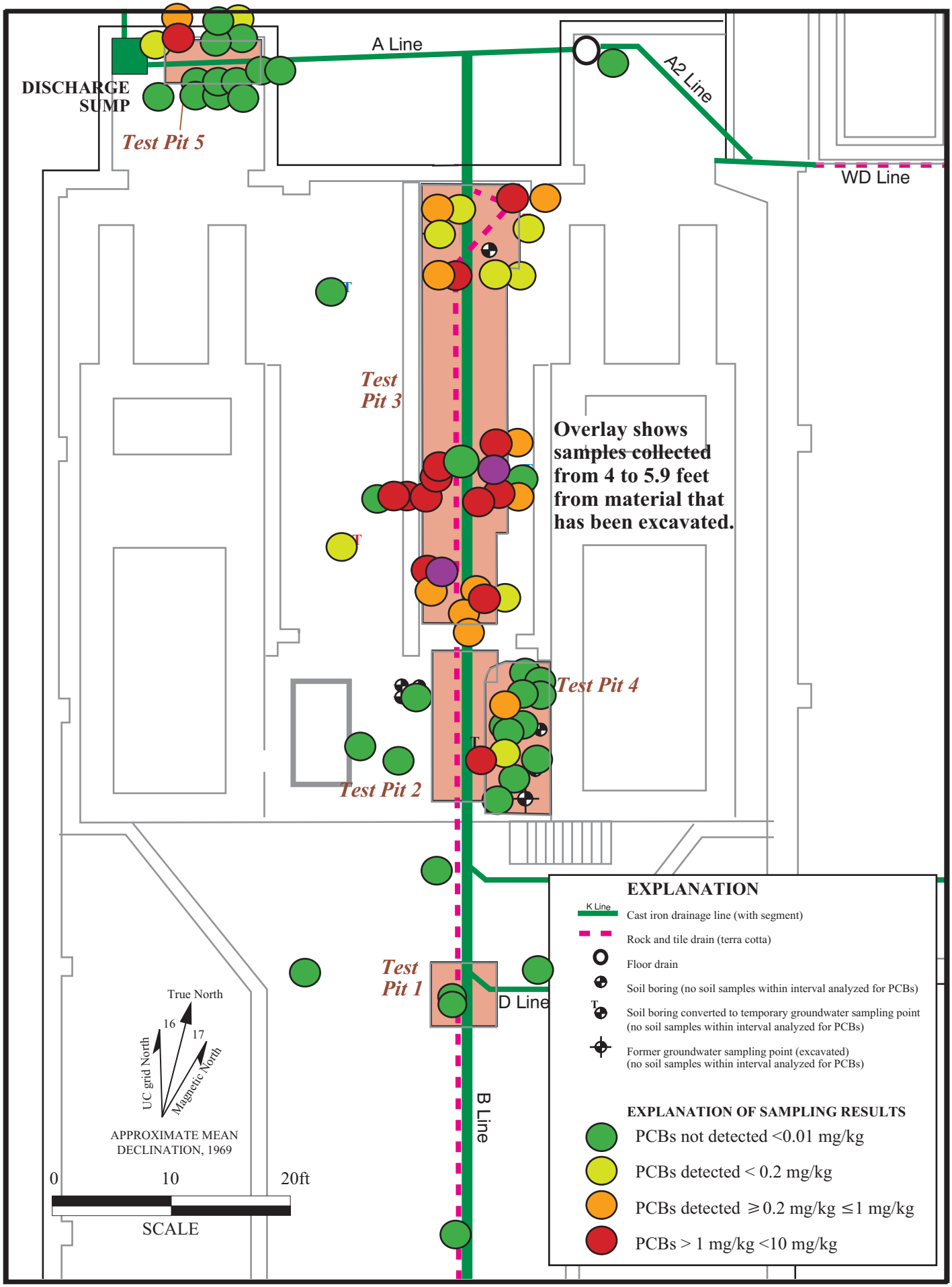


Figure 18. PCBs Remaining in Soil at Depths of 0 to 1.9 Feet Below Motor Generator Room Basement Floor, Building 51 Sanitary Sewer and Drainage System (AOC 9-9).



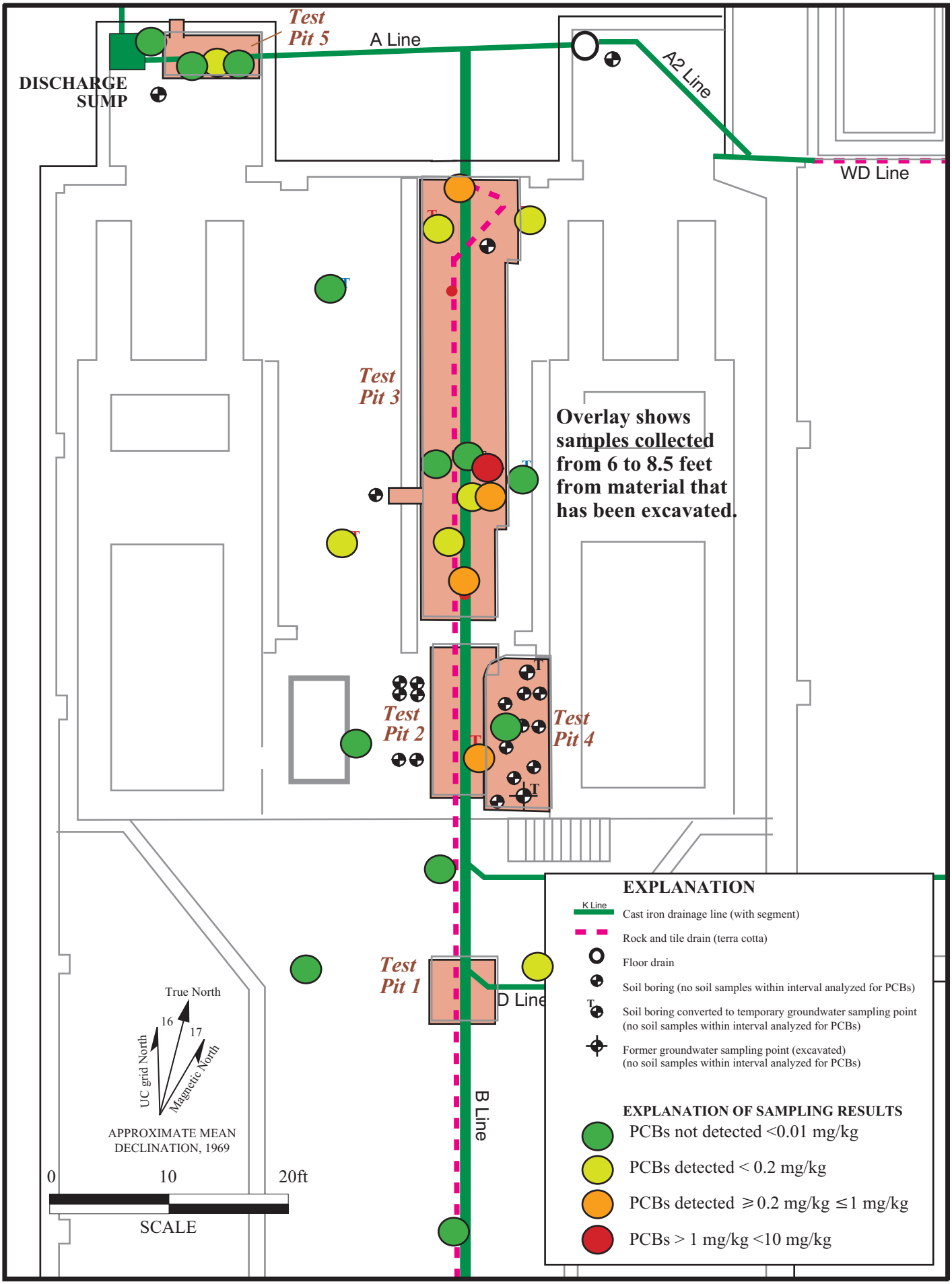
19-PCBs2-3.9.ai
04/00

Figure 19. PCBs Remaining in Soil at Depths of 2 to 3.9 Feet Below Motor Generator Room Basement Floor, Building 51 Sanitary Sewer and Drainage System (AOC 9-9).



20-PCBs4-5.9.ai
03/00

Figure 20. PCBs Remaining in Soil at Depths of 4 to 5.9 Feet Below Motor Generator Room Basement Floor, Building 51 Sanitary Sewer and Drainage System (AOC 9-9).



21PCBs6-8.5.ai
03/00

Figure 21. PCBs Remaining in Soil at Depths of 6 to 8.5 Feet Below Motor Generator Room Basement Floor, Building 51 Sanitary Sewer and Drainage System (AOC 9-9).

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Table 1a.

Drainline and Sump Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System

Sludge/Sediment (concentrations in mg/kg)

Boring/Sample ID	*Analyte* Date Sampled	VOCs 8260	SVOCs 8270	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	Oil & Grease 413.1
Test Pit 2							
SS-51MRP2-Drain	Mar-96	ND		Aroclor 1260=0.013			930
SS-51MRP2-Sludge	Mar-96	ND		<3			7600
Discharge Sump Sludge Samples							
SS-MR-DS-1 & -2	May-96			Aroclor 1242 = 4.8 Aroclor 1254=0.53		<300	11,000
SS-51DS-99-1	May-99		ND	Aroclor 1242 = 3.5 Aroclor 1260=1.3	Hydraulic/Motor Oil = 18,000		
Filter Sump Sludge Samples							
SS-51MR-FS-1 & 2	May-96			Aroclor 1242 = 380		<400	45,000
SS-51FS-99-1	May-99		Bis(2-ethylhexyl)phthalate=13 Fluoranthene=3.9 Pyrene=3.9	Aroclor 1242 = 330	Hydraulic/Motor Oil = 45,000		

Water (concentrations in µg/L)

Boring/Sample ID	*Analyte* Date Sampled	PCBs 8080
Sump Water Samples		
Discharge Sump	Apr-99	Aroclor-1242=4.9
Filter Sump	Apr-99	Aroclor-1242=3,600
K-Line Inflow to Filter Sump	Jun-99	Aroclor-1242=3.4

ND (or < reporting limit)	= Not detected
	= Not analyzed

Sludge and sediment has been removed

Table 1b.
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
Drainline and Sump Sampling Results for Metals
Sludge/Sediment
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
Test Pit 2																			
SS-51MRP2-Sludge	Mar-96	*<14*	5.9	118	*<1.5*	6.5	1310	NA	11	2060	382	43	18	37	9.0	5.6	*<14*	46	736
Discharge Sump Sludge Samples																			
SS-MR-DS-1 & -2	May-96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4.1	NA	NA	NA	NA	NA	NA	NA
SS-51DS-99-1	May-99	*<50*	19	656	*<5*	26	1100	NA	37	3680	775	28	*<25*	208	14	*<10*	*<50*	170	2430
SS-51DS-99-1	May-99	*<10*	3.6	131	<1	3.5	210	NA	7.5	648	138	3.0	*<5*	40	2.9	*<2*	*<10*	41	472
Filter Sump Sludge Samples																			
SS-51MR-FS-1 & -2	May-96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	105	NA	NA	NA	NA	NA	NA	NA
SS-51FS-99-1	May-99	*<10*	4.2	85	<1	8.7	305	NA	9.3	1600	301	46.0	*<5*	17	2.9	2.6	*<10*	46	369

NA	= Not analyzed
<5	= Not detected (reporting limit shown)

Sludge and sediment has been removed

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
Soil Borings								
SB51-96-5-4	Apr-96		ND	<1.0	Motor Oil=44			250
SB51-96-7-4	Apr-96		ND	<1.0	<4.0			<10
SB51-96-8-4	Apr-96	X	ND	**Aroclor 1242=23**	Motor Oil=2300			11,000
SB51-96-8-6	Apr-96	X	ND	**Aroclor 1242=8.0**	Motor Oil=1500			1500
SB51-96-9-4	Apr-96		ND	<0.02	Motor Oil=25			<10
SB51-96-9-6	Apr-96		ND	<0.02	<2.0			<10
SB51-96-11-4	Apr-96		ND	<1.0	<2.0			<10
SB51-96-11-6	Apr-96		ND	<0.02	<2.0			<10
SB51-96-12-4	Apr-96	X	ND	**Aroclor 1242=3.0**	Motor Oil=1000			1400
SB51-96-12-6	Apr-96		ND	**Aroclor 1242=1.0**	Motor Oil=1000			890
SB51-96-12-8	Apr-96		ND	Aroclor 1242=0.14	Motor Oil=390			120
SB51-98-1-2.1	Feb-98	X	ND	Aroclor 1242=**0.29**	Hydraulic/Motor Oil=540			
SB51-98-1-4	Jun-98	X	ND	Aroclor 1242=0.16	Hydraulic/Motor Oil=350			
SB51-98-1-6	Jun-98		ND	Aroclor 1242=0.031	Crude/Waste Oil=130			
SB51-98-2-2.0	Feb-98		ND	**Aroclor 1260=1.1**	Hydraulic/Motor Oil=75			
SB51-98-2-5	Jun-98		ND	<0.01	ND			
SB51-98-2-6.5	Jun-98		ND	<0.01	ND			
SB51-98-3-2.4	Feb-98		ND	<0.01	ND			
SB51-98-3-3.4	Feb-98		ND	<0.01	ND			
SB51-98-3-4	Jun-98		ND	<0.01	ND			
SB51-98-3-6	Jun-98		ND	<0.01	ND			
SB51-98-4-4	Jun-98		ND	Aroclor 1242=0.17	Hydraulic/Motor Oil=350			
SB51-98-4-6	Jun-98		ND	Aroclor 1242=0.18	Hydraulic/Motor Oil=740			
SB51-98-5-3	Feb-98		ND	<0.01	ND			
SB51-98-5-4	Jun-98		ND	Aroclor 1242=0.02	Crude/Waste Oil=34			
SB51-98-5-6	Jun-98		ND	Aroclor 1242=0.035	Crude/Waste Oil=28			
SB51-98-6-2.3	Feb-98		ND	<0.01	ND			
SB51-98-6-4	Jun-98		ND	<0.01	ND			
SB51-98-6-6	Jun-98		ND	<0.01	Crude/Waste Oil=40			
SB51-98-7-2.0	Jun-98	X	ND	<0.01	Crude/Waste Oil=150			
SB51-98-7-2.3	Feb-98	X	ND	<0.01	Crude/Waste Oil=1100			
SB51-98-7-3	Feb-98	X	ND	<0.01	Crude/Waste Oil=480			
SB51-98-7-4	Jun-98		ND	<0.01	Crude/Waste Oil=2000			
SB51-98-7-5	Jun-98		ND	<0.01	Crude/Waste Oil=540			
SB51-98-8-1.8	Feb-98		ND	Aroclor 1260=**0.27**	Hydraulic/Motor Oil=24			
SB51-98-8-5	Jun-98		ND	<0.01	ND			
SB51-98-8-6.5	Jun-98		ND	<0.01	ND			
SB51-98-9-2.6	Feb-98		ND	<0.01	ND			
SB51-98-9-3.6	Feb-98		ND	Aroclor 1260=0.03	Crude/Waste Oil=52			
SB51-98-9-4	Jun-98		ND	<0.01	ND			
SB51-98-9-6	Jun-98		ND	Aroclor 1260=0.16	ND			

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SB51-MRP2-WW-1A-2.0	Mar-00			<0.01	ND		ND	
SB51-MRP2-WW-1A-4.0	Mar-00			<0.01	ND		ND	
SB51-MRP2-WW-2-3.8	Feb-00			Aroclor-1242=0.017	ND		ND	
SB51-MRP2-WW-2A-2.0	Mar-00			<0.01	ND		ND	
SB51-MRP2-WW-3-2.0	Feb-00			<0.01	ND		ND	
SB51-MRP2-WW-3-3.8	Feb-00			<0.01	ND		ND	
SB51-MRP2-WW-4-2.0	Feb-00			<0.01	ND		ND	
SB51-MRP2-WW-4-4.0	Feb-00			<0.01	ND		ND	
SB51-MRP3-WW-11D-2.0	Feb-00			<0.01	ND		ND	
SB51-MRP3-WW-11D-4.0	Feb-00			<0.01	ND		ND	
51MRP4-SB1-1.2	Apr-99	X		<0.02	Hydraulic/Motor Oil = 28,000			
51MRP4-SB1-2.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 13,000			
51MRP4-SB1-3.9	Apr-99			<0.01	Hydraulic/Motor Oil = 20,000			
51MRP4-SB2-1.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 4,900			
51MRP4-SB2-2.2	Apr-99	X		Aroclor 1260 = 0.018	Hydraulic/Motor Oil = 1,000			
51MRP4-SB2-4.5	Apr-99			<0.01	Hydraulic/Motor Oil = 3,300			
51MRP4-SB3-1.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 27,000			
51MRP4-SB3-2.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 9,500			
51MRP4-SB3-3.9	Apr-99			<0.01	Hydraulic/Motor Oil = 4,900			
51MRP4-SB4-1.2	Apr-99	X		Aroclor 1260 = 0.023	Hydraulic/Motor Oil = 3,000			
51MRP4-SB4-2.2	Apr-99	X		<0.01				
51MRP4-SB4-4.2	Apr-99			<0.01				
51MRP4-SB5-1.2	Apr-99	X		<0.10	Hydraulic/Motor Oil = 25,000			
51MRP4-SB5-2.2	Apr-99	X		<0.01				
51MRP4-SB5-4.2	Apr-99			<0.01				
51MRP4-SB6-1.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 1,100			
51MRP4-SB6-2.2	Apr-99	X		<0.01				
51MRP4-SB6-4.2	Apr-99			<0.01				
51MRP4-SB7-1.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 1,200			
51MRP4-SB7-2.2	Apr-99	X		<0.01				
51MRP4-SB7-4.2	Apr-99			Aroclor 1242 = 0.54				
51MRP4-SB8-1.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 5,200			
51MRP4-SB8-2.2	Apr-99	X		<0.01				
51MRP4-SB8-4.2	Apr-99			Aroclor 1242 = 0.023				
51MRP4-SB9-1.2	Apr-99	X		<0.01	Hydraulic/Motor Oil = 57			
51MRP4-SB9-2.2	Apr-99	X		<0.01				
51MRP4-SB9-4.2	Apr-99			<0.01				
51MRP4-SB10-5.0	Apr-99			<0.01	Diesel = 27			
51MRP4-SB10-6.0	Apr-99			<0.01	Diesel = 32			
Test Pit 1								
SS-51MRPit-96-1-3	Mar-96	X	ND	<0.01				

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SS-51MRPit-96-2-2	Mar-96	X	ND	Aroclor-1260=0.10				
SS-51MRPit-96-3-0.75	Mar-96	X		**Aroclor-1260=1.0**				
SS-51MRPit-96-4-4.5	Mar-96	X	ND	<0.01				
SS-51MRPit-96-5-4.2	Mar-96	X	ND	<0.01				
SS-51MRPit-96-6-2	Mar-96			Aroclor 1260=**0.61**	Motor Oil=170	<20		200
Test Pit 2								
SS-51MRP2-1-0.8	Nov-96	X		**Aroclor 1254=3.6**				
SS-51MRP2-2-1.5	Nov-96	X	ND	<0.01				24
SS-51MRP2-3-1.6	Nov-96	X	ND	<0.01				100
SS-51MRP2-4-3.5	Nov-96	X	ND	Aroclor 1248=**0.94**	Motor Oil=570			2700
Test Pit 3								
SS-51MRPit3-98-1-4.0	Jul-98	X	ND	**Aroclor 1242=6.5**	Hydraulic/Motor Oil=4600			
SS-51MRPit3-98-2-4.0	Jul-98	X	ND	**Aroclor 1242=4.4**	Hydraulic/Motor Oil=2600			
SS-51MRPit3-98-3-6.0	Jul-98		ND	Aroclor 1242=0.025	Hydraulic/Motor Oil=110			
SS-51MRPit3-98-4-3.5	Jul-98	X	ND	Aroclor 1242=**0.51**	Hydraulic/Motor Oil=650			
SS-51MRPit3-98-5-4.0	Jul-98	X	ND	**Aroclor 1242=14**	Hydraulic/Motor Oil=1300			
SS-51MRPit3-98-6-6.3	Jul-98		ND	Aroclor 1242=**0.37**	Hydraulic/Motor Oil=740			
SS-51MRPit3-98-7-5.8	Jul-98		ND	Aroclor 1242=**0.32**	Hydraulic/Motor Oil = 550			
SS-51MRPit3-98-8-7.5	Jul-98	X	ND	Aroclor 1242=0.14	Hydraulic/Motor Oil=590			
SS-51MRPit3-98-9-3.0	Jul-98		ND	Aroclor 1254=0.084	Hydraulic/Motor Oil=270			
SS-51MRPit3-98-10-3.0	Jul-98	X	ND	**Aroclor 1242=2.8**	Hydraulic/Motor Oil=1300			
SS-51MRP3-99-1-7.3	Jun-99	X	methylene chloride=0.015	Aroclor 1242 = **0.26**				53
SS-51MRP3-99-W1A-2.3	Oct-99		ND	<0.01	ND		ND	
SS-51MRP3-99-W1B-2.3	Oct-99		ND	<0.01	ND		ND	
SS-51MRP3-99-W2A-3.0	Oct-99		ND	Aroclor-1242=0.058	Hydraulic/Motor Oil=62		ND	
SS-51MRP3-99-W2B-3.0	Oct-99		ND	<0.01	Hydraulic/Motor Oil=50		ND	
SS-51MRP3-99-W3A-1.5	Oct-99	X	ND	<0.01	ND		ND	
SS-51MRP3-99-W4A-4.3	Oct-99	X	ND	Aroclor-1242=**0.71**	Hydraulic/Motor Oil=370		Chr=0.012 Py=0.041	
SS-51MRP3-99-W5A-1.5	Oct-99	X	ND	<0.01	Hydraulic/Motor Oil=24		ND	
SS-51MRP3-99-W5B-1.5	Oct-99		ND	<0.01	Hydraulic/Motor Oil=30		Chr=0.012	
SS-51MRP3-99-W6A-4.5	Oct-99	X	ND	**Aroclor-1242=4.8**	Hydraulic/Motor Oil=9100		ND	
SS-51MRP3-99-W6B-4.5	Oct-99		ND	Aroclor-1242=0.016	Hydraulic/Motor Oil=60		ND	
SS-51MRP3-99-W7A-4.0	Oct-99	X	ND	**Aroclor-1242=2.1**	Hydraulic/Motor Oil=5300		ND	
SS-51MRP3-99-W8A-4.5	Oct-99		ND	Aroclor-1242=**0.45**	Hydraulic/Motor Oil=860		B(a)A=0.011 B(b)F=0.015 B(k)F=0.012 Chr=0.01 Fluora=0.022 Py=0.081	

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SS-51MRP3-99-W8B-4.5	Oct-99		ND	Aroclor-1242=**0.54**	Hydraulic/Motor Oil=870		Chr=0.011 Fluora=0.021 Py=0.053	
SS-51MRP3-99-W10A-5.5	Oct-99	X	ND	<0.01	ND		ND	
SS-51MRP3-99-W10B-6.5	Oct-99	X	ND	<0.01	Hydraulic/Motor Oil=25		ND	
SS-51MRP3-99-W11A-4.0	Oct-99	X	ND	**Aroclor-1242=7.0**	Hydraulic/Motor Oil=4000		Py=0.024	
SS-51MRP3-99-W11B-4.0	Oct-99	X	ND	**Aroclor-1242=6.6**	Hydraulic/Motor Oil=5200		Py=0.037	
SS-51MRP3-00-W11C-4.0	Feb-00	X		**Aroclor-1242=2.2**				
SS-51MRP3-99-W12A-1.8	Oct-99	X	ND	<0.01	ND		ND	
SS-51MRP3-99-W12B-1.8	Oct-99		ND	<0.01	ND		ND	
SS-51MRP3-99-W13A-4.5	Oct-99	X	ND	**Aroclor-1242=3.9**	Hydraulic/Motor Oil=2700		An=0.0022 B(a)A=0.017 B(b)F=0.022 Chr=0.011 Fluora=0.057 Py=0.16	
SS-51MRP3-99-W13B-4.5	Oct-99		ND	Aroclor-1242=**0.60**	Hydraulic/Motor Oil=620		Py=0.040	
SS-51MRP3-99-W14A-4.0	Oct-99	X	ND	**Aroclor-1242=8.2**	Hydraulic/Motor Oil=14,000		Py=0.083	
SS-51MRP3-99-W14B-4.0	Oct-99		ND	Aroclor-1242=**0.65**	Hydraulic/Motor Oil=1100		Py=0.063	
SS-51MRP3-99-W15A-2.0	Oct-99	X	ND	**Aroclor-1242=2.1**	Hydraulic/Motor Oil=1800		An=0.001 Py=0.059	
SS-51MRP3-99-W15B-2.0	Oct-99	X	ND	Aroclor-1242=0.058	Hydraulic/Motor Oil=68		ND	
SS-51MRP3-99-W16A-4.5	Oct-99	X	ND	**Aroclor-1242=1.2**	Hydraulic/Motor Oil=1100		Py=0.057	
SS-51MRP3-99-W16B-4.5	Oct-99	X	ND	Aroclor-1242=**0.52**	Hydraulic/Motor Oil=690		Py=0.045	
SS-51MRP3-99-W17A-3.0	Oct-99	X	ND	Aroclor-1242=0.10	Hydraulic/Motor Oil=230		ND	
SS-51MRP3-99-W17B-3.0	Oct-99		ND	<0.01	ND		ND	
SS-51MRP3-99-W18A-4.5	Oct-99	X	ND	Aroclor-1242=0.16	Hydraulic/Motor Oil=280		ND	
SS-51MRP3-99-W18B-4.5	Oct-99		ND	Aroclor-1242=0.079	WD-40=130		ND	
SS-51MRP3-99-W19A-4.5	Oct-99	X	ND	**Aroclor-1242=6.8**	Hydraulic/Motor Oil=7700		Acen=0.47 An=0.0027 Fluora=0.098 Py=0.061	
SS-51MRP3-99-W19B-4.5	Oct-99		ND	Aroclor-1242=**0.57**	Hydraulic/Motor Oil=690		An=0.0014 B(b)F=0.011 Py=0.056	
SS-51MRP3-99-W20A-4.8	Oct-99	X	ND	Aroclor-1242=0.072	Hydraulic/Motor Oil=78		ND	
SS-51MRP3-99-W20B-4.8	Oct-99	X	ND	Aroclor-1242=**0.27**	Hydraulic/Motor Oil=420		Fluora=0.19	
SS-51MRP3-99-W21A-3.5	Oct-99		ND	Aroclor-1242=0.17	Hydraulic/Motor Oil=540		ND	
SS-51MRP3-99-W21B-3.5	Oct-99		ND	<0.01	ND		ND	
SS-51MRP3-99-F1-6.5	Oct-99		ND	Aroclor-1242=0.13	Hydraulic/Motor Oil=160		ND	

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SS-51MRP3-99-F1-7.3	Oct-99		ND	Aroclor-1242=**0.21**	Hydraulic/Motor Oil=440		An=0.0014 B(a)A=0.044 **B(a)P=0.074** B(b)F=0.074 B(ghi)P=0.029 B(k)F=0.036 Chr=0.061 Fluora=0.072 I(123cd)P=0.032 Py=0.093	
SS-51MRP3-99-F2-6.5	Oct-99		TCE=0.011	<0.01	ND		ND	
SS-51MRP3-99-F2-8.5	Oct-99		ND	<0.01	ND		ND	
SS-51MRP3-99-F3-6.8	Oct-99		ND	<0.01	ND		An=0.002 B(a)A=0.012 Chr=0.024 Fluora=0.029 Phen=0.011	
SS-51MRP3-99-F3-8.2	Oct-99		ND	Aroclor-1242=0.024	Hydraulic/Motor Oil=28		Chr=0.014	
SS-51MRP3-99-F4-6.6	Oct-99		ND	Aroclor-1242=**0.31**	Hydraulic/Motor Oil=280		An=0.002 B(a)A=0.01 Chr=0.021 Fluora=0.028	
SS-51MRP3-99-F4-8.2	Oct-99		ND	Aroclor-1242=0.034	Hydraulic/Motor Oil=76		An=0.015 B(a)A=0.043 B(a)P=0.045 B(b)F=0.041 B(ghi)P=0.022 B(k)F=0.026 Chr=0.055 Fluora=0.2 I(123cd)P=0.023 Phen=0.068 Py=0.13	
SS-51MRP3-99-F5-6.5	Oct-99		ND	Aroclor-1242=0.027	Hydraulic/Motor Oil=150		An=0.0024 B(a)A=0.019 B(b)F=0.017 Chr=0.018 Fluora=0.07 I(123cd)P=0.012 Py=0.049	

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SS-51MRP3-99-F5-8.0	Oct-99		ND	Aroclor-1242=**0.28**	Hydraulic/Motor Oil=470		An=0.015 B(a)A=0.071 B(a)P=**0.063** B(b)F=0.074 B(ghi)P=0.036 B(k)F=0.037 Chr=0.074 Fluora=0.26 I(123cd)P=0.033 Phen=0.036 Py=0.21	
SS-51MRP3-99-FW9-4.0	Oct-99	X	ND	**Aroclor-1242=4.4**	Hydraulic/Motor Oil=3600		Chr=0.015	
Test Pit 4								
SS-51-MRP4-00-F1-4.5	Feb-00		ND	<0.01	Hydraulic/Motor Oil=25			
SS-51-MRP4-00-F1-6.0	Feb-00		ND	<0.01	ND			
SS-51-MRP4-00-F2-4.5	Feb-00		ND	<0.01	ND			
SS-51-MRP4-00-F2-6.0	Feb-00		ND	<0.01	ND			
SS-51-MRP4-00-F3-4.5	Feb-00		ND	<0.01	ND			
SS-51-MRP4-00-F3-6.0	Feb-00		ND	<0.01	Hydraulic/Motor Oil=41			
SS-51-MRP4-00-W1A-1.9	Feb-00		ND	Aroclor-1242=0.028	Hydraulic/Motor Oil=310			
SS-51-MRP4-00-W1B-2.2	Feb-00		ND	<0.01	Hydraulic/Motor Oil=30			
SS-51-MRP4-00-W2A-3.0	Feb-00		ND	<0.01	Hydraulic/Motor Oil=42			
SS-51-MRP4-00-W2B-3.0	Feb-00		ND	<0.01	ND			
SS-51-MRP4-00-W3A-2.8	Feb-00		ND	<0.01	ND			
SS-51-MRP4-00-W3B-2.8	Feb-00		ND	<0.01	ND			
Test Pit 5								
SS-51MRP5-99-F1-6.5	Oct-99		TCE=0.017	<0.01	ND		Chr=0.012	
SS-51MRP5-99-F1-8.0	Oct-99		TCE=0.058	<0.01	ND		An=0.0011 B(a)A=0.012 B(b)F=0.017 Chr=0.014 Fluora=0.030 Pyr=0.025	
SS-51MRP5-99-F2-6.5	Oct-99		ND	Aroclor-1242=0.058	Hydraulic/Motor Oil=88		An=0.0014 B(b)F=0.01	

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SS-51MRP5-99-F2-7.8	Oct-99		TCE=0.0053	<0.01	ND		An=0.0010 B(a)A=0.074 B(a)P=**0.082** B(b)F=0.084 B(k)F=0.043 Chr=0.090 Fluora=0.19 I(123cd)P=0.045 Py=0.16	
SS-51MRP5-99-F3-6.5	Oct-99		ND	<0.01	ND		An=0.0013 B(a)A=0.019 B(b)F=0.022 Chr=0.024 Fluora=0.056 Py=0.050	
SS-51MRP5-99-F3-7.8	Oct-99		TCE=0.016	<0.01	ND		An=0.0021 B(a)A=0.033 B(a)P=0.036 B(b)F=0.033 B(k)F=0.018 Chr=0.036 Fluora=0.072 I(123cd)P=0.02 Py=0.052	
SS-51MRP5-99-W1A-4.8	Oct-99		ND	<0.01	ND		ND	
SS-51MRP5-99-W1B-4.8	Oct-99		ND	Aroclor-1242=0.011	ND		ND	
SS-51MRP5-99-W2A-4.8	Oct-99		TCE=0.014 1,2,3-TCB=0.0054	<0.01	ND		ND	
SS-51MRP5-99-W2B-4.8	Oct-99		TCE=0.014	<0.01	ND		ND	
SS-51MRP5-99-W3A-4.8	Oct-99	X	n-butylbenzene=0.016 sec-butylbenzene=0.026 cis-1,2-DCE=0.005 PCE=0.048 TCE=0.16 1,2,4-TMB=0.044	**Aroclor-1242=1.9**	Hydraulic/Motor Oil=2600		An=0.0014 B(a)A=0.013 B(b)F=0.017 B(k)F=0.016 Chr=0.012 Fluora=0.036 Pyr=0.11	
SS-51MRP5-99-W3B-4.8	Oct-99		PCE=0.0092 TCE=0.030	Aroclor-1242=**0.40**	Hydraulic/Motor Oil=430		Pyr=0.038	
SS-51MRP5-99-W4A-4.9	Oct-99		TCE=0.013	<0.01	ND		ND	
SS-51MRP5-99-W4B-4.9	Oct-99		TCE=0.017	<0.01	ND		ND	

Table 2a.
Soil Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	VOCs 8260	PCBs 8080 or 8082	Fuels 8015M	TPH-D 8015M	PAHs 8310	Oil & Grease 413.1
SS-51MRP5-99-W5A-4.5	Oct-99		TCE=0.0078	<0.01	ND		B(b)F=0.012 Chr=0.015 Fluora=0.032 Pyr=0.025	
SS-51MRP5-99-W5B-4.5	Oct-99		TCE=0.0073	<0.01	ND		B(a)A=0.012 B(b)F=0.014 Chr=0.015 Fluora=0.030 Pyr=0.024	
SS-51MRP5-99-W6A-4.5	Oct-99		ND	<0.01	ND		ND	
SS-51MRP5-99-W6B-4.5	Oct-99		TCE=0.0054	<0.01	ND		Fluora=0.025	
SS-51MRP5-99-W7A-4.5	Oct-99		ND	<0.01	ND		ND	
SS-51MRP5-99-W7B-4.5	Oct-99		ND	<0.01	ND		ND	
SS-51MRP5-99-FW8A-5.0	Oct-99		PCE=0.23 TCE=0.026 1,2,4-TMB=0.011	Aroclor-1242=0.076	Hydraulic/Motor Oil=590		An=0.0033 B(a)A=0.019 B(b)F=0.017 Chr=0.021 Fluora=0.079 Phen=0.023 Pyr=0.052	
SS-51MRP5-99-FW8B-6.2	Oct-99		ND	<0.01	Hydraulic/Motor Oil=30		ND	

ND (or < reporting limit) = Not detected
* = Not analyzed

Concentrations of analytes detected in soil samples above PRGs for residential soil are shown in **bold**.
PCBs with the Aroclor number in **bold** for soil samples are above the 1 mg/kg Interim Measure cleanup level for s
* - X indicates that sample was collected from material that has been excavated

PRGs for Residential Soil for Detected Organic Analytes (mg/kg)

PCBs	0.2						
acenaphthene (Acen)	2,600	benzo(k)fluoranthene (B(k)F)	5.6	cis-1,2-dichloroethene (cis-1,2-DCE)	42	n-butylbenzene	130
acenaphthylene (Aceny)	2,600	chrysene (Chr)	56	methylene chloride	8.5	sec-butylbenzene	100
anthracene (An)	14,000	fluoranthene (Fluora)	2,000	tetrachloroethene (PCE)	4.7	1,2,3-trichlorobenzene (1,2,3-TCB)	none
benzo(a)anthracene (B(a)A)	0.56	ideno(123cd)pyrene (I(123cd)P)	0.56	trichloroethene (TCE)	2.7	1,2,4-trimethylbenzene (1,2,4-TMB)	51
benzo(a)pyrene (B(a)P)	0.056	phenanthrene (Phen)	none				
benzo(b)fluoranthene (B(b)F)	0.56	pyrene (Py)	1,500				
benzo(ghi)perylene (B(ghi)P)	none						

Table 2b.

Soil Sampling Results for Metals
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
*Maximum Background Concentrations***			5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs			30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs							9		0.2			130			150					
Soil Borings																				
SB51-96-8-4	Apr-96	X	<5	1.4	180	0.6	<0.5	110	NA	12	23	<5	<0.05	<2.5	81	<0.5	<1	<4	49	53
SB51-96-8-6	Apr-96	X	<5	1.4	180	0.6	<0.5	96	NA	11	22	<5	<0.05	<2.5	90	<0.5	<1	<4	50	55
SB51-96-9-4	Apr-96		<5	7.5	47	0.53	<0.5	120	NA	12	<1	25	<0.05	<2.5	72	<0.5	<1	<4	47	50
SB51-96-9-6	Apr-96		<5	1.7	98	0.73	<0.5	73	NA	14	23	<5	<0.05	<2.5	94	<0.5	<1	<4	59	63
SB51-96-11-6	Apr-96		<5	4.9	140	0.54	<0.5	48	NA	12	24	<5	<0.05	<2.5	66	<0.5	<1	<4	38	51
SB51-96-12-4	Apr-96		<5	13	220	0.32	<0.5	60	NA	12	30	<5	<0.05	<2.5	69	<0.5	<1	<4	61	59
SB51-96-12-6	Apr-96		<5	10	120	0.25	<0.5	68	NA	14	25	<5	<0.05	<2.5	45	<0.5	<1	<4	44	62
SB51-96-12-8	Apr-96		<5	6.7	120	0.21	<0.5	64	NA	12	30	12	<0.05	<2.5	45	<0.5	<1	<4	34	59
SB51-98-1-2.1	Feb-98	X	<0.2	1.9	106	<0.2	0.2	7.0	NA	2.1	12.6	3.7	<0.2	0.35	48.9	0.25	<0.2	<0.2	15.7	17.2
SB51-98-1-4	Jun-98	X	<10	5.3	227	<1	<1	86.0	NA	15	32	<5	<0.2	<5	94	<0.5	<2	<10	58	67
SB51-98-1-6	Jun-98		<10	1.9	212	<1	<1	84.0	NA	13	32	<5	<0.2	<5	95	<0.5	<2	<10	51	62
SB51-98-2-2	Feb-98		<0.2	0.71	57.5	<0.2	<0.2	16.5	NA	0.92	26.1	74	<0.2	0.47	25.7	<0.2	<0.2	<0.2	11.6	86.4
SB51-98-2-5	Jun-98		<10	<1	64	<1	<1	80	NA	22	8	<5	<0.2	<5	32	<0.5	<2	<10	30	66
SB51-98-2-6.5	Jun-98		<10	<1	81	<1	<1	65	NA	22	6.5	<5	<0.2	<5	47	<0.5	<2	<10	37	67
SB51-98-3-2.4	Feb-98		<0.2	2.2	94.9	<0.2	<0.2	22.5	NA	3.3	11.7	4.7	<0.2	0.48	24.1	0.63	0.47	<0.2	14.4	19.4
SB51-98-3-3.4	Feb-98		<0.2	0.52	113	<0.2	<0.2	8.8	NA	2.2	13.8	2.6	<0.2	<0.2	23.8	<0.2	<0.2	<0.2	16.7	24
SB51-98-3-4	Jun-98		<10	6	188	<1	<1	77	NA	15	34	<5	<0.2	<5	81	<0.5	<2	<10	60	70
SB51-98-3-6	Jun-98		<10	6.5	254	<1	2.5	76	NA	16	38	<5	<0.2	<5	90	<0.5	<2	<10	61	71
SB51-98-4-4	Jun-98		<10	5.6	256	<1	<1	144	NA	13	29	<5	<0.2	<5	79	<0.5	<2	<10	54	58
SB51-98-4-6	Jun-98		<10	3.2	218	<1	<1	81	NA	13	32	<5	<0.2	<5	88	<0.5	<2	<10	51	56
SB51-98-5-3	Feb-98		<0.2	1.1	114	<0.2	<0.2	23.4	NA	2.2	7.7	4	<0.2	<0.2	19.2	0.81	<0.2	<0.2	12.7	17.8
SB51-98-5-4	Jun-98		<10	11	219	<1	<1	86	NA	16	37	5.3	<0.2	<5	86	<0.5	<2	<10	62	70
SB51-98-5-6	Jun-98		<10	8.5	223	<1	<1	72	NA	14	40	<5	<0.2	<5	84	<0.5	<2	<10	50	64
SB51-98-6-2.3	Feb-98		<0.2	1.7	129	<0.2	<0.2	25.8	NA	1.2	9.9	4.5	<0.2	<0.2	27.3	0.45	<0.2	<0.2	17.1	20.1
SB51-98-6-4	Jun-98		<10	3.9	184	<1	<1	96	NA	13	34	<5	<0.2	<5	82	<0.5	<2	<10	57	68
SB51-98-6-6	Jun-98		<10	2.3	196	<1	<1	82	NA	12	28	<5	<0.2	<5	89	<0.5	<2	<10	49	57
SB51-98-7-2.0	Jun-98	X	<10	6.1	193	<1	<1	78	NA	14	34	<5	0.89	<5	85	<0.5	<2	<10	56	68
SB51-98-7-2.3	Feb-98	X	<0.2	1.1	64.5	<0.2	<0.2	21.2	NA	3.8	4.4	2.8	<0.2	<0.2	8	<0.2	<0.2	<0.2	13	19.1
SB51-98-7-3	Feb-98	X	<0.2	1.1	85.6	<0.2	<0.2	39.3	NA	2.1	9.3	4.8	<0.2	<0.2	13.9	<0.2	<0.2	<0.2	16.4	22.3
SB51-98-7-4	Jun-98		<10	5.8	299	<1	<1	67	NA	14	30	<5	<0.2	<5	81	<0.5	<2	<10	56	59
SB51-98-7-5	Jun-98		<10	10	358	<1	<1	69	NA	12	24	6.6	<0.2	<5	72	<0.5	<2	<10	38	61
SB51-98-8-1.8	Feb-98		<0.2	0.99	195	<0.2	0.3	18.1	NA	2.9	2.9	1.8	<0.2	0.33	6.3	<0.2	<0.2	<0.2	12.1	16.8
SB51-98-8-5	Jun-98		<10	<1	83	<1	<1	104	NA	20	14	<5	<0.2	<5	35	<0.5	<2	<10	69	64
SB51-98-8-6.5	Jun-98		<10	1.2	87	<1	<1	91	NA	14	10	<5	<0.2	<5	28	<0.5	<2	<10	118	51

Table 2b.
Soil Sampling Results for Metals
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	Date Sampled	Excavated*	Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
*Maximum Background Concentrations***			5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs			30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs							9		0.2			130			150					
SB51-98-9-2.6	Feb-98		<0.2	3.9	94.5	<0.2	<0.2	12.9	NA	3.2	11	18.6	<0.2	<0.2	18.1	0.26	<0.2	<0.2	21.3	26.4
SB51-98-9-3.6	Feb-98		<0.2	3.2	143	<0.2	<0.2	5.7	NA	3.3	4.5	6.3	<0.2	<0.2	8.9	<0.2	<0.2	<0.2	11.2	25.7
SB51-98-9-4	Jun-98		<10	<1	67	<1	<1	77	NA	20	10	<5	<0.2	<5	22	<0.5	<2	<10	72	63
SB51-98-9-6	Jun-98		<10	1.1	77	<1	<1	86	NA	20	10	<5	<0.2	<5	22	<0.5	<2	<10	72	64
Test Pit 1																				
SS-51MRPit-96-1-3	Mar-96	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRPit-96-2-2	Mar-96	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.82	NA	NA	NA	NA	NA	NA	NA
SS-51MRPit-96-4-4.5	Mar-96	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRPit-96-5-4.2	Mar-96	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRPit-6-2	Apr-96		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.23	NA	NA	NA	NA	NA	NA	NA
Test Pit 3																				
SS-51MRPit3-98-1-4.0	Jul-98	X	<10	2.2	156	<1	<1	66	NA	12	41	8.3	<0.2	<5	93	<1	<2	<10	41	62
SS-51MRPit3-98-2-4.0	Jul-98	X	<10	5.4	221	<1	<1	33	NA	7.5	23	9.3	<0.2	<5	43	<1	<2	<10	29	40
SS-51MRPit3-98-3-6.0	Jul-98		<10	1.2	271	<1	<1	50	NA	11	32	5.0	<0.2	<5	85	<1	<2	<10	31	55
SS-51MRPit3-98-4-3.5	Jul-98	X	<10	4.5	256	<1	<1	83	NA	13	44	9.4	<0.2	<5	90	<1	<2	<10	51	72
SS-51MRPit3-98-5-4.0	Jul-98	X	<10	10	178	<1	<1	73	NA	14	45	12	<0.2	<5	83	<1	<2	<10	55	72
SS-51MRPit3-98-6-6.3	Jul-98		<10	9.7	248	<1	<1	113	NA	16	40	14	<0.2	<5	116	1.4	<2	<10	82	81
SS-51MRPit3-98-7-5.8	Jul-98		<10	7.2	272	<1	<1	95	NA	16	46	10	<0.2	<5	103	<1	<2	<10	64	84
SS-51MRPit3-98-8-7.5	Jul-98	X	<10	2.2	184	<1	<1	72	NA	15	37	7.0	<0.2	<5	86	<1	<2	<10	57	68
SS-51MRPit3-98-9-3.0	Jul-98		<10	5.2	146	<1	<1	74	NA	13	53	8.8	<0.2	<5	79	<1	<2	<10	51	73
SS-51MRPit3-98-10-3.0	Jul-98	X	<10	4.3	195	<1	<1	75	NA	13	39	10	<0.2	<5	82	<1	<2	<10	42	66
SS-51MRP3-99-W1A-2.3	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W1B-2.3	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W2A-3.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W2B-3.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W3A-1.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W4A-4.3	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W5A-1.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W5B-1.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W6A-4.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W6B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W7A-4.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W8A-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W8B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W10A-5.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W10B-6.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W11A-4.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA

Table 2b.

Soil Sampling Results for Metals
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

			Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
*Maximum Background Concentrations***			5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs			30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs							9		0.2			130			150					
Boring/Sample ID	**Date Sampled**	**Excavated***																		
SS-51MRP3-99-W11B-4.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W12A-1.8	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W12B-1.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W13A-4.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W13B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W14A-4.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W14B-4.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W15A-2.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W15B-2.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W16A-4.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W16B-4.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W17A-3.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W17B-3.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W18A-4.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W18B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W19A-4.5	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W19B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W20A-4.8	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W20B-4.8	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W21A-3.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-W21B-3.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F1-6.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F1-7.3	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F2-6.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F2-8.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F3-6.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F3-8.2	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F4-6.6	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F4-8.2	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F5-6.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-F5-8.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP3-99-FW9-4.0	Oct-99	X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
Test Pit 5																				
SS-51MRP5-99-F1-6.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-F1-8.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-F2-6.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-F2-7.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-F3-6.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA

Table 2b.

Soil Sampling Results for Metals
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

			Sb	As	Ba	Be	Cd	Cr	CrVI	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
*Maximum Background Concentrations***			5.5	19.1	323.6	1.0	2.7	99.6		22.2	69.4	16.1	0.4	7.4	119.8	5.6	1.8	27.1	74.3	106.1
USEPA Region 9 PRGs			30	0.38	5200	150	37	210	30	3300	2800	400	22	370	1500	370	370	6	520	22000
California Modified PRGs							9		0.2			130			150					
Boring/Sample ID	**Date Sampled**	**Excavated***																		
SS-51MRP5-99-F3-7.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W1A-4.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W1B-4.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W2A-4.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W2B-4.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W3A-4.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W3B-4.8	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W4A-4.9	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W4B-4.9	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W5A-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W5B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W6A-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W6B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W7A-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-W7B-4.5	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-FW8A-5.0	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA
SS-51MRP5-99-FW8B-6.2	Oct-99		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	NA	NA	NA	NA	NA	NA	NA

* - X indicates that sample was collected from material that has been excavated

NA	= Not analyzed
<5	= Not detected (reporting limit shown)
25	= Concentration above background but below PRG.
40	= Concentration above both background and PRG.

Table 3.

Product and Wipe Sampling Results for Organics
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in mg/kg)

Boring/Sample ID	*Analyte* Date Sampled	SVOCs 8270	PCBs 8080 or 8082	Fuels 8015M	PAHs 8310	Hg SW7471
Test Pit 2						
SS-51MRP2-PROD	Nov-96		Aroclor 1242=430	Motor Oil=950,000		*<0.2*
Test Pit 3						
51MRPIT3-PRODUCT	Jul-98	ND	Aroclor 1242=570	Hydraulic/Motor Oil=640,000	Acenapthene=57 Acenapthylene=19 Anthracene=1.3 Benzo(a)anthracene=3.5 Benzo(b)fluoranthene=3.6 Fluoranthene=17 Pyrene=20	
Pump Oil Samples						
51MRBSMT-EPUMPOIL#1	Apr-99		<0.3			
51MRBSMT-EPUMPOIL#3	Apr-99		<0.3			
Wipe Samples (Concrete wall east of Pit 3)						
51MR-99WALLWIPE-1	Apr-99		<0.003 mg/wipe			
51MR-99WALLWIPE-2-5.0'	Apr-99			Crude/Waste Oil = 1.7 mg/wipe		

ND (or < reporting limit)	= Not detected
	= Not analyzed

Table 4.

Groundwater Sampling Results
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in µg/L)

		Organics				Metals
	Analyte	VOCs	PCBs	Total O&G	Fuel Identification	Metals
Sample ID	Date Sampled	8260	8080	9070	8015M	6000 and 7000 Series
SB51-96-6	4/9/96	TCE=40.8 cis-1,2-DCE=31.2 trans-1,2-DCE=21.5 vinyl chloride=16.7 toluene=1.3 p-isopropyltoluene=1.2				
	4/17/96		<0.5			
	5/2/96					
	5/8/96			<5000		
	11/11/96	All ND (<100 or higher)				
	12/16/97	TCE=1.1 cis-1,2-DCE=3.6 trans-1,2-DCE=4.0				
SB51-96-8	4/9/96	All ND (<1 or <2)	Aroclor-1242=93	7300		
	5/2/96					
	11/11/96	cis-1,2-DCE=14.9 trans-1,2-DCE=3.2 1,1-DCA=6.0 Vinyl chloride=5.3				
	11/22/96		Aroclor-1242=56			
	12/11/96					Total arsenic = 2.6 Total barium = 300
	12/16/97	cis-1,2-DCE=5.3 1,1-DCA=2.6 Vinyl chloride=2.0				
SB51-96-12	4/9/96	1,1-DCA=1.1 Vinyl chloride=1.4				

Table 4.
Groundwater Sampling Results
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in µg/L)

		Organics				Metals
	Analyte	VOCs	PCBs	Total O&G	Fuel Identification	Metals
Sample ID	Date Sampled	8260	8080	9070	8015M	6000 and 7000 Series
SB51-96-12	4/11/96		Aroclor-1242=6.2			
	4/15/96			16,000		
	5/2/96					
	11/8/96	cis-1,2-DCE=1.4 1,1-DCA=2.3				
	11/11/96 12/11/96		Aroclor-1242=31			Total arsenic = 27 Total barium = 170 Total vanadium = 39
	12/16/97	cis-1,2-DCE=4.4 1,1-DCA=3.7 Vinyl chloride=3.0				
	12/17/98	1,1,1-TCA=1.1 cis-1,2-DCE=1.5 1,1-DCA=2.4 Vinyl chloride=3.0 MTBE=2.1				
	12/22/98		Aroclor-1242=12			
	6/18/99	cis-1,2-DCE=1.6 1,1-DCA=2.3 Vinyl chloride=1.7				
SB51-98-1	4/22/99		<0.2			
SB51-98-3	6/15/98	TCE=2.3 cis-1,2-DCE=4.2 1,1-DCA=2.6 Vinyl chloride=3.7				
	6/30/98				Crude/waste oil = 130	

Table 4.
Groundwater Sampling Results
AOC 9-9: Building 51 Sanitary Sewer and Drainage System
(Concentrations in µg/L)

		Organics				Metals
	Analyte	VOCs	PCBs	Total O&G	Fuel Identification	Metals
Sample ID	Date Sampled	8260	8080	9070	8015M	6000 and 7000 Series
SB51-98-3	7/14/98		<0.2			Dissolved arsenic = 15 Dissolved molybdenum = 69
	4/22/99		<0.2			
SB51-98-4	6/15/98	All ND (<1 or <2)				
	7/10/98				Crude/waste oil = 4,900	Dissolved arsenic = 15 Dissolved barium = 130 Dissolved molybdenum = 50 Dissolved selenium = 2.1 Dissolved vanadium = 12
	7/14/98		Aroclor-1242=22			
	4/22/99		Aroclor-1242=0.37			
SB51-98-5	6/30/98		Aroclor-1260=0.92		Crude/waste oil = 1,000	
	7/14/98					Dissolved arsenic = 11 Dissolved selenium = 5.0
	4/22/99		<0.2			
SB51-98-6	6/15/98	All ND (<1 or <2)				
	7/10/98		<0.2		Crude/waste oil = 780	Dissolved arsenic = 29 Dissolved molybdenum = 91 Dissolved vanadium = 28
	4/22/99		<0.2			
SB51-98-7	6/15/98	cis-1,2-DCE=3.6 1,1-DCA=1.9 Toluene=1.1				

Table 5a.
Surface Water Sampling Results for Organics
North Fork Strawberry Creek
(Concentrations in µg/L)

Date Sampled	VOCs (8260)	SVOCs (8270)	PCBs (8080)
Feb-93	ND		
Apr-93	ND		
Aug-93	ND ND (D)		
Mar-94	ND		
Jul-94	ND ND (D)		
Jan-95	ND		
May-95 (a)	1,1,1-TCA=0.95 1,1,1-TCA = 0.91 (D)		
Jul-95	ND		
Jan-96	ND		
Apr-96 (b)	ND		
Apr-97	ND		
Jan-98	ND		
Apr-98	ND	diethyl phthalate = 2.2	
Jul-98		ND	
Apr-99	ND		
Jul-99			<0.2
Jul-99 (a)			<0.2
Jan-00	ND		

ND = Not detected above quantitation limit

(D) = Duplicate sample
(a) = Erosion control basin
(b) = Sample missed holding time for 8260 analysis

Table 5b.
Surface Water Sampling Results for Metals
North Fork Strawberry Creek
(Concentrations in µg/L)

	Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
MCL:	6	50	1000	4	5	50	NS	1000 (a)	15 (b)	2	NS	100	50	100 (a)	2	NS	5000 (a)
DATE																	
Aug-93	<20	<5	96	<1	<1	<10	<10	<5	<10	<1	15	<20	<10	7	<10	<10	93
	<20	<5	45	<1	<1	<10	<10	<5	<10	<1	<5	<20	<10	<5	<10	40	8
Jul-94	<100	<2	<100	<10	<5	<10	<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
	<100	2	<100	<10	<5	<10	<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
Jul-95	<4	<2	<100	<10	<5	<10	<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
Jan-96	<4	2.4	<100	<10	<5	<10	<10	<10	<5	<0.20	<10	<50	<2	<10	<5	<50	<50
Apr-96	<50	<2	<50	<5	<40	<50	<50	<50	<40	<0.20	<50	<50	<1	<50	<50	<50	<20
Apr-97	<4	<2	104	<4	<5	<5	<5	<5	<5	<0.20	<50	<50	<2	<5	<1	<5	<20
Jan-98	<1	<2	40.2	<1	<1	<5	<5	2.3	<1	<0.10	<5	<5	<2	<1	<1	4.3	8.8
Apr-98	<1	<2	48.7	<1	<1	1.0	<1	1.9	2.9	<0.20	1.4	<1	5.2	<1	<1	5.1	6.9
Apr-99	<1	4.2	76.9	<1	<1	8.6	<1	1.2	<1	<0.25	2.5	<1	4.5	<1	<1	15.9	9.3
Jan-00	<1	<2	41.0	<1	<1	2.5	<1	4.6	<1	<0.10	1.6	1.5	<2	<1	<1	5.4	51.6

MCL: Maximum contaminant level for drinking water (determined by California DTSC)
(a): secondary MCL
(b): action level
(c): erosion control basin
NS: Not Specified

< = Not detected above quantitation limit
= Not analyzed

Table 6a.
Sediment Sampling Results for Organics and Fuels
North Fork Strawberry Creek
(Concentrations in mg/kg)

Sample ID	Date	VOCs (8240)	SVOCs (8270)	PCBs (8080)	TPH-Gasoline	TPH-Diesel
SSBC-1A/2A-0.4	Apr-93	ND	ND		49*	<0.2
SSBC-3A/4A-0.5/0.8	Apr-93	Toluene=0.013	ND		<5*	<0.2
SS-NFSTRAW-98-1-0.0	Jan-98			<0.02		
SS-NFSTRAW-98-2-0.0	Jan-98			<0.02		
SS-NFSTRAW-98-3-0.0	Jan-98			<0.02		

ND = Not detected above quantitation limit
< = Not detected above quantitation limit
* = Oil detected

Table 6b.
Sediment Sampling Results for Metals
North Fork Strawberry Creek
(Concentrations in mg/kg)

Sample ID	Date	Sb	As	Ba	Be	Cd	Cr	Cr6	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn
SSBC-1A/2A-0.4	Apr-93	<2	3	140	<0.2	0.6	59		8.9	47	180	0.3	0.6	32	<2	3.5	<3	28	160
SSBC-3A/4A-0.5/0.8	Apr-93	<2	5	79	<0.2	0.6	45		11	40	53	0.6	<0.6	38	<2	<0.2	<3	35	160
SS-ERBAS-N-L-1-0 (a)	Jan-95											<0.2							
SS-ERBAS-N-U-1-0 (a)												<0.2							
SS-ERBAS-S-U-1-0 (a)												<0.2							
SS-ERBAS-S-L-1-0 (a)												<0.2							
SS-ERBAS-S-U-2-0 (a)	Jul-95	<5	2.6	334	<0.5	<0.5	36		6.8	28	17	<0.2	<2.5	26	<0.5	<1	5.4	31	130
SS-ERBAS-S-U-3-0 (a)		<5	1.9	93	<0.5	0.57	42		6.5	38	73	<0.2	<2.5	29	<0.5	<1	<5	32	259
SS-ERBAS-S-U-4-0 (a)		<5	2.0	52	<0.5	0.5	33		8.0	55	45	0.22	<2.5	27	<0.5	<1	<5	29	182
SS-ERBAS-S-U-5-0 (a)		<5	2.5	47	<0.5	<0.5	79	<1*	6.8	216	69*	<0.2	<2.5	27	<0.5	<1	<5	32	314
SS-NFStraw-96-1A-0	Aug-96	<10	3.5	98	<1	<1	129		7.1	19	17	<0.2	15	105	1.0	<2	<10	37	109
SS-NFStraw-96-2A-0		<10	4.7	83	<1	1.2	43		8.7	30	49	<0.2	<5	27	1.6	<2	<10	53	108
SS-NFStraw-96-3A-0		<10	9.2	1300	<1	2.5	21		13	44	21	<0.2	<5	181	2.6	<2	<10	48	148
SS-NFStraw-96-4A-0		<10	4.1	78	<1	<1	31		6.1	18	20	<0.2	<5	20	1.1	<2	<10	37	115
SS-NFStraw-96-5A-0		<10	4.2	81	<1	<1	29		7.3	26	19	<0.2	<5	22	1.0	<2	<10	49	144
SS-NFStraw-FL-99-1-0	Jul-99							<0.1											
SS-NFStraw-BSN-99-1-0 (a)								<0.1											

< = Not detected above quantitation limit
= Not analyzed
(a) = erosion control basin
* = Additional waste extraction test (WET) performed: CrVI<1 mg/L; Pb = 4.3 mg/L.

LIST OF PHOTOGRAPHS

Photograph 1. Oil Product Near the Cast Iron Pipe in Test Pit 3, Building 51 Motor Generator Room Basement.

Photograph 2. View Northward of Test Pit 3, Building 51 Motor Generator Room Basement.

Photograph 3. Detailed View of Northward Extent of Test Pit 3, Showing Connection of Terra Cotta Drain Line with Cast Iron Drain Pipe, Building 51 Motor Generator Room Basement.

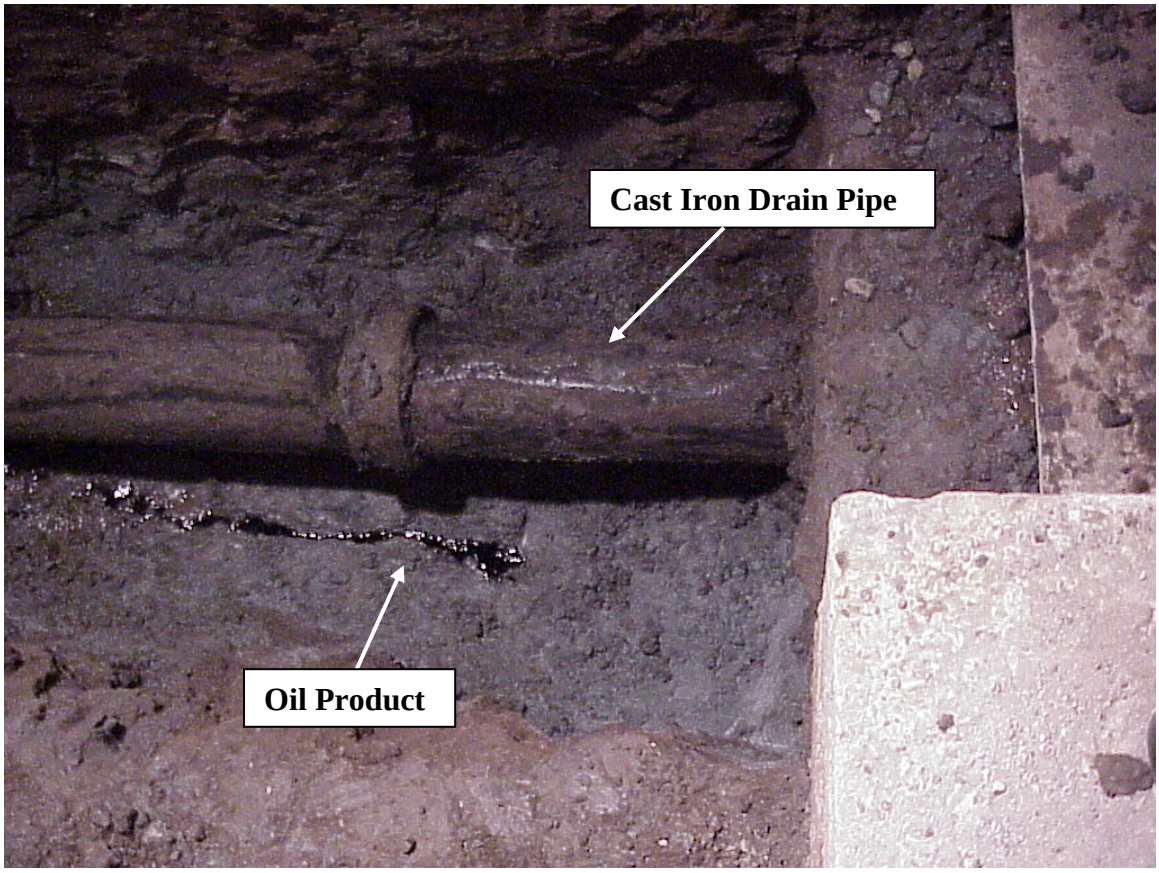
Photograph 4. Connection Point of Cast Iron Pipe and Terra Cotta Drain Line, Test Pit 3 Extension, Building 51 Motor Generator Room Basement.

Photograph 5. Discharge Sump During Cleaning Operations, Building 51 Motor Generator Room Basement.

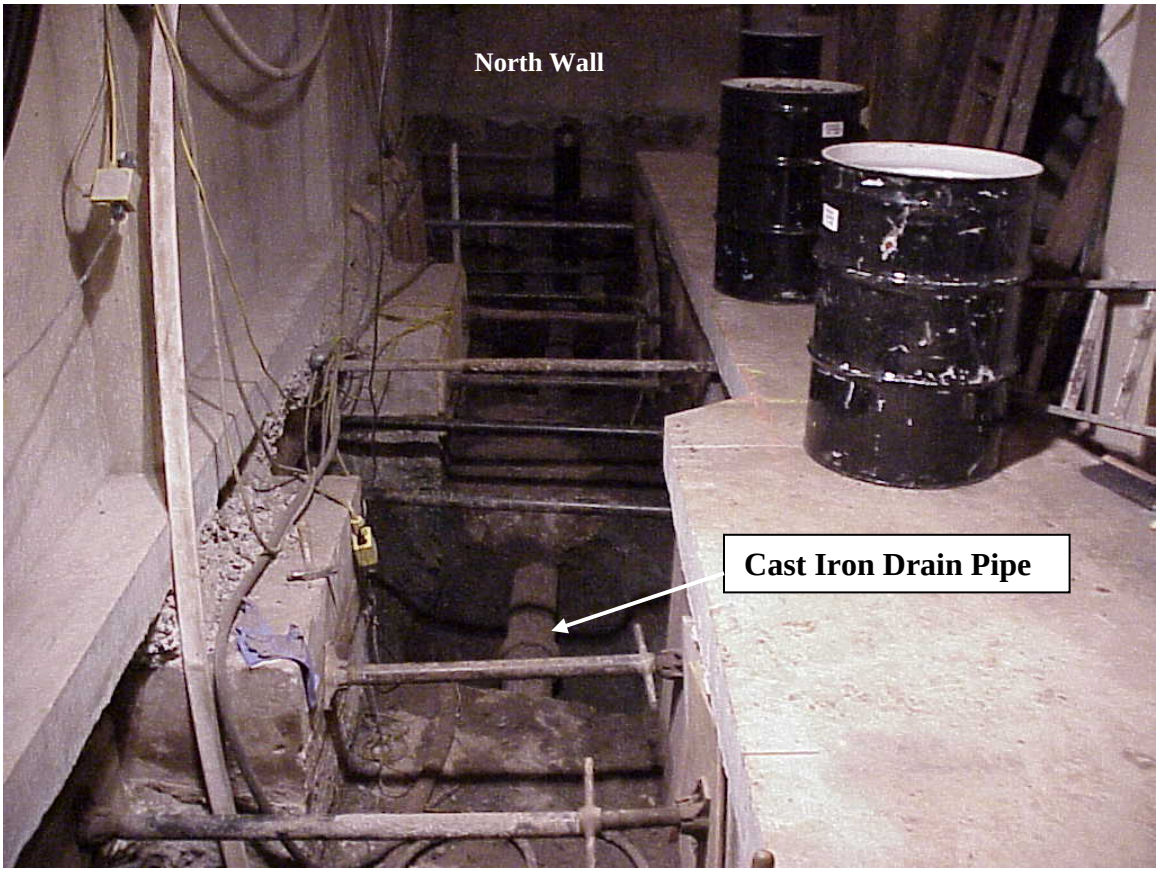
Photograph 6. Vacuum Truck Used During Cleaning Operations of Cast Iron Pipe, Building 51 Motor Generator Room Basement.

Photograph 7. Cleaning Operations of Cast Iron Pipe, Building 51 Motor Generator Room Basement.

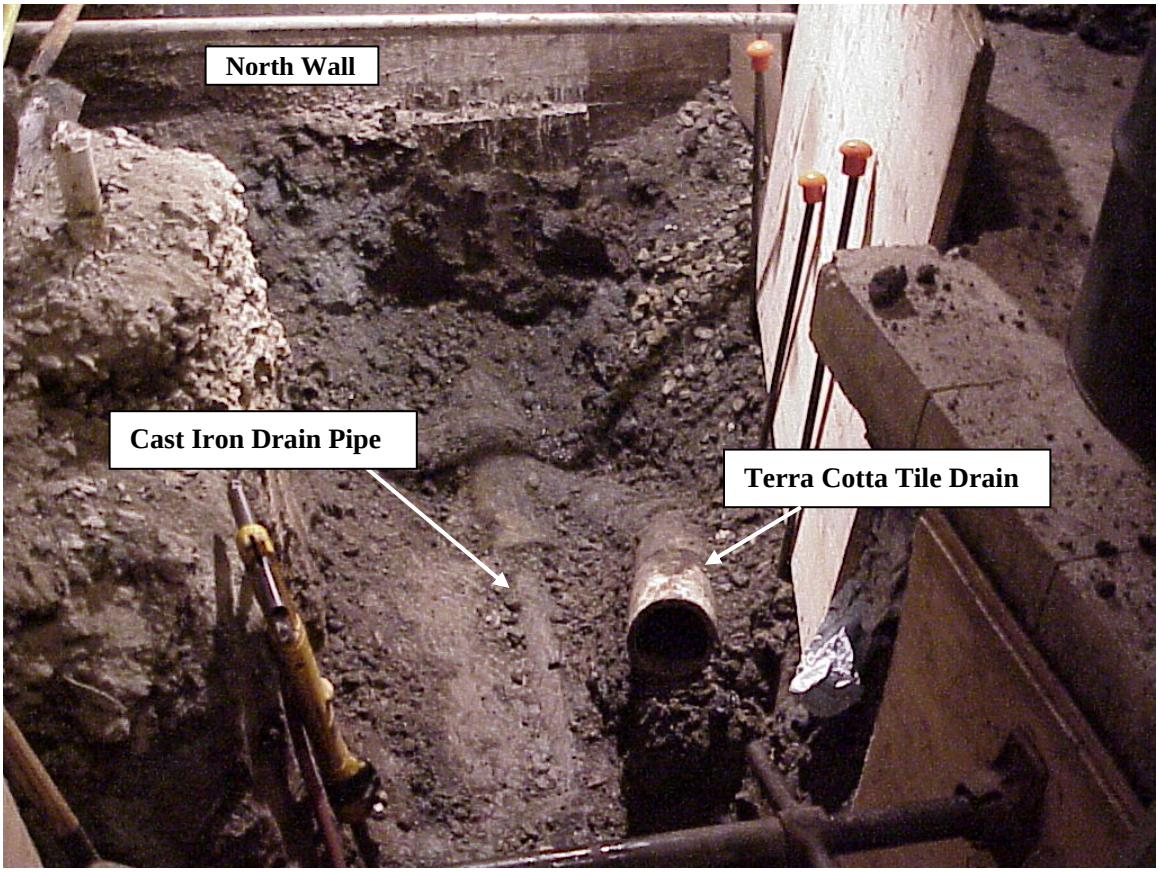
Photograph 8. Vacuum Truck and Storage Tank During Cleaning Operations of Cast Iron Pipe, Building 51 Motor Generator Room Basement.



Photograph 1. Oil Product Near the Cast Iron Pipe in Test Pit 3, Building 51 Motor Generator Room Basement.



Photograph 2. View Northward of Test Pit 3, Building 51 Motor Generator Room Basement.



Photograph 3. Detailed View of Northward Extent of Test Pit 3, Showing Connection of Terra Cotta Drain Line with Cast Iron Drain Pipe, Building 51 Motor Generator Room Basement.

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