August 27, 2003

Interim Test Report for Recent Karst Conduit Testing at Lemon Lane Landfill
(Last Update 3/13/2003)

Over the last few months the following actions have occurred:

- New shallow wells were installed in known sinkhole areas in the southeast corner of the landfill and near the locations of abandoned wells LF-1 and LF-5.

- A dye test with a high volume flush was conducted in well OO-370. The test occurred on 6/18/2003.

- Dye tests with low volume flushes were conducted in the new wells. Four wells have been injected. PZ-H and PZ-I were injected on 7/8/2003 and PZ-J and LF-1 were injected on 7/24/2003.

- A number of additional well monitoring instruments were moved to the site for continuous monitoring. These instruments were periodically set to log data on five minute intervals during predicted storm periods and/or test periods.

- Wells MW-17 and MW-20 on the east side were filled with bentonite pellets to an elevation of approximately 801 feet. This was done to eliminate connection to the 795-800 zone. After filling, the water levels were measured in the wells.

Attached are tables and figures with the pertinent dye recovery data summaries and well/spring logging data for the events. A brief review of the data and recommended future tests are also included.

A. Shallow Well Installation

Shallow wells were installed the week of 6/23/2003. The new well data is as follows:

LF-1 Summary

LF-1 was drilled on 6/26/2003. It was offset approximately 2.5 feet south of the original location. Beginning ground elevation was 878.17. Rock was encountered at 6.5 feet and an 8 inch diameter steel casing was set and grouted. The boring was advanced to 32 feet below ground level (bgl). Fractures were encountered at 28.5-30 feet bgl that made water.

The elevation of the top of the 8 inch steel casing on the north side is 879.76 feet amsl. Coordinates of the well are: Northing 1429643.88 and Easting 3101422.93.

Depth to water measured 11:15 hours 7/1/2003 from the top of the 8 inch steel casing on the north side was 27.44 feet or 852.32 feet amsl. The well had an odor of PCBs and was sampled on 7/17/2003. The sample result was 540,000 ppb Aroclor 1242. This indicates

that DNAPL must be present in or near the well, but no separate DNAPL phase was observed when sampling.

The rate that the well can take water was tested and found to be 3-5 gpm.

LF-5 Summary

LF-5 was drilled on 6/30/2003. It was offset approximately 12.5 feet southwest of the original location. Beginning ground elevation was 880.93. Rock was encountered at 8.5 feet and an 8 inch diameter steel casing was set and grouted. The boring was advanced to 37 feet (bgl). Fractures were encountered at 30.5-33 feet bgl that seemed to have made water.

The elevation of the top of the 8 inch steel casing on the north side is 881.82 feet amsl. Coordinates of the well are: Northing 1429716.62 and Easting 3101422.20.

Depth to water measured 11:09 hours 7/1/2003 from the top of the 8 inch steel casing on the north side was 37.5 feet or 844.32 feet amsl. However, the bottom measurement was also about 37.5 feet, so there was just a small amount of water on the bottom.

The rate the well can take water was tested and found to be less than 1 gpm. Further investigations at the well have shown it to be dry.

PZ-H Summary

Top of bedrock piezometer PZ-H (near PZ-F) was installed on 6/25/2003. An 8 inch auger was advanced to rock and 5 feet of a 4 inch PVC screen with riser was installed. The bottom 5 feet of clay was wet. Sand was packed to 2 feet above screen and the remaining annulus was sealed with bentonite pellets. A 6 inch steel protective cover was cemented in place over the 4 inch PVC riser pipe. No water was in the piezometer the next day.

Coordinates are: Northing 1429598.68 and Easting 31011195.88

Elevation of the top of the 4" PVC riser on the north side is 871.73 feet amsl and depth to bottom from top of riser is 40.4 feet, so bedrock elevation is 831.33 feet amsl.

The rate the piezometer will take water was tested and measured to be 25 gpm.

Depth to water from 4 inch PVC at 11:25 hours on 7/1/2003 was 39.48 feet and is probably remnants of the flush-test water.

PZ-I Summary

Top of bedrock piezometer PZ-I (near MW-15) was installed on 6/25/2003. An 8 inch auger was advanced to rock and 5 feet of a 4 inch PVC screen with riser was installed. The bottom 5 feet of clay was wet. Sand was packed to 2 feet above screen and the remaining

annulus was sealed with bentonite pellets. A 6 inch steel protective cover was cemented in place over the 4 inch PVC riser pipe. Water was in the piezometer the next day at 32.02 feet below the top of the riser.

Coordinates are: Northing 1429580.08 and Easting 31011306.63

Elevation of the top of the 4 inch PVC riser on the north side is 875.30 feet amsl and depth to bottom from top of riser is 35.0 feet, so bedrock elevation is 840.3 feet amsl.

The rate the piezometer will take water was tested and measured to be 8 gpm.

Depth to water from the 4 inch PVC at 11:20 hours on 7/1/2003 was 32.45 feet which yields an elevation of 842.85. Subsequent water level checks have shown the well to maintain approximately this water level.

PZ-J Summary

Top of bedrock piezometer PZ-J (near MW-18) was installed on 6/27/2003. An 8 inch auger was advanced to rock and 5 feet of a 4 inch PVC screen with riser was installed. The bottom 5 feet of clay was moist. Sand was packed to 2 feet above screen and the remaining annulus was sealed with bentonite pellets. A 6 inch steel protective cover was cemented in place over the 4 inch PVC riser pipe. No water was in the piezometer the next day.

Coordinates are: Northing 1429834.81 and Easting 3101428.66

Elevation of the top of the 4 inch PVC riser on the north side is 888.85 feet amsl and depth to bottom from the top of the riser is 34.3 feet, so bedrock elevation is 854.55 feet amsl.

The rate the piezometer will take water was tested and measured to be 15 gpm.

Depth to water from a 4 inch PVC at 11:03 hours on 7/1/2003 was 33.8 feet and is probably remnants of the flush-test water. Subsequent water level checks have shown the well to be dry.

B. OO-370 High Volume Flush Test

No discernable breakthrough curve was seen at Illinois Central Spring when OO-370 was injected with dye on 10/22/2002, despite the occurrence of nearly 20,000 ppb detection in well MW-18. On 3/15/2003, OO-370 was injected with 250 grams of fluorescein while at the same time 200 grams of rhodamine WT was flushed into Martin's Sink. The rhodamine WT was detected in a sharp breakthrough curve at Illinois Central Spring, but there was no evidence of the fluorescein injected in OO-370 at Illinois Central Spring or any of the east side wells.

It seems inconceivable that that much fluorescein would not be highly visible, much less not detected at 0.5 ppb levels at Illinois Central Spring if OO-370 was on any type of active flow path. To further examine this, MW-1s and MW-1d were tested on 5/23/2003 to determine their ambient conductivities. Extremely red water was present in both wells (more so in MW-1s) even though it has been thirteen years since those wells were injected with rhodamine WT. Apparently there are areas or zones where very little groundwater circulation takes place. In an effort to overcome that possibility and to try and force a positive result, a plan was developed to reinject OO-370 with dye and flushed with a much larger volume of water to try to ensure that the dye leaves the immediate vicinity of the well. The fact that several epikarst locations in the southeast portion of the site had a component of the dye injected in them appear in OO-370 makes the understanding of this pathway important.

A second goal of the test was to introduce a large volume of water in a longer controlled fashion and attempt to see the flow of water around the site with an array of monitoring instrumentation set on five minute intervals.

The dye and flush test was carried out on 6/18/2003. The following is a detailed chronology of events:

Time	Description
10:30	Begin water flow into well
10:33	Initial rate is 50 gpm
10:36	Adjust rate to 30 gpm
10:43	Start injection of 500 ml of 50% fluorescein dye solution
10:45	Injection of dye complete
10:46	Stop water flow due to approaching train
10:52	Resume water flow at 30 gpm
13:05	Notice flow of water has decreased to 23 gpm, re-adjust back to 30 gpm
14:00	Flush test terminated, water flow stopped

The flushing water had a conductivity of 175 mS/cm and a temperature of 20.2° C at the well.

Table 1 lists the results for the dye analysis at Illinois Central Spring. Table 2 lists the dye results at the Stony East and West Springs. Table 3 lists the results for the Valhalla wells. Table 4 lists the results for the east side wells. Table 5 lists the results for MW-4i, which had the automatic sampler.

Figure 1 shows the dye and conductivity results at MW-4i. Conductivity values were rising in the well until the rain event beginning on July 19 shortly after 0800 hours. There is a slight decline in conductivity in MW-4i and a corresponding slight rise in fluorescein. It is a very slight breakthrough curve with a maximum dye differential of only 0.7 ppb.

Figure 2 is a plot of Illinois Central Spring flow from the SRS sump fill data. There is a slight displacement of flow upwards coinciding with the water injection times indicating a

pressure-pulse displacement of water to Illinois Central Spring. This indicates a hydraulic connection from the well to the spring. Average flow was about 420 gpm which would translate to a travel time from site to spring of 6 to 8 hours based on the storm flow regression equation. The tracer should have arrived at Illinois Central Spring between 1700 and 1900 hours on 6/18/2003. However, once again, there is no indication from dye concentration or conductivity of that arrival.

An inspection of Table 2 indicates no dye detection at either of the Stony Springs. The increase in fluorescence after the 6/19/2003 storm is storm background and turbidity.

Figure 3 shows the datalogger elevation water data for all wells collected from 6/17/2003 through 6/20/2003. Figure 4 shows the relative change due to the flushing water taking the last reading of the datalogger before flushing began. Figure 5 shows the hand measured data taken during the flush at OO-370. Maximum water level rise in OO-370 was 4.15 feet. Table 7 shows each well and its distance from OO-370 and the maximum water level rise measured. In a homogeneous and isotropic medium the maximum water level change would vary proportionally to the distance from the injection well. Discrepancies in that variation should reveal the anisotropic variation in the aquifer.

MW-6 and NN-700 stand out because there appears to be more rise in those wells than their distance to OO-370 would account for. Because NN-300, OO-300, and MW-B1 are all screened in the lower phreatic zone, a better connection between MW-6 and OO-370 may exist in an upper phreatic conduit. The connection between NN-700 and OO-370 seems even better developed given that distance. In the October 2002 dye traces, eosine injected in NN-700 was detected first in OO-370.

The current theory concerning the results obtained from this dye test and flush is that the dye was pushed into conduits low in the well in the 795-800 zone, but that most of the water actually flowed out an upper level phreatic conduit (conduits are visible at 817 and 814 in the video log of the well). This would explain the lack of dye recovery and yet the increase in flow at Illinois Central Spring. This implies that the 795-800 zone near this well is interconnected to the aquifer feeding the spring but not an active flow zone or such a large reservoir that 5,000 gallons cannot push the dye from this area. Another dye injection with the lower zone blocked off will be attempted from this well to determine if upper level conduits exist that will take appreciable water.

C. Well Modifications

The MW-4I area on the eastern edge of the landfill has historically shown low water levels. This is especially true of MW-4S and MW-4I. MW-4S has always shown the lowest level of any phreatic well. This well is screened in a higher phreatic zone than most other wells around the site. It has not been clear if this lower water level is indicative of upwelling from the 795-800 zone or if it is just an anomaly caused by a lack of or poor connection to the main water bearing units. The well does respond to events such as pumping of the 795-800 zone and some connection surely does exist. The goal of the well modification

was to block off the lower zones of a well on either side of MW-4S to see if they would then indicate a lower water level like MW-4S.

Wells MW-17 and MW-20 were modified the week of 7/28/2003. Well MW-17 was obstructed at an elevation of approximately 803 to 807 feet amsl. The well was cleared of the obstructions and then filled with bentonite chips to yield a final depth to bottom of approximately 801 feet amsl. Well MW-20 had no obstructions and was filled with bentonite chips to a new bottom elevation of approximately 801 feet amsl.

Well MW-21 was known to be obstructed at an elevation of approximately 803 to 807 feet amsl. An attempt to clear this well was also made. However, it was not entirely successful since it appeared that some of the material obstructing the well was pushed to the bottom of the well and closed some of the bottom off.

After modifying the wells, new water level measurements were taken. The levels were taken twice on 8/1/2003, once in the morning and once in the afternoon. The data is shown below.

Well	Time	DTW	Elevation
17	10:35	68.52	816.42
4s	10:37	71.72	815.9
21	10:42	69.15	816.26
4i	10:43	69.2	816.86
20	10:45	68.99	816.26
18	10:51	68.15	817.05
17	13:17	68.46	816.48
4s	13:20	71.72	815.9
21	13:22	69.16	816.25
4i	13:25	69.2	816.86
20	13:28	69.02	816.23
18	13:29	68.15	817.05
16	13:31	64.63	816.89
18	13:33	62.63	816.92

The data shows that wells MW-17, MW-20 and MW-21 are now maintaining a lower level than well MW-4I. This has not historically been the case. There are two possibilities that could explain this. First, this may indicate that water in this area of the site has an upward gradient from the 795 to 800 zone (well MW-4I is still exposed to the 795 to 800 zone) to a higher phreatic level. Second, it could simply mean that the main water bearing zone at these wells is the 795 to 800 zone and if a well is blocked off from this zone, it will be mostly isolated and not show full system pressure. Since all dyes injected in the east side wells have traveled to the MW-4I well area, and dye injected deep in the 795 to 800 horizon has traveled to the Illinois Central Spring with timing similar to the PCB travel time, it is important to understand the flow patterns in this area.

The dye data indicates that the MW-4I area is a collecting point for waters in the 795 to 800 zone and the new level data may indicate that this water then upwells to a higher phreatic zone in the vicinity of MW-4I. It is therefore important to sort out whether this upwelling is really occurring or the new water levels in MW-17, MW-21 and MW-20 are just an anomaly caused by poor connection to the water bearing zone.

To sort this out, the response of MW-20 and MW-17 will be monitored during storms and flush tests to see if the water levels respond as they should if they have maintained a good connection to the phreatic conduits.

C. Shallow Well Dye Injections at PZ-H and PZ-I

Shallow well dye injections were conducted on 7/8/2003 in new wells PZ-H and PZ-I. Rhodamine was injected in PZ-H and fluorescein in PZ-I. The work was conducted in accordance with the test plan distributed to all parties on 7/2/2003. The goal of shallow dye injections is to assess where the epikarst waters flow and to determine if the pathway these waters take can be detected in phreatic wells.

The well sample dye results are shown in Tables 7 and 8. The data shows that both dyes arrived at wells OO-370 and OO-300A in Valhalla Cemetery. About a day and a half after injection, a large storm event occurred. This storm has confounded the analysis of the dye recovery data. For example, the morning after the rain, both dyes appeared in wells OO-300, MW-15, and fluorescein appeared in wells MW10, MW20, MW4I, and PZF.

Both dyes were detected at Illinois Central Spring. This data is shown in Figure 6. The arrivals coincided with a storm pulse at the spring. Three inches of rain fell on 7/9/2003 (the day after dye injection). Rhodamine arrived 38 hours after injection followed by the fluorescein an hour later. The average Illinois Central flow rate from injection to dye detection at the spring was 60 gpm (this is a geometric mean flow since the flow frequency distribution is highly non-normal because of the storm event). The expected PCB travel time for this average flow rate is 36 hours. The actual travel time agrees with the predicted travel time within 10% which is considered excellent. Fluorescein also arrived at the spring the same time as the PCB rise during the storm. This is curious since both dyes were in the phreatic system well ahead of the storm pulse. The expectation is that both dyes should have beaten the PCB storm pulse to the spring. In addition it appears the PCB storm pulse arrived earlier than expected.

The shapes of the dye breakthrough curves are different for the two dyes. Although both curves are sharp, the fluoroscein has a much sharper curve than the rhodamine. This indicates a better connection with the conduit system for the PZ-I area than the PZ-H area. It is not known if this is simply a function of the actual PZ location/connection to the sink feature or a true indication of the general sink connection to the conduit. However, in pre-injection testing, PZ-H took water at 25 gpm whereas PZ-I took water at only 8 gpm. This would indicate that the difference in breakthrough curves is more related to overall sinkhole connections rather than a local well phenomenon.

There are several possible explanations for the concurrent arrival of fluorescein and PCBs at Illinois Central Spring. First, it could be that it is mere coincidence that the fluorescein arrived coincident with the PCB storm pulse. There is some data scatter in expected PCB arrival times during storms and the PCBs could have been accelerated beyond their normal expected travel times because of some unknown storm specific reason such as the high intensity of the initial rain period of this particular storm. Second, the early arrival of the PCB pulse for this storm could have been caused by the flush of water accompanying the dye injection at PZ-I. This would imply that the PZ-I area is a major PCB transport source. Third, there was a smaller storm event that occurred the afternoon of 7/9/2003. This small storm event changed flows at Illinois Central Spring from 50 gpm to about 200 gpm and could be responsible for the apparent early arrival of PCBs.

The average flow rate was 299 gpm from the first spring response for the small storm until the PCB arrived at Illinois Central Spring. The predicted travel time for 300 gpm is about 9 hours. The actual travel time from the small storm initiation was 6 hours. This is more than a 10% difference from expected arrivals and makes the third scenario suspect.

The two storms have confounded the analysis of the arrival/travel times. The average flow rate for the second more intense storm period from the time of initial spring response to PCB arrival at the spring is 645 gpm. The PCB travel time relationship previously developed would predict a travel time of 4.7 hours for this flow rate. The actual arrival time was approximately 2 hours. This appears to be early, lending credence to the second scenario above.

A number of well level instruments were employed during the dye injection period. The change in level after injection is an indication of when the dye and flush water entered the phreatic zone. Figure 7 shows the response at wells MW-6 and MW-4I. It appears that the flushing water entered the phreatic zone within 5 minutes after injection and that the flush to the phreatic zone was complete within 2 hours. This implies that the dyes were in the phreatic conduit system well ahead of the storm event. This again would lead one to expect that the dyes should have arrived ahead of a normal storm induced PCB pulse during the subsequent storm.

The concurrent arrival of PCBs and fluorescein at Illinois Central Spring along with the apparent early arrival of the PCB storm pulse implies that more investigation is warranted for the PZ-I area. A larger volume flush and dye injection during a stable flow period is indicated to see if a PCB pulse is initiated at the spring.

D. Shallow Well Dye Injections at PZ-J and LF-1

These shallow wells were injected on the morning of 7/24/2003. Rhodamine was injected in PZ-J and fluorescein into LF-1. During injection, a significant spillage of fluorescein occurred resulting in approximately 25% of the planned amount of fluorescein actually entering the well.

The well sample dye results are shown in Tables 9 and 10. Both dyes were detected at wells MW-19 and MW-16 within 4 hours of injection. Rhodamine also appeared in wells MW-4I and MW-20 by the evening of 7/24/2003. Fluorescein also showed up in well PZ-E by the evening of 7/24/2003 and wells OO-370 and possibly OO-300A by the next morning.

Both dyes were detected at Illinois Central Spring. This data is shown in Figure 8. The rhodamine arrived at Illinois Central Spring at 0200 on 7/25/2003. The average spring flow from injection to arrival was about 254 gpm. The predicted PCB travel time for this flow rate would be 10.4 hours. The actual dye travel time was 15 to16 hours. The peak dye concentration for rhodamine was only 10 ppb. This is a weak peak concentration. The dye recovery curve is also somewhat drawn out compared to a typical PCB storm pulse curve.

The fluorescein arrived at the Illinois Central Spring at about 0700 on 7/25/2003. This is a travel time of approximately 19 to 20 hours. The average flow during this time period was 249 gpm which yields a predicted travel time of 10.6 hours. The peak dye concentration was only about 2 ppb. The dye recovery curve is also very drawn out.

Well levels monitored during the dye injection included MW-6 and MW-4I. The levels during and after injection are shown in Figure 9. These levels do not show a definite response in the phreatic zone. However, there is a rather small slope change in the well levels that appears to last from about 10:00 am to 10:00 pm. This indicates that these dyes were injected into the epikarst and did not travel as quickly to the phreatic zone as the injection into PZ-H and PZ-I. This is consistent with the delayed travel time and small response at the Illinois Central Spring. This response indicates that these zones are indeed perched and have only slow leakage to the phreatic zone under non-storm conditions.

The dye recovered in wells MW-19 and MW-16 is thought to have arrived in the well by leaking down the well bore from the epikarst. It is known that both these wells have active leakage in the well bore from the 852 conduit zones. The 852 conduit zone is the water producing zone that received both dyes injected in PZ-J and LF-1. Previous testing of this zone at the old LF-1 and LF-5 showed a weak connection between these wells and indicated the overall gradient to the south. This data is consistent with this gradient. The strongest dye detection was for fluorescein in PZ-E which is both south and west of LF-1. The strongest detection of rhodamine was in well MW-19 which is south of PZ-J.

It is suspected that a good deal of the dyes injected in these wells is still hung up in the epikarst zones. These may provide a continuous slow leakage source to the spring, raising the general background levels.

Since injection of these wells, the rhodamine background has remained elevated in wells MW-19 and MW-20. Elevated backgrounds of both dyes persist in wells OO-300 and NN-300. Well LF-1 is shown to have very high PCB levels. If this well is in a perched aquifer that is slowly leaking to the phreatic zone, then this perched aquifer could be a continual source of PCBs to Illinois Central Spring.

E. **Storm Event Five Minute Well Data**:

A large storm occurred on 6/13/2003. The following wells were monitored on a 5 minute interval during this event:

MW-6
MW-B1
MW-19
MW-16
MW-4S
MW-17
MW-18
OO-300
NN-700

Plots of the data are shown in Figures 10 to 13. As can be seen in Figure 10, the storm totaled about 1.46 inches of rain and came in two intervals. The first interval contained over an inch of rain and the second interval about .4 inches.

Referring to the water level plot in Figure 10, MW-6 again has the largest level change during the storm. It is surprising to see the level differential between MW-B1 and MW-6 that develops during the storm since these wells are only a few feet apart. It should be noted that although both wells are screened in the phreatic zone, MW-6 is screened from about 793 to 818 and MW-B1 is screened from about 790 to795.

Referring to the temperature plot in Figure 11, MW-19 had the largest temperature change during the storm. Also, of particular note is the sharp rise in temperature seen in MW-6 (see Figure 12) during the first 15 minutes of level rise before the temperature then falls. Conductivity at MW-6, shown in Figure 13, also shows a sharp initial quick rise prior to falling after the first five minutes. The data for MW-6 shows details of temperature and conductivity responses during the storm not previously seen in hourly data. The instrument in MW-B1 was installed at the 814 elevation. This is well above the screened interval, indicating that the temperature response in this well is strictly caused by displacement of water up from the screened interval.

The response at MW-6 is different enough from previous hourly records to warrant taking additional 5 minute data during other events in this and other wells. Which wells are instrumented during each storm and where within the well column the instrument will be located will be changed to gather data on specific zones of interest.

Figure 1 - Dye and Conductivity in MW-4i

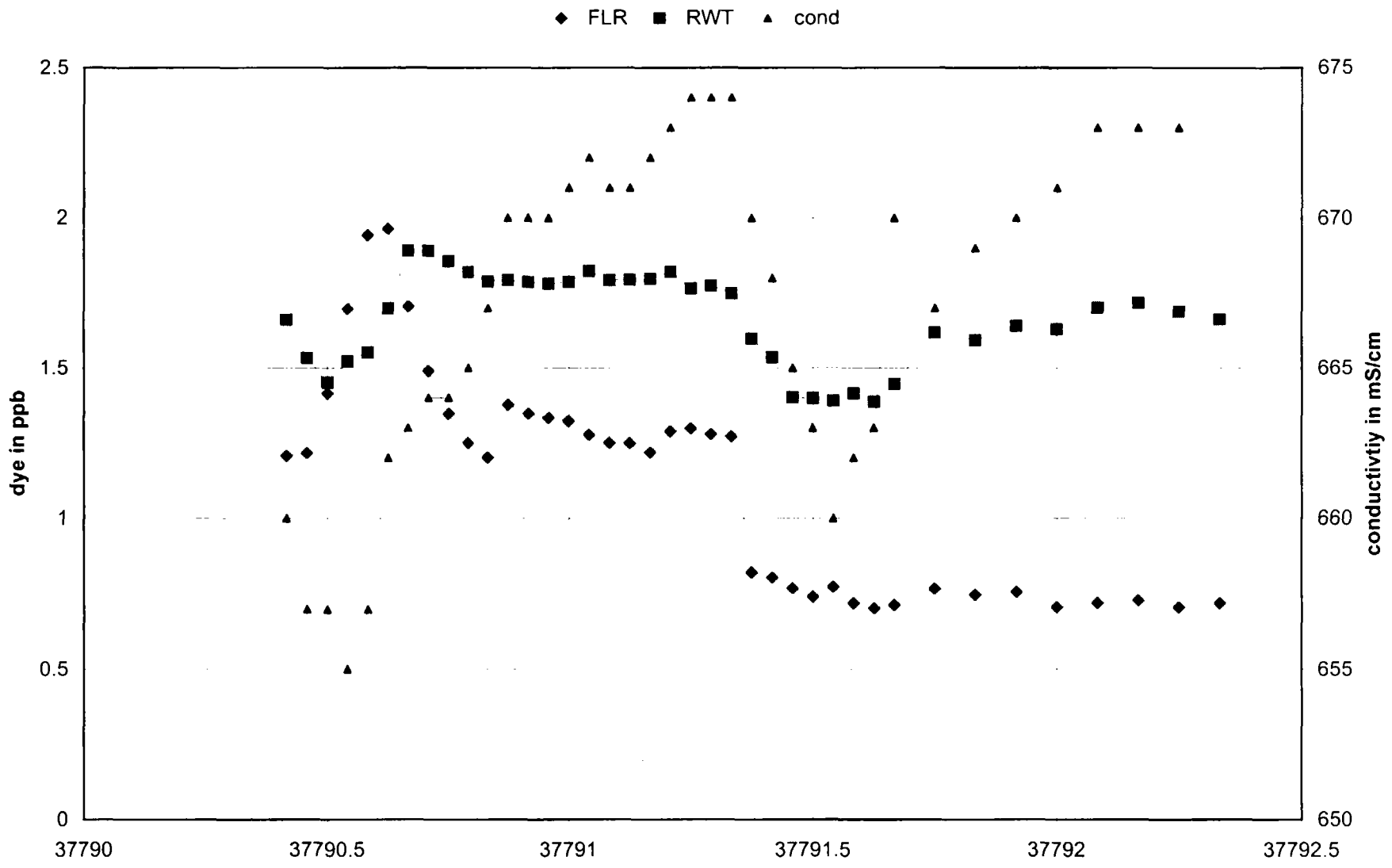

Figure 2 : ICS Flow

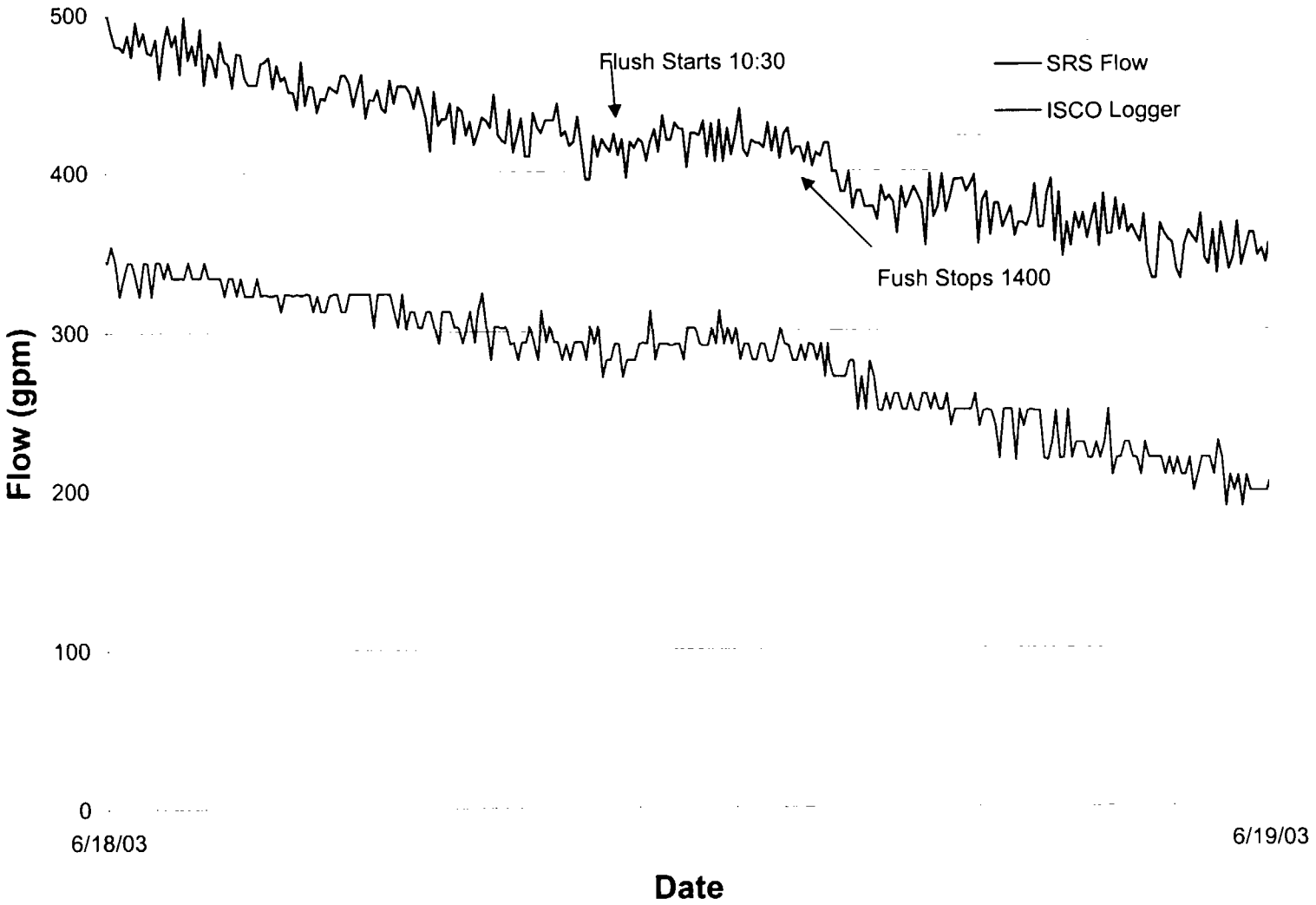

Figure 3: OO370 Flush 5 min level data all wells

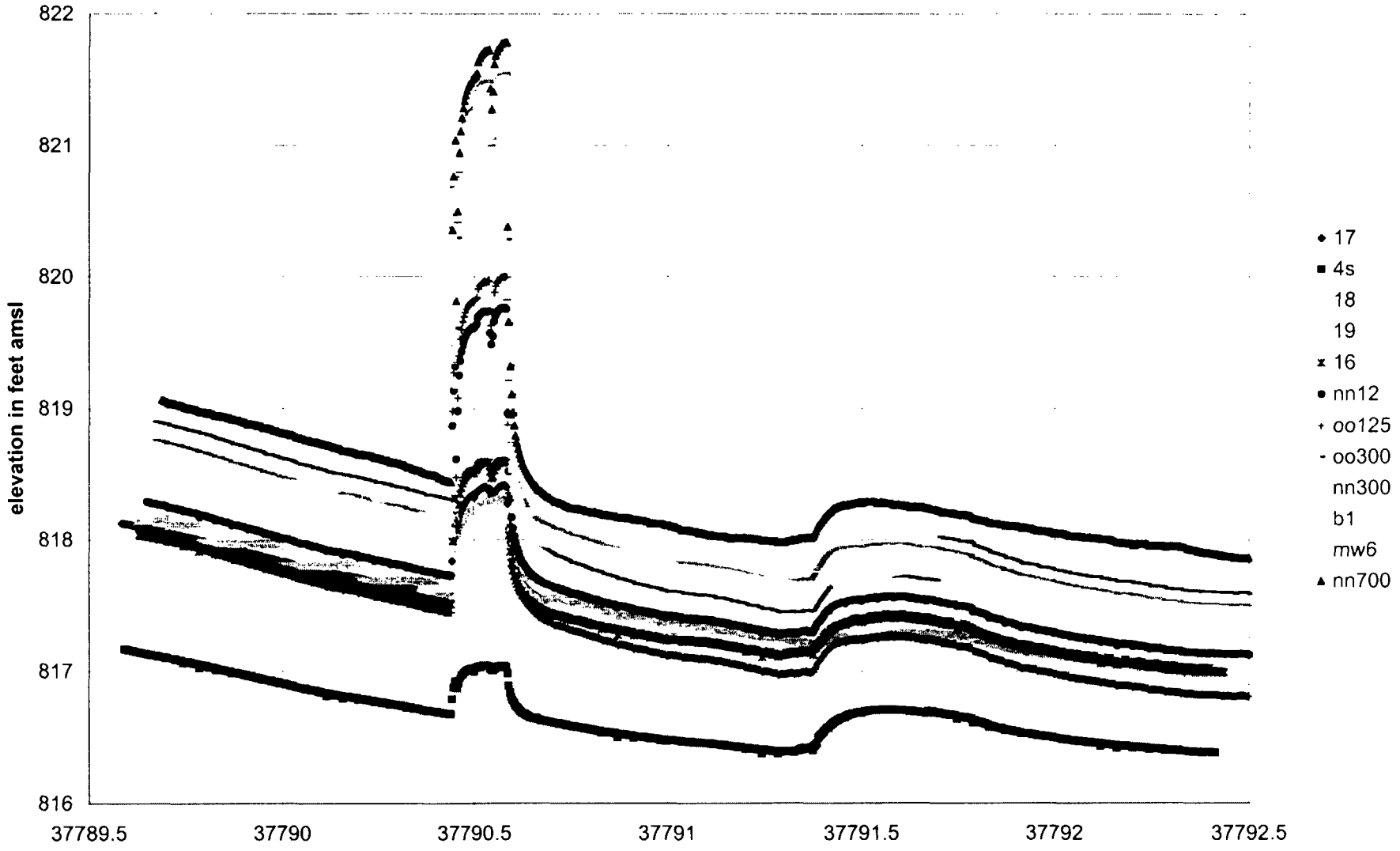

Figure 4: Maximum Water Level Increase vs. Distance From OO370

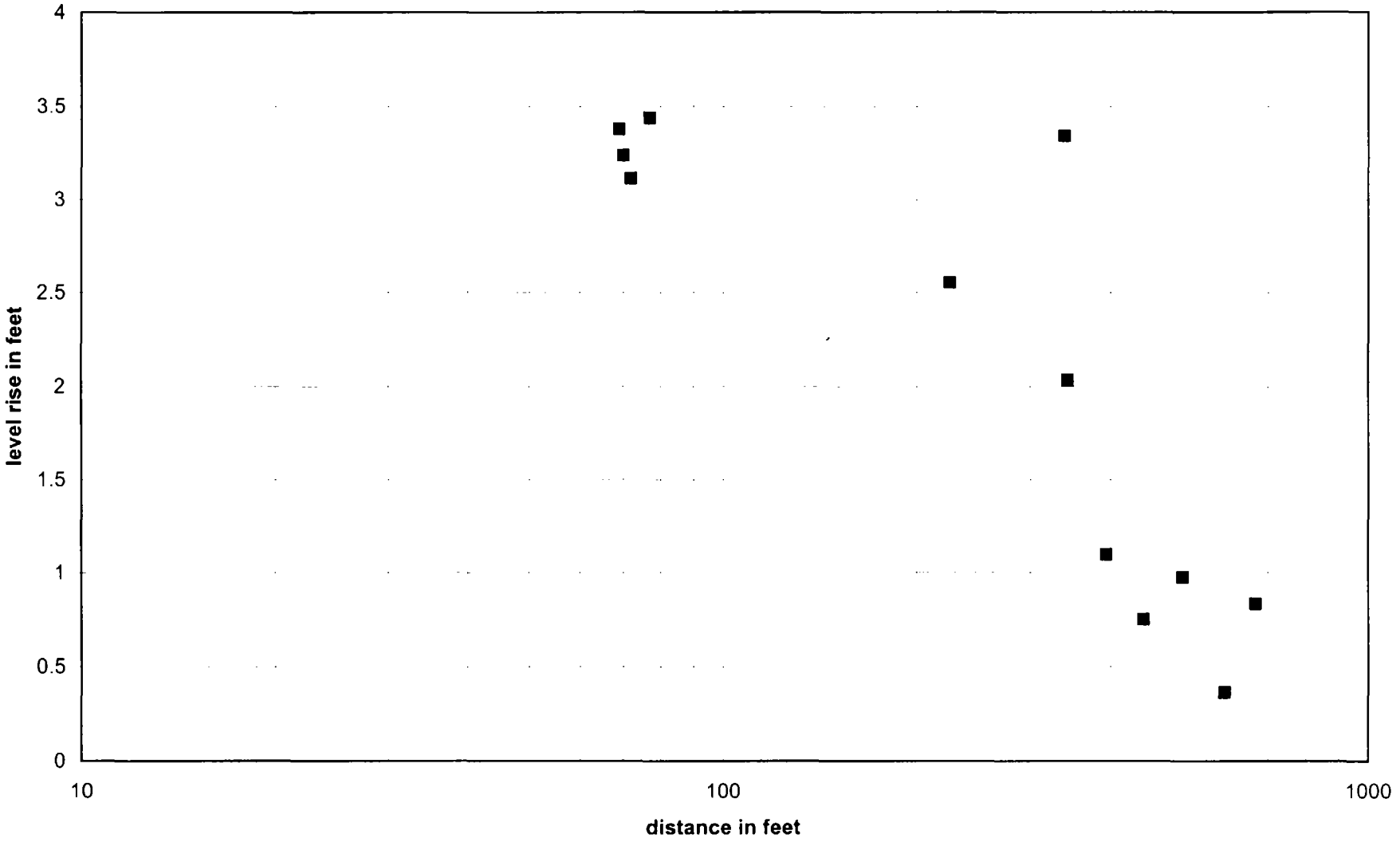

Figure 5: OO370 Level During High Volume Flush

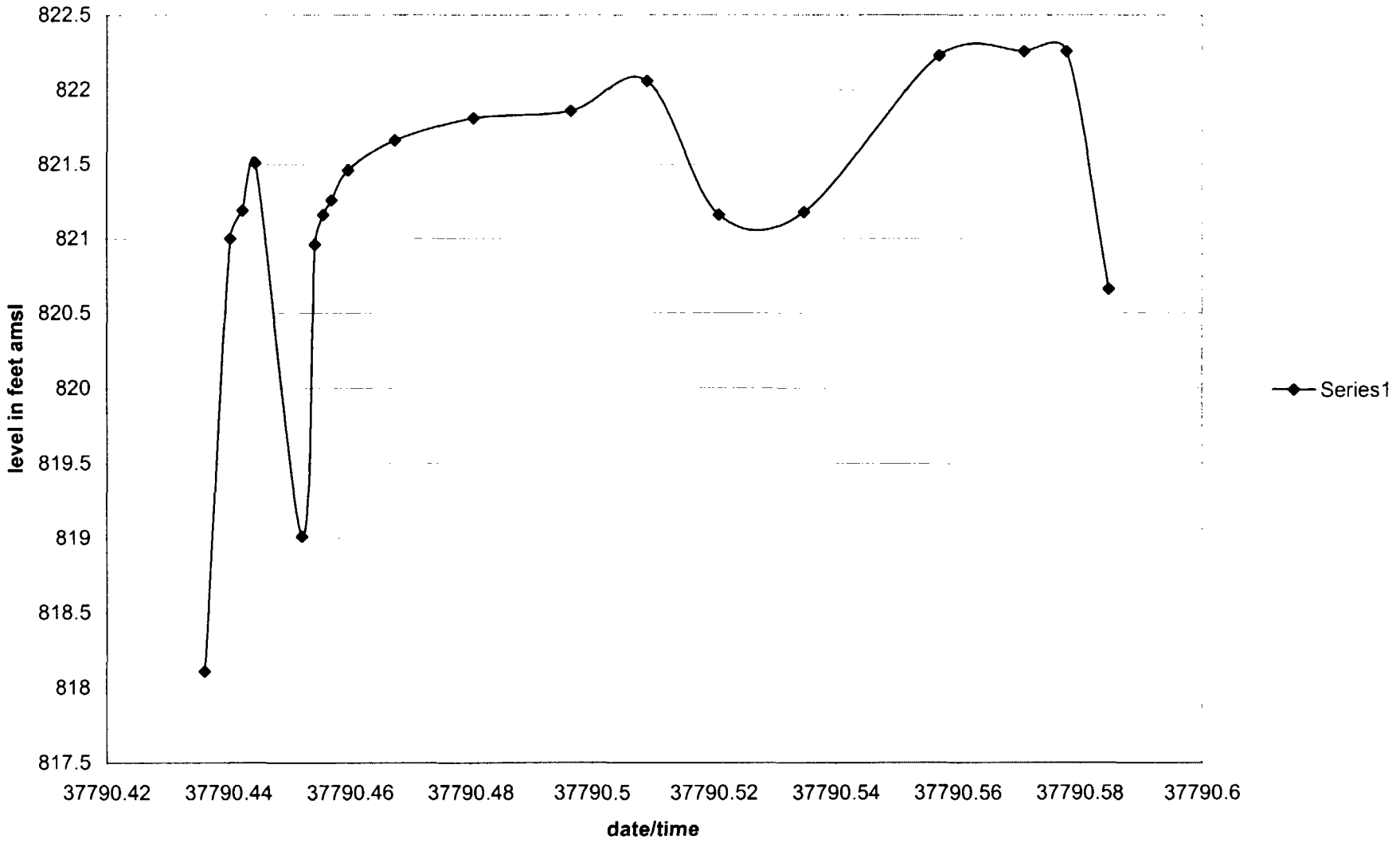

Figure 6: PZ-H PZ-I Flush and Storm Data

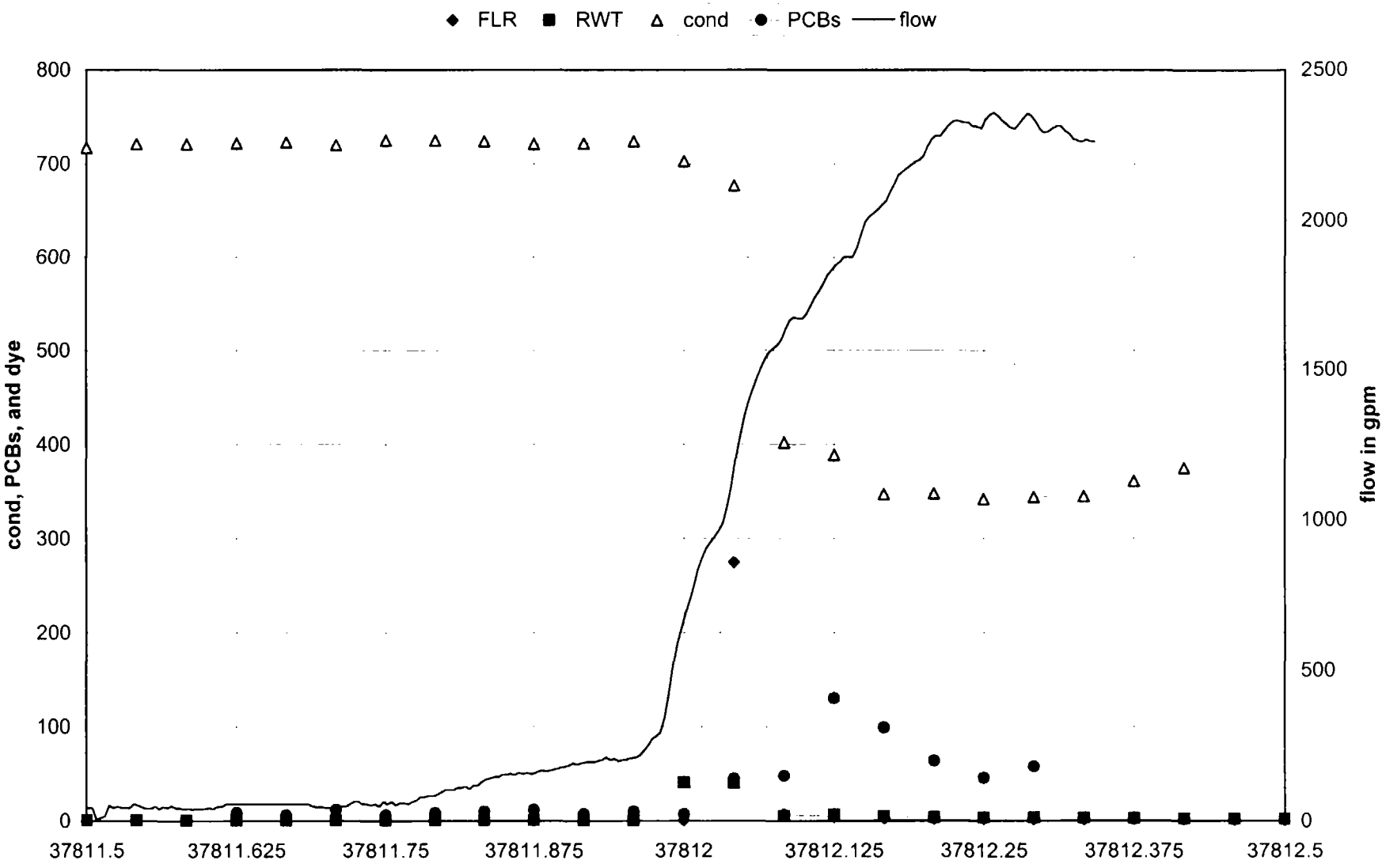

Figure 7: PZH/I Dye Injections Well Levels

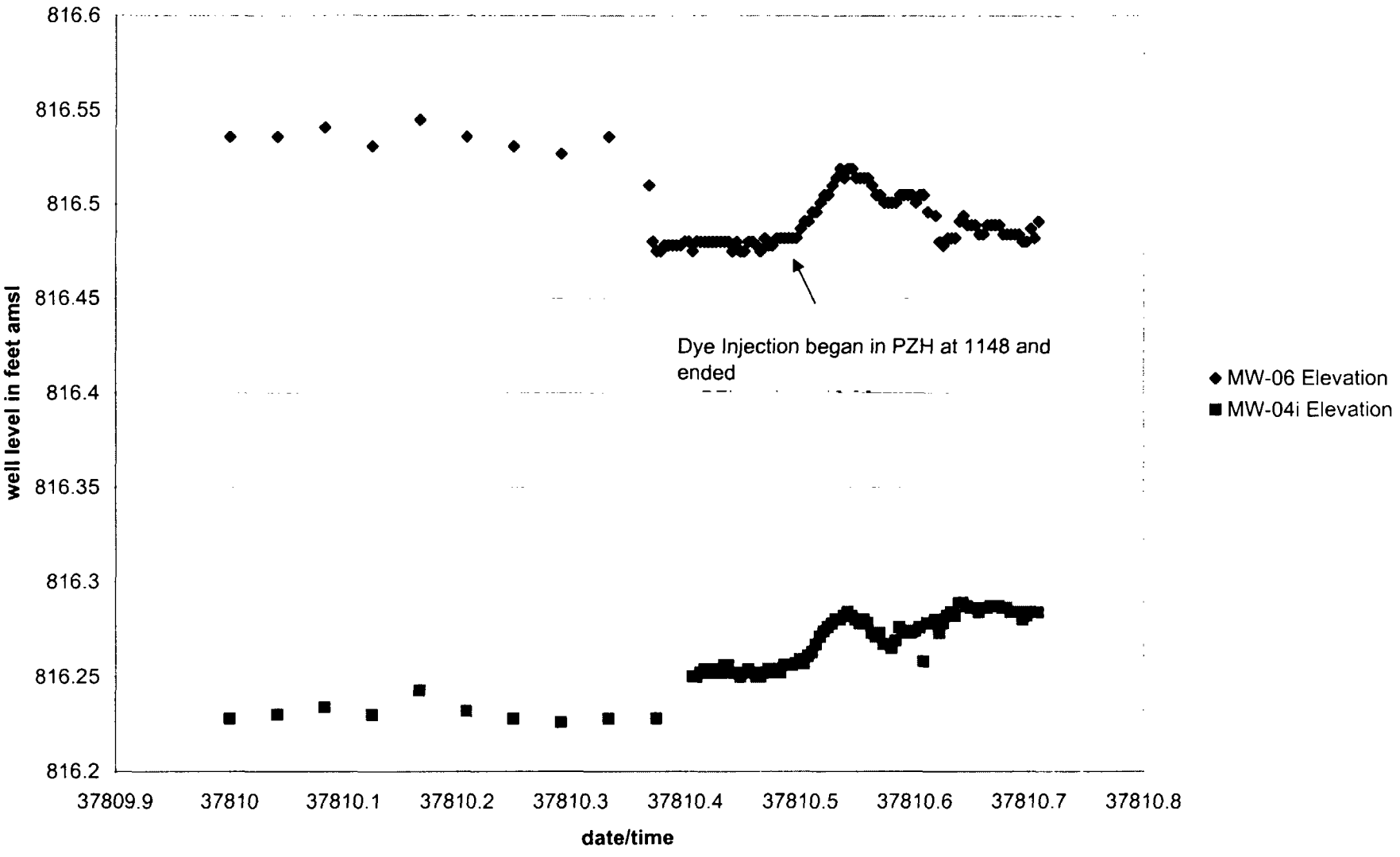

Figure 8: PZJ/LF1 Dye Injections
IC Spring Data

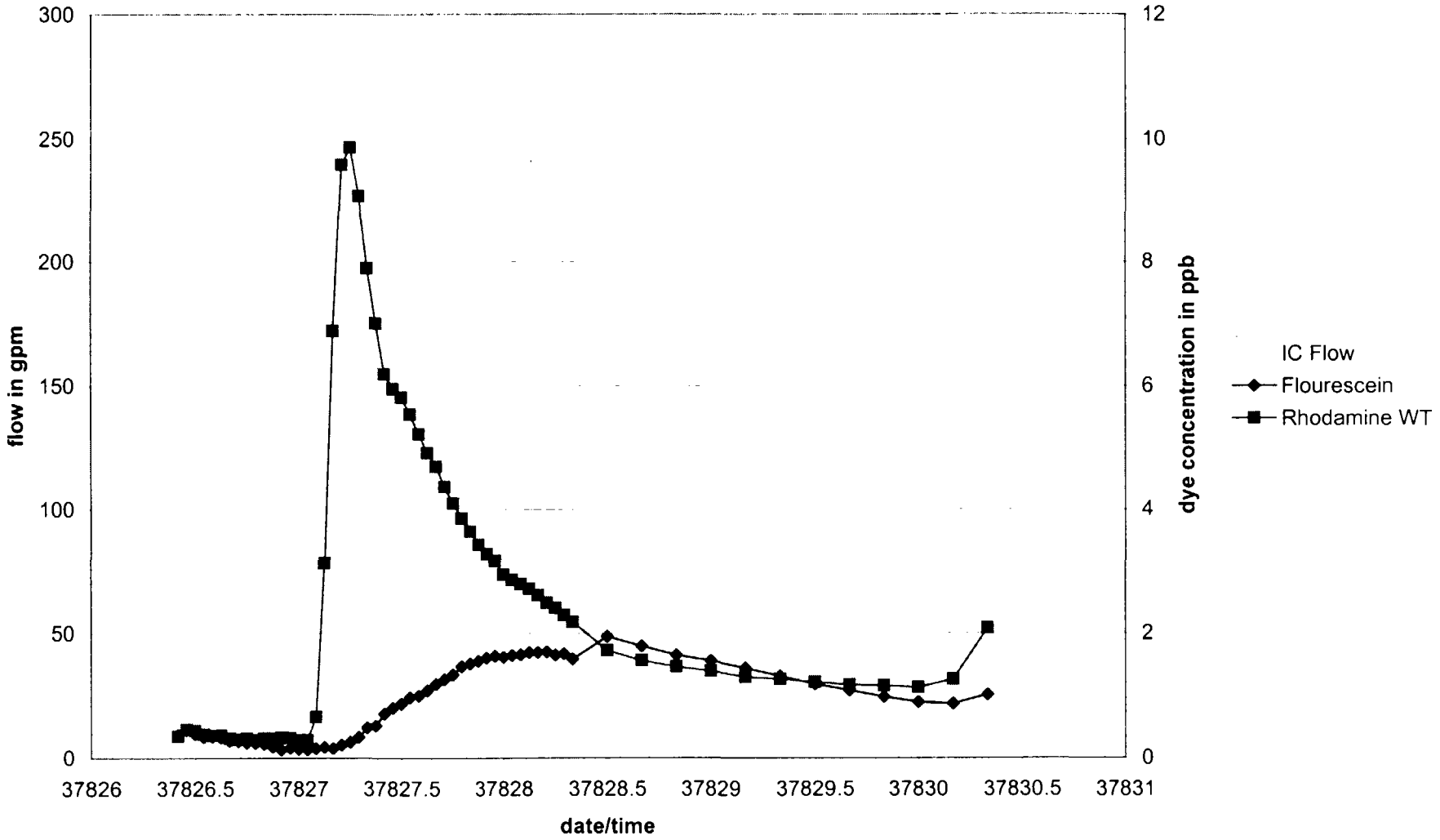

Figure 9: PZJ/LF1 Dye Injection Well Levels

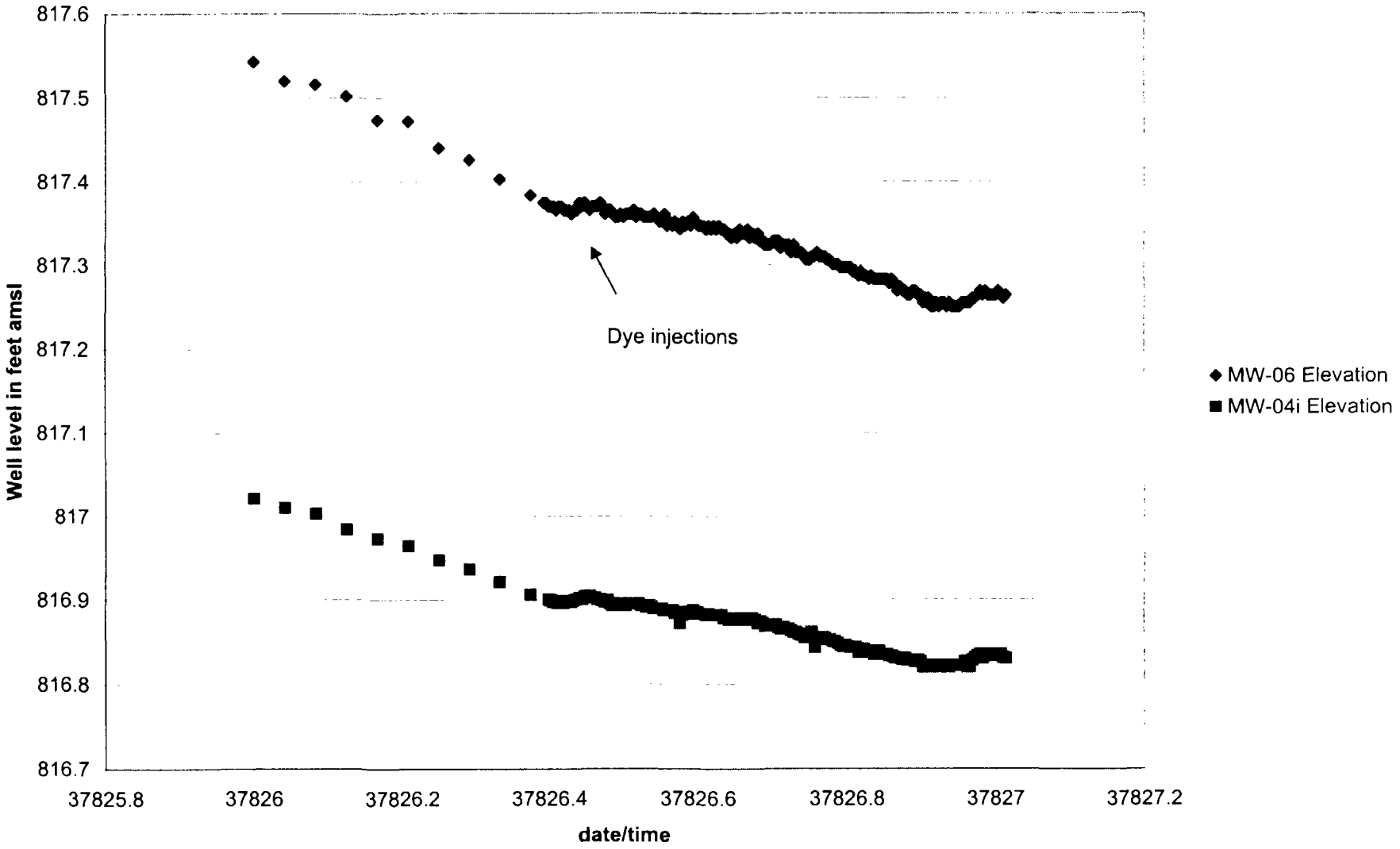

Figure 10: 6/13/03 Event 5 Minute Data

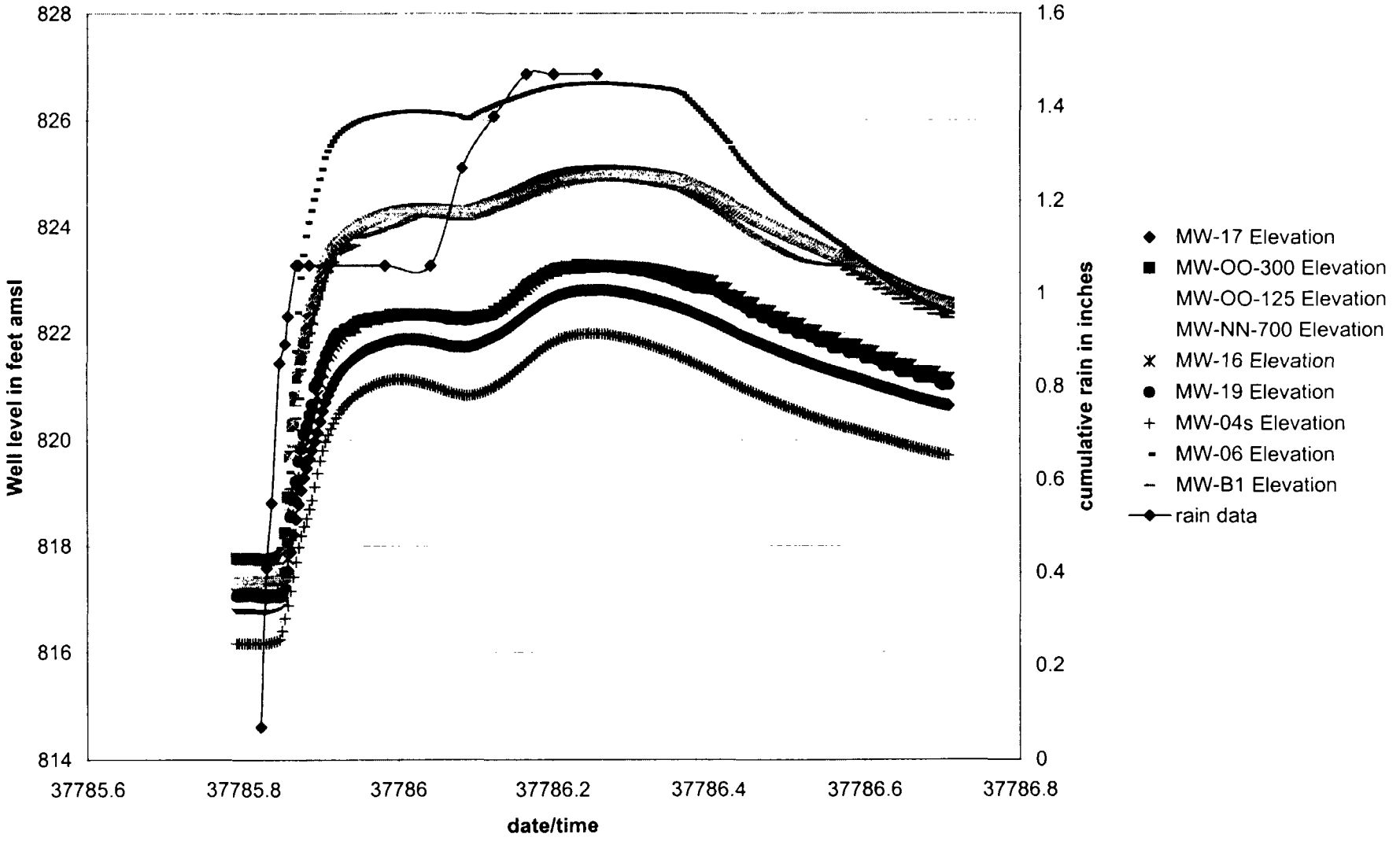

Figure 11: 6/13/03 Event Temperatures
(5 min data)

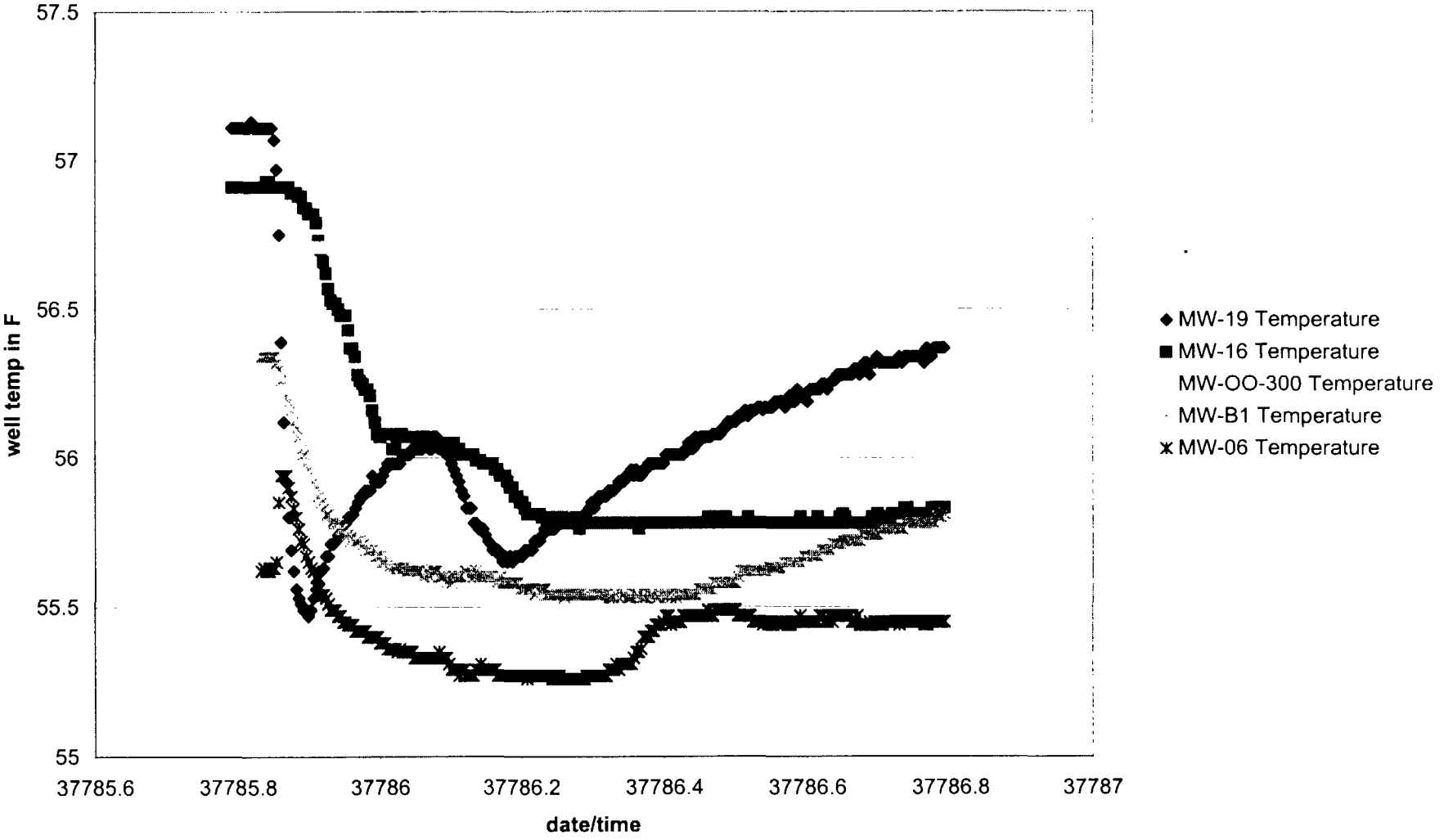

Figure 12: MW6 Temperature and Level 6/13/03 Event (5 minute data)

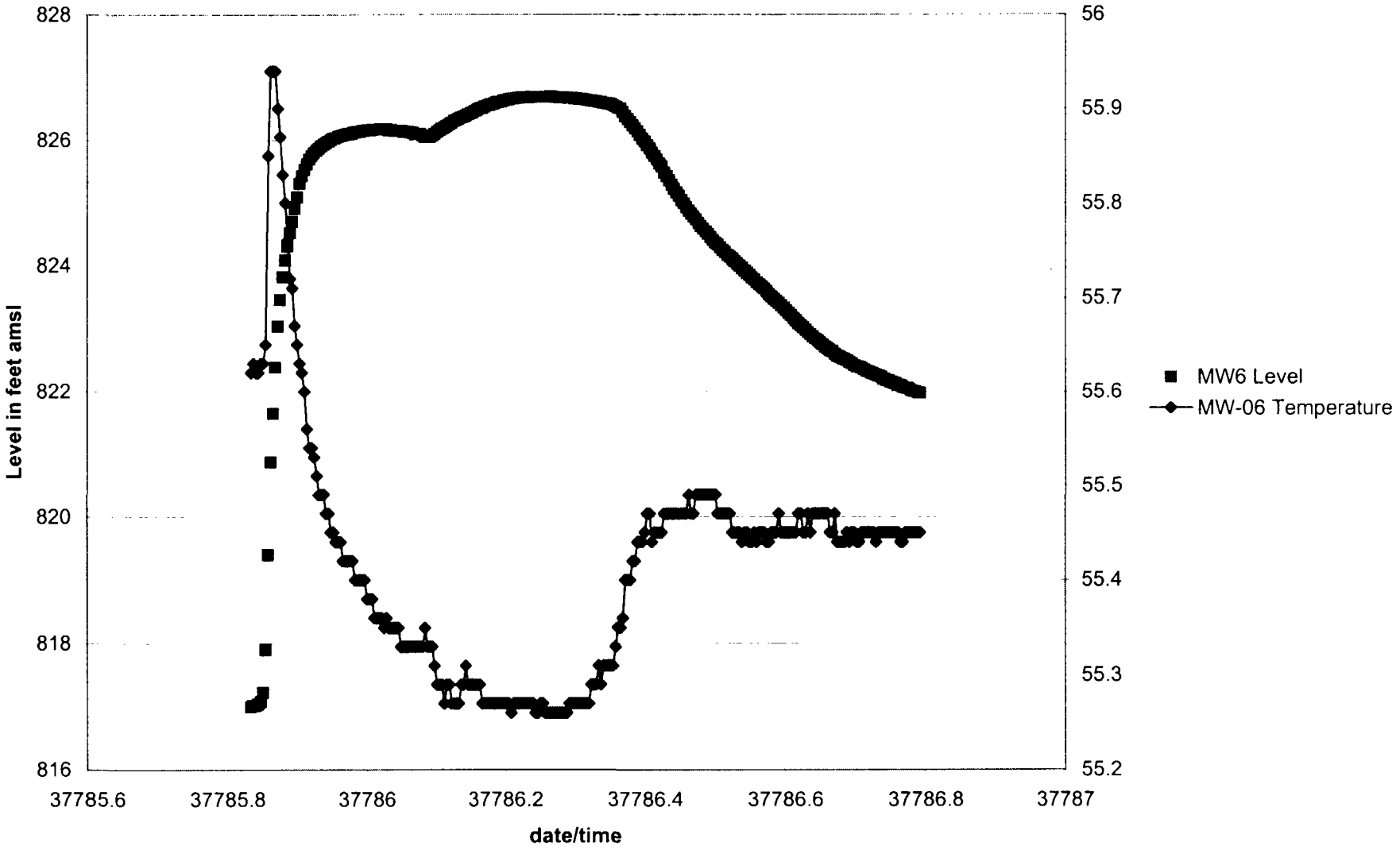

Figure 13: MW6 Level and Specific Conductance 6/13/03 Event (5 Minute Date)

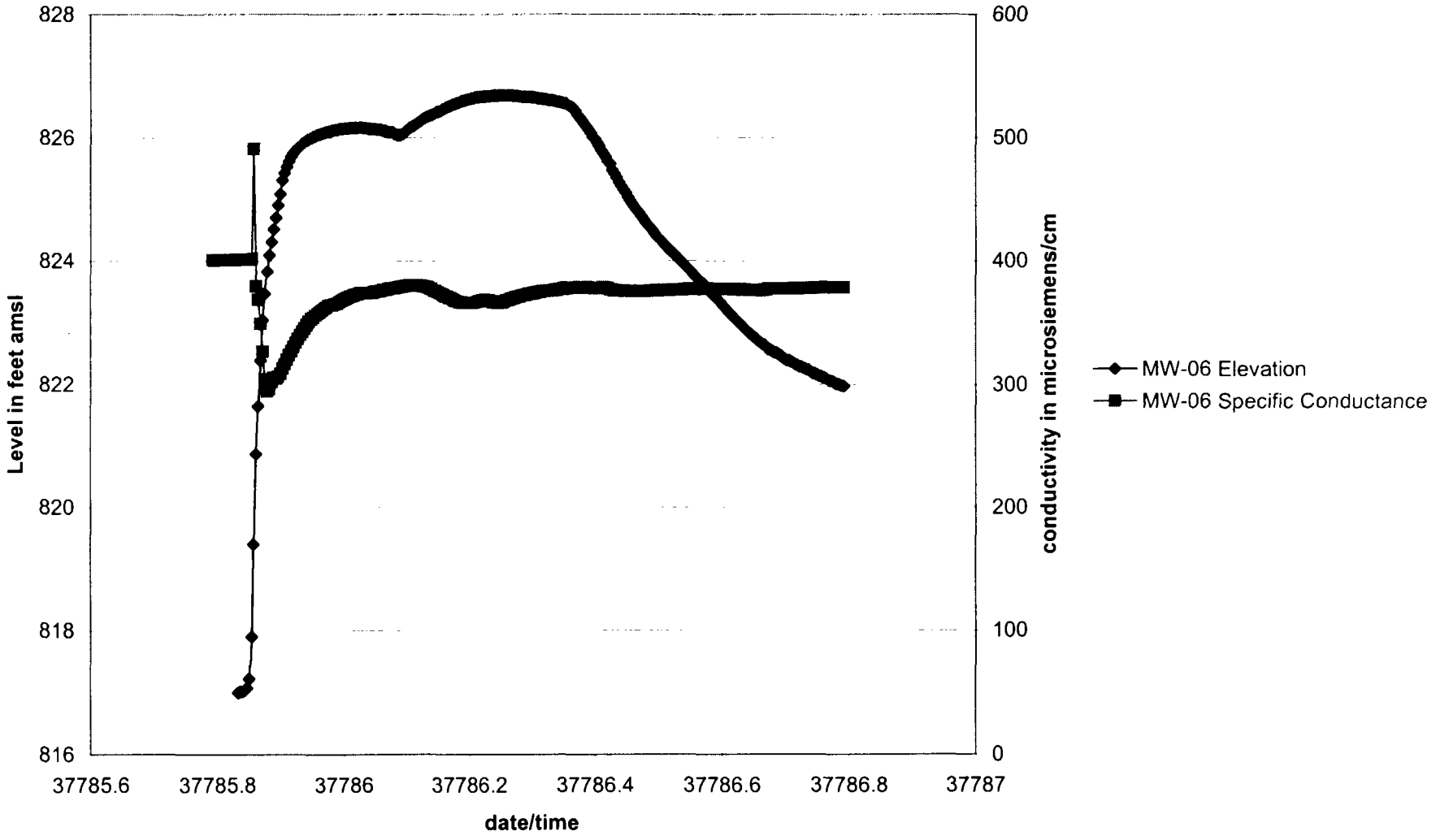

Table 1 - IC Spring Tracer Results

	IC Spring		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/17/03 16 00	0 093	0 364	550
6/18/03 8 00	0 466	0 311	563
6/18/03 10 00	0 297	0 297	569
6/18/03 12 00	0 304	0 300	569
6/18/03 12 18	0 252	0 298	569
6/18/03 13 00	0 290	0 299	569
6/18/03 14 00	0 262	0 286	568
6/18/03 15 00	0 199	0 301	568
6/18/03 16 00	0 161	0 284	568
6/18/03 17 00	0 152	0 273	572
6/18/03 18 00	0 216	0 304	572
6/18/03 19 00	0 266	0 397	578
6/18/03 20 00	0 232	0 426	582
6/18/03 21 00	0 216	0 427	581
6/18/03 22 00	0 251	0 427	584
6/18/03 23 00	0 230	0 359	583
6/19/03 0 00	0 267	0 353	583
6/19/03 1 00	0 412	0 334	582
6/19/03 2 00	0 304	0 271	582
6/19/03 3 00	0 237	0 292	584
6/19/03 4 00	0 254	0 269	583
6/19/03 5 00	0 281	0 273	585
6/19/03 6 00	0 238	0 301	584
6/19/03 7 00	0 257	0 307	584
6/19/03 8 00	0 283	0 280	584
6/19/03 9 00	0 115	0 106	595
6/19/03 10 00	0 072	0 063	587
6/19/03 11 00	0 085	0 070	586
6/19/03 12 00	0 084	0 043	588
6/19/03 13 00	0 073	0 069	595
6/19/03 14 00	0 058	0 040	599
6/19/03 15 00	0 068	0 108	592
6/19/03 16 00	0 082	0 168	583
6/19/03 17 00	0 087	0 119	574
6/19/03 18 00	0 097	0 170	566
6/19/03 19 00	0 052	0 124	564
6/19/03 20 00	0 092	0.170	568
6/19/03 21 00	0 040	0 115	566
6/19/03 22 00	0 043	0.101	568
6/19/03 23 00	0 043	0 102	571
6/20/03 0 00	0 053	0 134	575
6/20/03 1 00	0 025	0 081	579
6/20/03 2 00	0 033	0 072	583
6/20/03 3 00	0 025	0 049	589
6/20/03 4 00	<0 05	<0 05	590
6/20/03 5 00	<0 05	<0 05	593
6/20/03 6 00	<0 05	<0 05	594
6/20/03 7 00	<0 05	<0 05	595
6/20/03 8 00	<0 05	<0 05	597
6/20/03 16 00	<0 05	0 178	604
6/21/03 0 00	<0 05	0 221	606
6/21/03 8 00	<0 05	0 227	619
6/21/03 16 00	<0 05	0 223	623
6/22/03 0 00	<0 05	0 263	627
6/22/03 8.00	<0 05	0 236	634
6/22/03 16 00	<0 05	0 242	637
6/23/03 0 00	<0 05	0 263	641
6/23/03 8 00	<0 05	0 260	648

Table 2 - Other Springs Tracer Results

	Stony East Spring		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/17/03 14 30	0 063	0 246	704
6/18/03 8 00	0 154	0 033	620
6/18/03 10 00	0 197	<0 05	620
6/18/03 12 00	0 110	<0 05	620
6/18/03 14 00	0 152	<0 05	622
6/18/03 16 00	0 154	0 061	624
6/18/03 18 00	0 108	<0 05	626
6/18/03 20 00	0 107	<0 05	628
6/18/03 22 00	0 076	<0 05	630
6/19/03 0 00	0 072	<0 05	634
6/19/03 2 00	0 076	<0 05	641
6/19/03 4 00	0 069	<0 05	637
6/19/03 6 00	0 092	<0 05	638
6/19/03 9 40	0 234	0 277	596
6/19/03 10 00	<0 05	<0 05	592
6/19/03 12 00	0 224	0 475	490
6/19/03 14 00	0 123	0 061	517
6/19/03 16 00	<0 05	<0 05	551
6/19/03 18 00	<0 05	<0 05	578
6/19/03 20 00	<0 05	<0 05	598
6/19/03 22 00	<0 05	<0 05	608
6/20/03 0 00	<0 05	<0 05	616
6/20/03 2 00	<0 05	<0 05	619
6/20/03 4 00	<0 05	<0 05	622
6/20/03 6 00	<0 05	<0 05	630
6/20/03 8 00	<0 05	<0 05	630
6/20/03 16 00	<0 05	<0 05	604
6/21/03 0 00	<0 05	<0 05	616
6/21/03 8 00	<0 05	<0 05	628
6/21/03 16 00	<0 05	<0 05	633
6/22/03 0 00	<0 05	<0 05	641
6/22/03 8 00	<0 05	<0 05	653
6/22/03 16 00	<0 05	<0 05	657
6/23/03 0 00	<0 05	<0 05	657
6/23/03 8 00	<0 05	0 094	646

	Stony West Spring		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/17/03 15 15	0 222	0 693	495
6/18/03 8 00	0 416	0 496	479
6/18/03 10 00	0 429	0 510	474
6/18/03 12 00	0 387	0 510	474
6/18/03 14 00	0 412	0 540	471
6/18/03 16 00	0 400	0 489	470
6/18/03 18 00	0 388	0 562	469
6/18/03 20 00	0 405	0 508	469
6/18/03 22 00	0 368	0 445	470
6/19/03 0 00	0 380	0 486	473
6/19/03 2 00	0 388	0 492	476
6/19/03 4 00	0 377	0 530	478
6/19/03 6 00	0 409	0 525	479
6/19/03 9 55	1 698	2 809	211
6/19/03 10 00	0 790	1 486	234
6/19/03 12 00	0 571	0 905	238
6/19/03 14 00	0 522	0 637	271
6/19/03 16 00	0 349	0 596	384
6/19/03 18 00	0 280	0 323	429
6/19/03 20 00	0 276	0 239	449
6/19/03 22 00	0 235	0 218	460
6/20/03 0 00	0 196	0 175	469
6/20/03 2 00	0 180	0 168	476
6/20/03 4 00	0 148	0 199	482
6/20/03 6 00	0 162	0 237	485
6/20/03 8 00	0 164	0 232	487
6/20/03 16 00	0 140	0 293	491
6/21/03 0 00	0 142	0 310	487
6/21/03 8 00	0 154	0 317	496
6/21/03 16 00	0 134	0 339	494
6/22/03 0 00	0 162	0 466	487
6/22/03 8 00	0 129	0 379	491
6/22/03 16 00	0 098	0 381	488
6/23/03 0.00	0 133	0 441	486
6/23/03 8 00	0 133	0 490	491

Table 3 - Valhalla Wells Tracer Results

MW-6				MW-B1			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/6/03 14:30	1.147	0.089		6/6/03 14:40	18.7	1.125	
6/17/03 14:40	0.064	0.299	493	6/17/03 14:45	7.969	1.946	437
6/18/03 15:32	1.067	0.894	457	6/18/03 15:37	15.24	1.835	445
6/19/03 10:38	1.381	0.953	457	6/19/03 9:50	20.52	3.929	485
6/19/03 16:44	0.876	0.713	431	6/19/03 16:44	11.87	1.655	442

NN-300				OO-300			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/6/03 15:00	1.345	254		6/6/03 15:10	0.352	17.85	
6/17/03 14:55	0.505	160.2	437	6/17/03 15:00	0.176	15.57	497
6/18/03 15:54	0.946	180.1	444	6/18/03 15:49	0.481	15.64	499
6/19/03 9:39	1.088	190.8	468	6/19/03 9:40	0.697	16.25	505
6/19/03 16:34	0.768	190.1	473	6/19/03 16:40	0.379	15.84	505

OO-370			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/6/03 15:50	2353	47.000	
6/18/03 15:41	373	12.080	550
6/19/03 9:44	0.645	0.610	612
6/19/03 16:56	0.753	5.087	585

Table 4 - Lemon Lane East-Side Wells Tracer Results

MW-18				MW-19			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/17/03 11:10	0.165	0.428	693	6/17/03 14:00	<0.05	<0.05	713
6/18/03 15:36	0.216	0.543	707	6/18/03 15:32	0.081	0.109	733
6/18/03 20:00	0.242	0.558	703	6/19/03 10:55	0.377	0.266	646
6/19/03 10:10	0.465	0.819	698	6/19/03 16:20	0.035	0.036	713.000
6/19/03 16:16	0.114	0.414	718				
6/20/03 8:50	0.180	0.554	726				

MW-16				MW-15			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond
6/17/03 14:15	0.076	0.188	783	6/17/03 14:20	0.267	0.499	709
6/18/03 15:27	0.145	0.183	772	6/18/03 15:25	0.32	0.21	692
6/19/03 9:25	0.432	0.546	819	6/19/03 9:29	0.447	0.366	708
6/19/03 16:24	0.116	<0.05	771	6/19/03 16:28	0.196	0.048	717

MW-4s				MW-10			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond.	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond.
6/17/03 10:35	2.170	2.339	770	6/17/03 10:15	0.848	5.564	715
6/18/03 15:43	3.250	3.074	778	6/18/03 16:10	1.537	10.640	720
6/19/03 9:20	3.484	1.451	763	6/19/03 10:25	1.730	6.782	687
6/19/03 16:10	1.561	0.732	808	6/19/03 17:08	1.097	9.516	760

MW-20			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond.
6/17/03 10:45	0.969	6.146	722
6/18/03 15:34	2.730	3.949	709
6/19/03 9:21	2.096	4.008	725
6/19/03 16:13	1.095	3.856	734

Table 5- Well MW-4i Results

Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Cond.
6/17/03 13:40	0.672	1.282	666
6/18/03 10:00	1.206	1.661	636
6/18/03 11:00	1.216	1.533	660
6/18/03 12:00	1.414	1.451	657
6/18/03 13:00	1.697	1.523	657
6/18/03 14:00	1.944	1.551	655
6/18/03 15:00	1.965	1.699	657
6/18/03 16:00	1.706	1.891	662
6/18/03 17:00	1.489	1.89	663
6/18/03 18:00	1.346	1.856	664
6/18/03 19:00	1.250	1.820	664
6/18/03 20:00	1.201	1.788	665
6/18/03 21:00	1.376	1.793	667
6/18/03 22:00	1.346	1.786	670
6/18/03 23:00	1.333	1.781	670
6/19/03 0:00	1.323	1.788	670
6/19/03 1:00	1.277	1.823	671
6/19/03 2:00	1.250	1.793	672
6/19/03 3:00	1.249	1.794	671
6/19/03 4:00	1.218	1.798	671
6/19/03 5:00	1.288	1.820	672
6/19/03 6:00	1.298	1.766	673
6/19/03 7:00	1.279	1.774	674
6/19/03 8:00	1.271	1.749	674
6/19/03 9:00	0.823	1.598	674
6/19/03 10:00	0.806	1.535	670
6/19/03 11:00	0.771	1.401	668
6/19/03 12:00	0.743	1.398	665
6/19/03 13:00	0.775	1.388	663
6/19/03 14:00	0.721	1.414	660
6/19/03 15:00	0.704	1.386	662
6/19/03 16:00	0.715	1.444	663
6/19/03 18:00	0.768	1.617	670
6/19/03 20:00	0.749	1.593	667
6/19/03 22:00	0.758	1.640	669
6/20/03 0:00	0.708	1.629	670
6/20/03 2:00	0.722	1.701	671
6/20/03 4:00	0.73	1.718	673
6/20/03 6:00	0.707	1.688	673
6/20/03 8:00	0.721	1.662	673

Table 6: OO370 High Volume Flush

dist. From OO370 (feet)	max delta feet	Well
77	3.439	mw6
69	3.38	nn300
339	3.342	nn700
70	3.239	oo300
72	3.114	b1
225	2.553	oo125
343	2.034	nn12
394	1.096	mw16
517	0.974	mw18
670	0.832	mw17
450	0.75	mw19
600	0.365	mw4s

Table 7: PZH/PZI Dye Test Lemon Lane East-Side Wells Tracer Results

MW-18			MW-19			MW-16			MW-15		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/8/03 8:33	2.9	0.799	7/8/03 8:36	0.125	0.04	7/8/03 8:42	<0.05	<0.05	7/8/03 8:47	0.12	0.033
7/8/03 14:45	2.801	0.780	7/8/03 14:48	0.936	0.199	7/8/03 14:52	0.049	<0.05	7/8/03 14:55	0.067	0.003
7/8/03 20:02	2.716	0.832	7/8/03 20:06	0.107	0.014	7/8/03 20:10	0.05	<0.05	7/8/03 20:14	0.104	0.09
7/9/03 9:13	3.136	0.906	7/9/03 9:16	0.16	0.018	7/9/03 9:19	0.027	0.031	7/9/03 9:23	0.057	0.019
7/10/03 8:34	1.074	0.728	7/10/03 8:39	0.375	0.438	7/10/03 8:43	0.49	0.574	7/10/03 8:49	14.800	7.291

MW-4i			MW-4s			MW-10			MW-20		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/8/03 8:25	2.817	1.960	7/8/03 8:20	1.018	0.532	7/8/03 8:10	1.184	6.044	7/8/03 8:30	2.134	2.891
7/8/03 14:34	2.977	2.034	7/8/03 14:38	1.134	0.346	7/8/03 14:30	1.257	6.998	7/8/03 14:41	2.195	2.975
7/8/03 19:57	3.137	2.096	7/9/03 9:03	1.207	0.376	7/8/03 19:35	1.237	8.031	7/8/03 20:00	2.269	3.080
7/9/03 9:08	3.205	2.044	7/10/03 8:26	12.620	18.640	7/9/03 8:52	1.281	8.380	7/9/03 9:10	2.327	2.997
7/10/03 8:29	6.309	1.466				7/10/03 8:18	3.841	4.871	7/10/03 8:31	6.527	1.691

PZF			LF6-8		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/8/2003 9:07	3.397	20.25	7/8/2003 8:55	863.9	20.51
7/8/2003 15:16	4.607	26.14			
7/8/2003 20:50	5.583	34.04			
7/9/2003 9:27	3.179	35.55			
7/10/2003 8:54	59.69	47.23			

Table 8: PZH/PZI Dye Test Valhalla Wells Tracer Results

MW-6			NN-300			OO-300		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/8/03 8:45	0.268	0.268	7/8/03 8:56	0.936	193.5	7/8/03 9:08	0.333	17.74
7/8/03 14:40	0.412	0.242	7/8/03 15:05	1.451	196.8	7/8/03 14:56	0.405	15.02
7/8/03 20:20	0.163	0.145	7/8/03 20:43	1.908	199.1	7/8/03 20:35	0.599	15.11
7/9/03 9:51	0.038	0.157	7/9/03 10:09	1.833	195.4	7/9/03 10:01	0.562	14.81
7/10/03 9:01	0.661	0.987	7/10/03 9:13	2.863	209	7/10/03 9:07	432.000	306

OO-370			OO300A			NN-300A		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/8/03 8:53	0.14	3.723	7/8/2003 9:13	0.701	19.86	7/8/2003 4:02	1.641	286.8
7/8/03 14:50	4.359	4388.000	7/8/2003 15:00	0.641	18.72			
7/8/03 20:30	21820.000	3152.000	7/8/2003 20:39	1366	2427			
7/9/03 9:57	1401.000	464.000	7/9/2003 10:06	1710	1750			
7/10/03 9:04	95.000	21.640	7/10/2003 9:09	531	484			

Table 9: PZJ/LF1 Dye Test Lemon Lane East-Side Wells Tracer Results

	MW-18			MW-19				MW-16				MW-15	
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/23/03 9:47	0.393	0.413	7/23/03 9 52	0 068	0 103		7/23/03 9 57	0.052	<0 05		7/23/03 10:04	0 135	0 345
7/24/03 14.03	0 511	0.454	7/24/03 14:08	2.257	3257	dil= 1000	7/24/03 14 13	612.2	12 24	cal @ 500/200	7/24/03 14:18	0 509	0 085
7/24/03 18:07	0.386	0.566	7/24/03 18:10	0 829	1755	dil= 1000	7/24/03 18 15	337 6	6.827	cal @ 500/200	7/24/03 18 20	<0 05	0 082
7/25/03 11:13	1 774	14 010	7/25/03 11:18	0 4	327 000	dil= 1000	7/25/03 11 23	68 52	1.811	cal @ 500/200	7/25/03 11 27	0 157	0 032
7/26/03 7 53	2.083	23 790	7/26/03 7:56	0.76	165.900	cal @ 200 ppb R	7/26/03 8.02	22.77	0 884				

Lemon Lane 4-Series Wells Tracer Results

	MW-4i			MW-4s			MW-10			MW-20		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	hodamine WT conc. in ppb	Comments
7/23/03 9.28	1.543	1 180		7/23/03 9:38	5.194	10.720	7/23/03 9 33	0.648	4.845	7/23/03 9:41	2.553	1.503	
7/24/03 13:50	2 390	1.554		7/24/03 13:56	6.183	9.299	7/24/03 13:54	0.872	4.212	7/24/03 0:00	4 036	2 163	
7/24/03 17:51	3.730	222.000	cal @ 500/200	7/24/03 17:58	5.354	6 021	7/24/03 17:54	0.807	3 275	7/24/03 18:02	5 910	182.700	cal @ 500/200
7/25/03 10:57	6.902	78.420	cal @ 500/200	7/25/03 11:03	5.283	4.871	7/24/03 11:03	1.065	3.868	7/25/03 11:09	3 865	5.562	

	PZ-F			PZ-E				LF6-8			
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments
7/23/2003 11:37	3.648	39.2	cal @ 500/200	7/23/2003 11:30	0.749	1.985		7/23/2003 10 55	860.5	11.19	
7/24/2003 14:20	5.609	35.58		7/24/2003 14:40	0.506	0.354		7/24/2003 14:22	455 4	9.175	cal @ 500/200
7/24/2003 18:25	5.858	38.9		7/24/2003 18:39	127.5	2.781	cal @ 500/200	7/24/2003 18:30	429.8	8 616	cal @ 500/200
7/25/2003 11:29	5.765	50.08	cal @ 500/200	7/25/2003 11:40	47.85	1.41	cal @ 500/200	7/25/2003 11:34	532.6	11.79	cal @ 500/200
				7/26/2003 8:09	25.51	2.076					

Table 10: PZJ/LF1 Dye Test Valhalla Wells Tracer Results

ta			NN-300				OO-300				OO-370		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/23/03 10:20	0.188	0.301	7/23/03 10:26	13.34	74.04	cal @ 500/200	7/23/03 10:36	229	150.7		7/23/03 10:45	1.081	2.318
7/24/03 13:30	0.541	0.616	7/24/03 13:34	20.92	84.55	cal @ 500/200	7/23/03 10:36	550.9	189.8	cal @ 500/200	7/24/03 13:42	5.855	11.490
7/24/03 17:30	0.584	0.578	7/24/03 17:34	19.35	84.1	cal @ 500/200	7/24/03 13:36	366	180		7/24/03 15:40	4.593	8.908
7/25/03 10:32	0.225	0.304	7/25/03 10:35	17.65	86.15	cal @ 500/200	7/24/03 17:38	377.900	176.4		7/24/03 17:44	7.458	13.990
							7/24/03 13:36	393.200	216.8	cal @ 500/200	7/25/03 10:48	20.890	12.510
							7/24/03 17:38	405.000	213.7	cal @ 500/200	7/26/03 8:16	22.690	14.430
							7/25/03 10:39	390.100	221.5	cal @ 500/200			

OO300A				NN-12			OO-125		
Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Comments	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb	Date/Time	Flourescein conc. in ppb	Rhodamine WT conc. in ppb
7/23/2003 10:40	5.38	78.93		7/24/2003 9:18	1.399	4.033	7/24/2003 9:24	<0.05	0.282
7/24/2003 13:39	7.578	75.53	cal @ 500/200	7/25/2003 12:35	1.517	4.47	7/25/2003 12:40	0.08	0.328
7/24/2003 17:40	7.234	80.02	cal @ 500/200						
7/25/2003 10:42	12.49	76.31	cal @ 500/200						