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Bruce Buel
General Manager
NIPOMO COMMUNITY SERVICES DISTRICT
148 S. Wilson
Nipomo, CA 93444

April 2, 2007
19996.37

Evaluation of Southland WWTF Ground Water Monitoring Data

As requested, we have evaluated the ground water monitoring data at Southland Wastewater Treatment Facility (WWTF). Our objective has been to provide a better understanding of current ground water conditions. We include below a summary of existing ground water data collected from onsite monitoring wells, and from other nearby wells identified by the District. These results are compared to the District's wastewater effluent quality and effluent permit limits. We also include recommendations regarding collecting additional data.

Background

The Regional Water Quality Control Board (Regional Board) prohibited discharge from individual sewage disposal systems (i.e., private septic systems) in 1978[1]. The District began discharging treated wastewater via infiltration basins at the Southland WWTF in 1985[2] under Waste Discharge Requirements adopted in 1984[3]. The plant was rated to treat 0.36 MGD. The treated effluent was initially disposed to ground water through three infiltration basins, later expanded to six basins[4].

Ground water monitoring was required as part of these Waste Discharge Requirements. Three wells were installed and were used to collect the required samples.

In May of 1997 a hydrogeologic analysis[5] of the wells, the geology of the site, and the monitoring data showed the possible presence of a fault separating the monitoring wells, and the likelihood that the wells were sampling different geologic formations. Water quality data showed that the percolated effluent had not degraded two of the three monitoring wells, but that

[1] Resolution 78-02, March 17, 1978.
[2] Staff Report for Regional Board Meeting on Order 97-75, August 5, 1997.
[3] Order 84-56, Regional Board.
[4] Final Project Inspection, NCSD Southland WWTF, SRF C-06-4501-110/120, 11/14/2000.
[5] Letter from Cleath & Associates, May 22, 1997.

one of the wells appeared "to have water quality more in line with the percolated effluent." The report concluded that "percolated effluent appears to flow down to the base of the sand dune deposits and then laterally both east and west (possibly over buried faults), where it percolates down to the ground water bearing deposits." This lateral movement before reaching ground water deposits is an indication of two water tables – a shallow aquifer and a deep aquifer.

According to the Regional Board[6], in July 1997 a hydrogeologic study furnished to the Board concluded that "due to poor construction, ground water collected from District monitoring wells is not representative of either the shallow or deep aquifers", and that "no determination of ground water flow direction in the shallow aquifer is possible." (It is not clear if this study is the same 5/22/97 analysis noted above.)

In October 1997 the Regional Board adopted updated Waste Discharge Requirements[8] for the expansion of the Southland WWTF. Its maximum monthly average treatment capacity was permitted to increase from 0.36 MGD to 0.90 MGD. Monitoring requirements contained in that order included the installation of new shallow monitoring wells, determination of ground water flow, and an investigation of impacts caused by the discharge.

The Phase I treatment facility expansion was completed in April 1999 and included headworks expansion and construction of a third aeration lagoon, a plant influent force main, and sludge drying beds. The Phase II expansion was completed in July 2000 and included additional improvements as well as construction of a fourth aerated lagoon and additional infiltration basins, bringing to 8 the total number of infiltration basins, covering an area of 14.4 acres.[9]

New, shallow monitoring wells were installed in January 2000[10] to sample the shallow aquifer and to monitor the effects of WWTF discharge.

Summary of Existing Data

The following summary of existing ground water data collected from onsite monitoring wells, and from other nearby wells identified by the District, is based on the following information:

1. Treatment facility influent quantity, effluent quality, and monitoring well water quality data reported annually to the Regional Water Quality Control Board.
2. Well water surface elevation data occasionally reported to the Regional Water Quality Control Board and also as provided by NCSD staff.

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[6] Letter from Roger Briggs to Doug Jones, October 6, 1999.
[7] Letter from Roger Briggs to Doug Jones, October 6, 1999.
[8] Order 97-75, Adopted October 24, 1997
[9] Final Project Inspection, NCSD Southland WWTF, SRF C-06-4501-110/120, 11/14/2000.
[10] Well driller's report from Doug Elona for monitoring wells installed between 1/24/2000 and 1/28/2000.

3. Official monthly rainfall totals for the City of Santa Maria, furnished by the Santa Barbara County Flood Control District.
4. Graphical displays of water quality data contained in a letter report from Cleath & Associates, dated 5/22/1997, regarding ground water flow from percolation ponds.
5. Water quality and water depth data summarized in a letter to the Regional Board from Garing Taylor & Associates, dated 9/3/1997, regarding additional information in support of proposed Waste Discharge Requirements.
6. Well log and location information provided in a letter from Cleath & Associates, dated 1/13/2000.
7. Hand written well installation notes from January 2000. The locations of the monitoring wells and piezometer were noted on a sketch map. Approximate ground elevations at well head locations were furnished by Garing Taylor & Associates via email.

Shallow Aquifer – Elevation and Gradient

Well installation and test hole records indicate a clay layer at a depth of between 25 and 135 feet, dropping to the west. See Attachment 1 (Figure 1 from Cleath & Associates, 1/13/2000).

See Attachment 2 (Figure 3 from Cleath & Associates, 5/22/1997) for location of monitoring wells (MW1, MW2, and MW3) and piezometer (PZ1).

The gradient in the shallow aquifer is apparently away from the infiltration basins in all directions. (See attachments 14 and 15.) The gradients between the piezometer and all 3 monitoring wells appear to vary between 1% and 3%. The extent and shape of the mounded area are unknown at this time.

Additionally, the data show a higher water table in 2006 than in 2000. Water levels were 5, 8, and 26 feet higher for monitoring wells MW-1, MW-2, and MW-3 respectively, when compared to the single reading reported for 2000. *(Data for years 2001-2004 has not been provided by NCSD, and was therefore not reviewed.)* The piezometer is also showing a steady rise, being approximately 10 feet higher than the values reported in 2000 and 2001. (See Attachment 3.) These changes in ground water level occurred during a time when WWTF flow rates increased from approximately 0.4 MGD to 0.6 MGD. (See Attachment 4.)

Shallow Aquifer – Water Quality

Comparison of water quality data collected from the shallow aquifer monitoring wells installed in 2000 to previously collected data (See Attachment 5) is difficult because:

- Ground water quality data from neighboring wells in the 1980's come from samples collected from wells that showed water levels at 207 and 213 feet depth[11] – presumably

[11] Garing Taylor & Associates, Letter to Regional Board 9/3/1997.

from the deeper aquifer. (These wells are shown as Ioimo and Egg City wells on Attachment 5 map.)

- Ground water quality data collected in the 1990's from District monitoring wells A, B, and C is not considered to be "representative of either the shallow or deep aquifers"[12] by the Regional Board.

With those limitations in mind, the following observations are made:

Total Dissolved Solids in MW-3 have risen from approximately 400 mg/L to 1200 mg/L. Meanwhile, MW-1 and MW-2 levels have risen from 1000 mg/L to 1200 mg/L. (See Attachment 6.)

Samples collected from the deep aquifer in the 1980's showed average values of 648 and 877 mg/L. District monitoring wells in the 1990's showed values between 200 and 400 mg/L in shallow wells, and between 800 and 1000 mg/L in the deeper well.

Sodium (Na) in MW-3 has risen from approximately 75 mg/L to 200 mg/L. Meanwhile, MW-1 and MW-2 levels have remained fairly steady at approximately 200 mg/L. (See Attachment 7.)

Samples collected from the deep aquifer in the 1980's showed average values of 92 and 102 mg/L. District monitoring wells in the 1990's showed values near 50 mg/L in shallow wells, and near 150 mg/L in the deeper well.

Chlorides (Cl) in all three monitoring wells have risen from approximately 100 mg/L to between 200 and 250 mg/L. MW-1 and MW-2 levels rose to this level in 2000, while MW-3 took an additional 2 years to reach this level. (See Attachment 8.)

Samples collected from the deep aquifer in the 1980's showed average values of 115 and 116 mg/L. District monitoring wells in the 1990's showed values less than 100 mg/L in shallow wells, and near 175 mg/L in the deeper well.

Total Nitrogen (Tot-N) levels appear to be more variable than other constituents, and appear to have risen since 2000. During year 2000, 5 of the 6 samples collected showed levels less than 10 mg/L. However, since January 2002, only 2 of the 30 samples have shown levels less than 10 mg/L. (See Attachment 9.)

Comparison with older data is complicated because prior to 2000 nitrate concentrations were measured, but since 2000 only total nitrogen concentrations have been reported. *(Additionally, at this time we are unsure whether the earlier reported values for nitrate are for "nitrate" or for "nitrate as nitrogen".)* Samples collected from the deep aquifer in the 1980's showed average nitrate values of 11 and 2 mg/L. District monitoring wells in the 1990's showed nitrate values generally between 5 and 12 mg/L in shallow wells, and near 175 mg/L in the deeper well.

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[12] Letter from Roger Briggs to Doug Jones, October 6, 1999.

Sulfate (SO_4) levels appear somewhat variable. Concentrations in all 3 monitoring wells appear to be approaching a level between 200 and 350 mg/L. Levels in MW-1 and MW-2 have dropped slightly since 2000, while MW-1 levels have risen since that time. (See Attachment 10.)

These recent concentrations reported in the shallow aquifer are similar to samples collected in the 1980's from deeper neighboring wells, and to results from the deep monitoring well sampled in the 1990's.

Boron (B) in MW-3 has risen from approximately 0.05 mg/L to 0.3 mg/L. Meanwhile, MW-1 and MW-2 levels have shown a slight rising trend, currently at a level of approximately 0.40 mg/L. (See Attachment 11.)

These recent concentrations reported in the shallow aquifer are similar to samples collected in the 1980's from deeper neighboring wells, and to results from the deep monitoring well sampled in the 1990's.

Shallow Aquifer – Water Quality vs. Rainfall

No significant correlation between ground water quality and rainfall was observed. Weak positive correlations were found between chlorides in MW-3 and previous 3-month rainfall, and between sulfate levels in MW-3 and previous 3-month rainfall. Therefore, higher chloride and sulfate concentrations may have a slightly increased chance of occurring following times of more rain. (See Attachments 12 and 13.)

Comparison to Effluent Data and Effluent Limits

Effluent Limits in WDR Order No. 97-75:

Parameter (units)	Mean	Maximum
Suspended Solids (mg/L)	60	100
Settleable Solids (mg/L)	0.2	0.5
pH	Within the range 6.5 to 8.4	
Dissolved Oxygen (mg/L)	Minimum 1.0	

None of the water quality constituents noted above were monitored in shallow ground water samples collected between 2000 and present.

Comparison to Ground Water Limitations

Ground water limitations in WDR Order No. 97-75:

1. The treatment or discharge shall not cause nitrate concentrations in the ground water down gradient of the disposal facilities to exceed 10.0 mg/L (as N).

2. The discharge shall not cause a significant increase of mineral constituent concentrations in underlying ground waters, as determined by comparison of samples collected from wells located up gradient and down gradient of the disposal area.

3. The discharge shall not cause concentrations of chemicals and radionuclides in ground water to exceed limits set forth in Title 22, Chapter 15, Articles 4, 4.5, 5 and 5.5 of the California Code of Regulations.

Nitrate

If the Total Nitrogen (Tot-N) reported in sampled ground water is assumed to consist primarily of nitrate, then it would appear that nitrate levels in ground water are regularly exceeding the 10 mg/L limit for nitrate as nitrogen. (See Attachment 9) However, it is questionable whether these exceedances should be considered a violation, because "ground water" in this case appears to be primarily "perched" plant effluent and may not represent deeper groundwater supplies.

Mineral Constituent Concentrations

Monitoring wells MW-1 and MW-2 were placed adjacent to locations where treated wastewater had been percolating since 1985. Monitoring well MW-3 was installed approximately 1000 feet west of the pre-2000 infiltration basins, and approximately 400 feet west of the current infiltration basins. Therefore, changes in MW-3 may represent changes that are "caused" by District discharges of treated wastewater. If this cause and effect relationship is true, then it appears that Southland WWTF discharges are causing increases in total dissolved solids (TDS), sodium (Na), chlorides (Cl), total nitrogen (Tot-N), sulfate (SO_4), and boron (B) in shallow ground water beneath the infiltration basins.

Title 22 Constituents

Title 22, Chapter 15, Articles 4, 4.5, 5 and 5.5 of the California Code of Regulations set Maximum Contaminant Limits (MCLs) for protection of drinking water for inorganic constituents, organic constituents, trihalomethanes, and radioactive constituents, respectively. Because none of these constituents were measured in ground water samples collected from the shallow aquifer, no assessment of impacts is possible.

Comparison to the Basin Plan

The Regional Board has established water quality guidelines for selected ground waters, including the Lower Nipomo Mesa Sub-area of the Santa Maria ground water sub-basin, where the WWTF is located. The median ground water objectives "are intended to serve as a water quality baseline for evaluating water quality management in the basin."[13] These objectives and recently observed values in the shallow aquifer are listed below.

Region 3 Basin Plan Ground Water Objectives (mg/L)

Constituent	Objective	Levels in Shallow Aquifer years 2005 and 2006
Total Dissolved Solids (TDS)	710	1000 – 1200
Sodium (Na)	90	~ 200
Chlorides (Cl)	95	200 – 275
Nitrogen (N)	5.7	5 – 35
Sulfate (SO4)	250	250 – 350
Boron (B)	0.15	0.3 – 0.5

Constituent levels in the shallow ground water clearly exceed s these water quality objectives.

Conclusions and Recommendations

There are at least two aquifers beneath the plant that have historically had different water quality. Recent data (since 2000) appear to capture only the "shallow" aquifer. Based on the monitoring results presented herein, the shallow aquifer appears to consist of "perched" treatment plant effluent. Impacts to the deeper aquifer are of more concern than impacts to the shallow aquifer, and therefore the deeper aquifer should also be monitored.

We recommend conducting a hydrologeological investigation in order to determine the characteristics of these two aquifers in the vicinity of the plant, and to determine the fate of water from the "shallow" aquifer.

The District should continue monitoring the existing shallow aquifer wells, but should either use the existing nearby deep aquifer wells for additional monitoring or should drill new deep monitoring wells as recommended by a qualified hydrogeologist. (The existing Walsh Windmill and Ioimi wells may be suitable as "deep" aquifer monitoring wells.)

[13] Regional Water Quality Control Board, region 3, Basin Plan, Chapter 3.

If new monitoring wells are drilled, we also recommend collecting deep soil samples in the unoccupied southwest portion of the property, in anticipation of future percolation ponds.

The elevation of the reference marks for the existing monitoring wells and piezometer should be determined. This data can then be used to verify the "effluent mounding" which has been previously noted at the WWTF. Sampling for nitrate and nitrite, in ground water should be incorporated into the monitoring program. The present monitoring program includes total nitrogen, nitrate + nitrite, and Kjeldahl nitrogen (the sum of free ammonia and organic nitrogen). Sampling and analysis should be conducted on a quarterly basis, at a minimum.

Sampling for the Title 22 drinking water constituents is needed if the District wishes to determine compliance with the Title 22 ground water limitations in WDR Order No. 97-75.

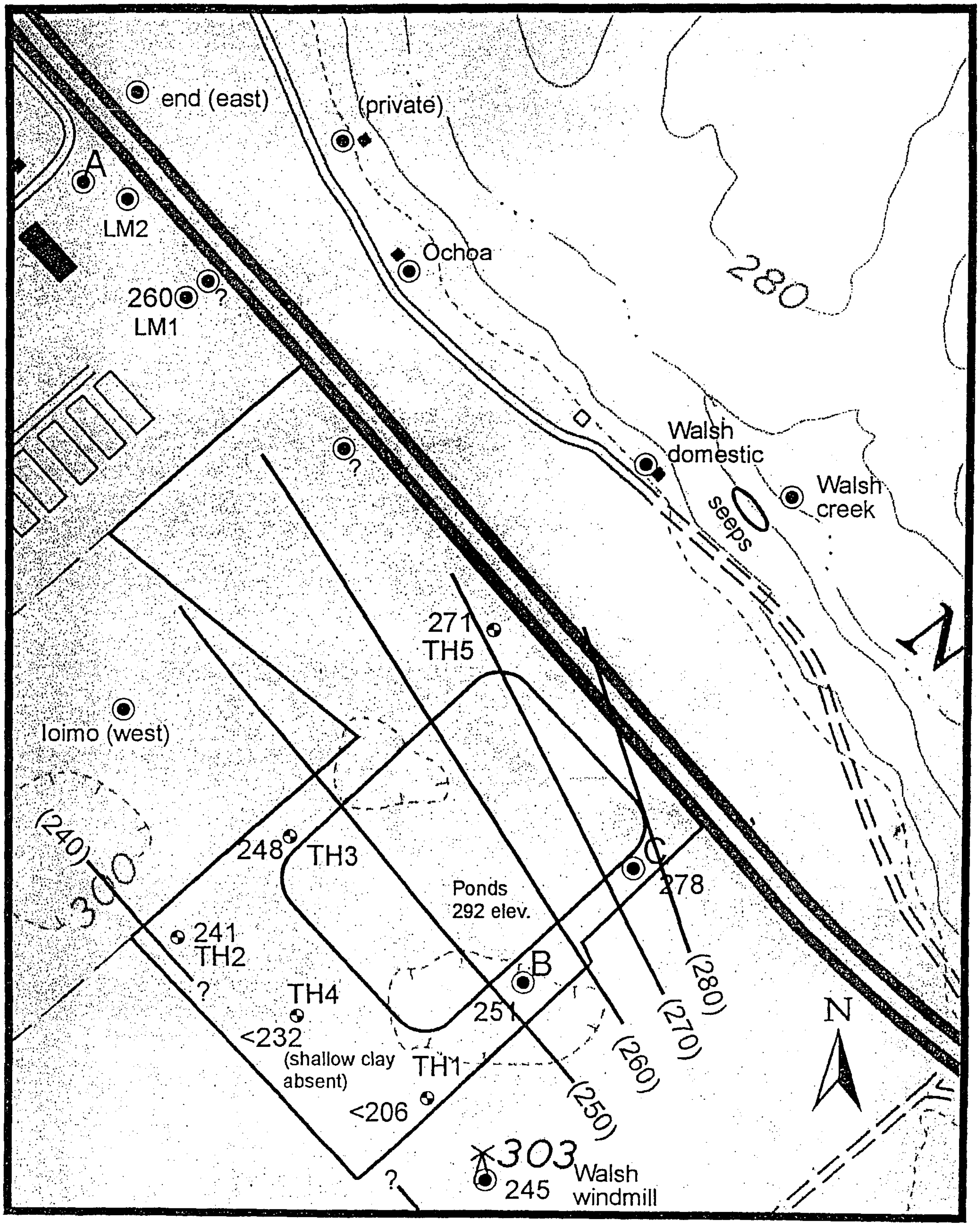
Boyle Engineering Corporation

M. a. McE

Malcolm McEwen, PE
Senior Engineer

19996.37/MM /LETTER REPORT TO BRUCE BUEL.DOC

Attachment 1



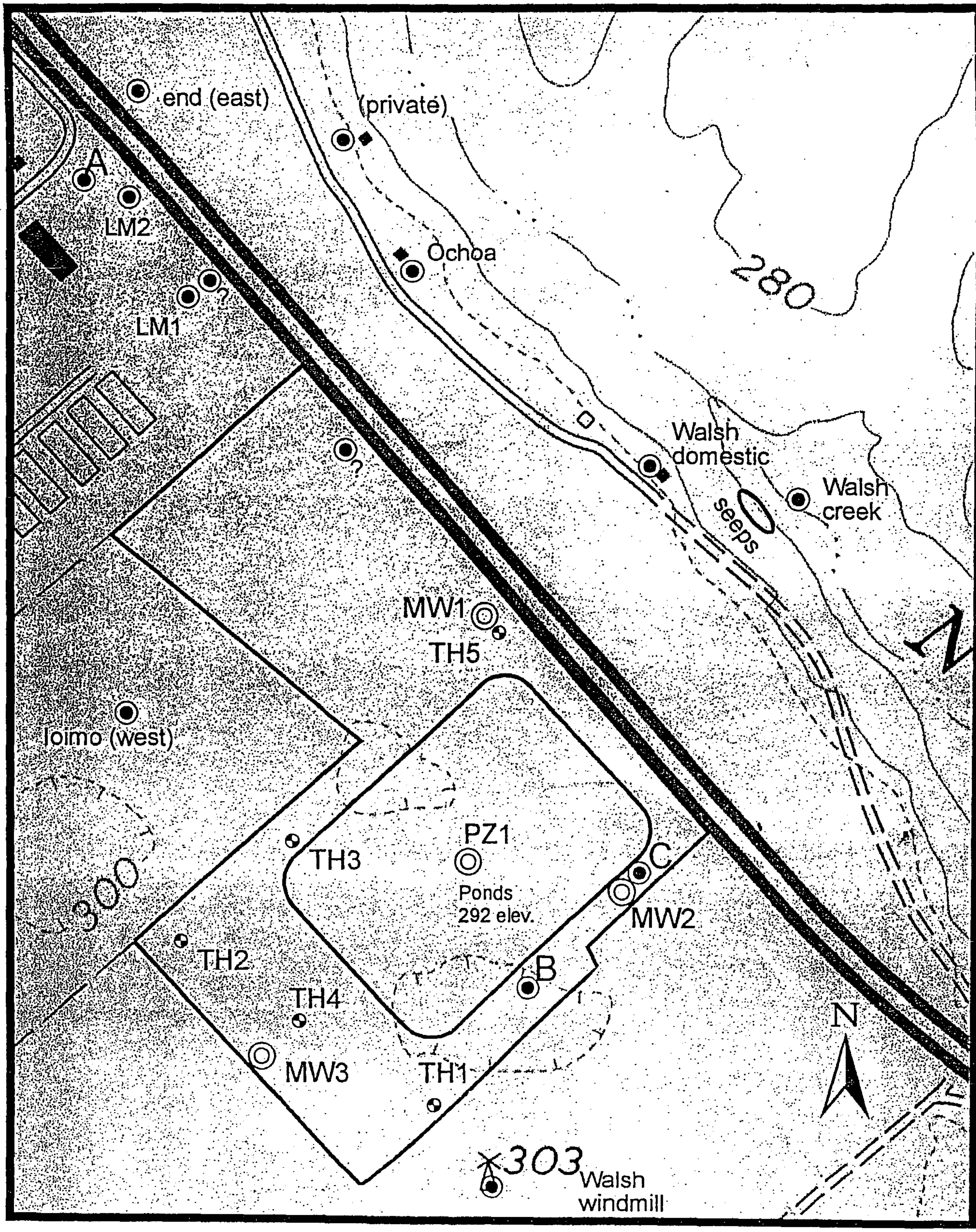
Base map: USGS Topo, Nipomo
Map Scale: 1 inch = 500 feet

Figure 1

Top of first clay
Nipomo CSD Percolation Ponds
Cleath & Associates

(240) ———— Inferred elevation contour on top of first clay in feet above sea level

Attachment 2

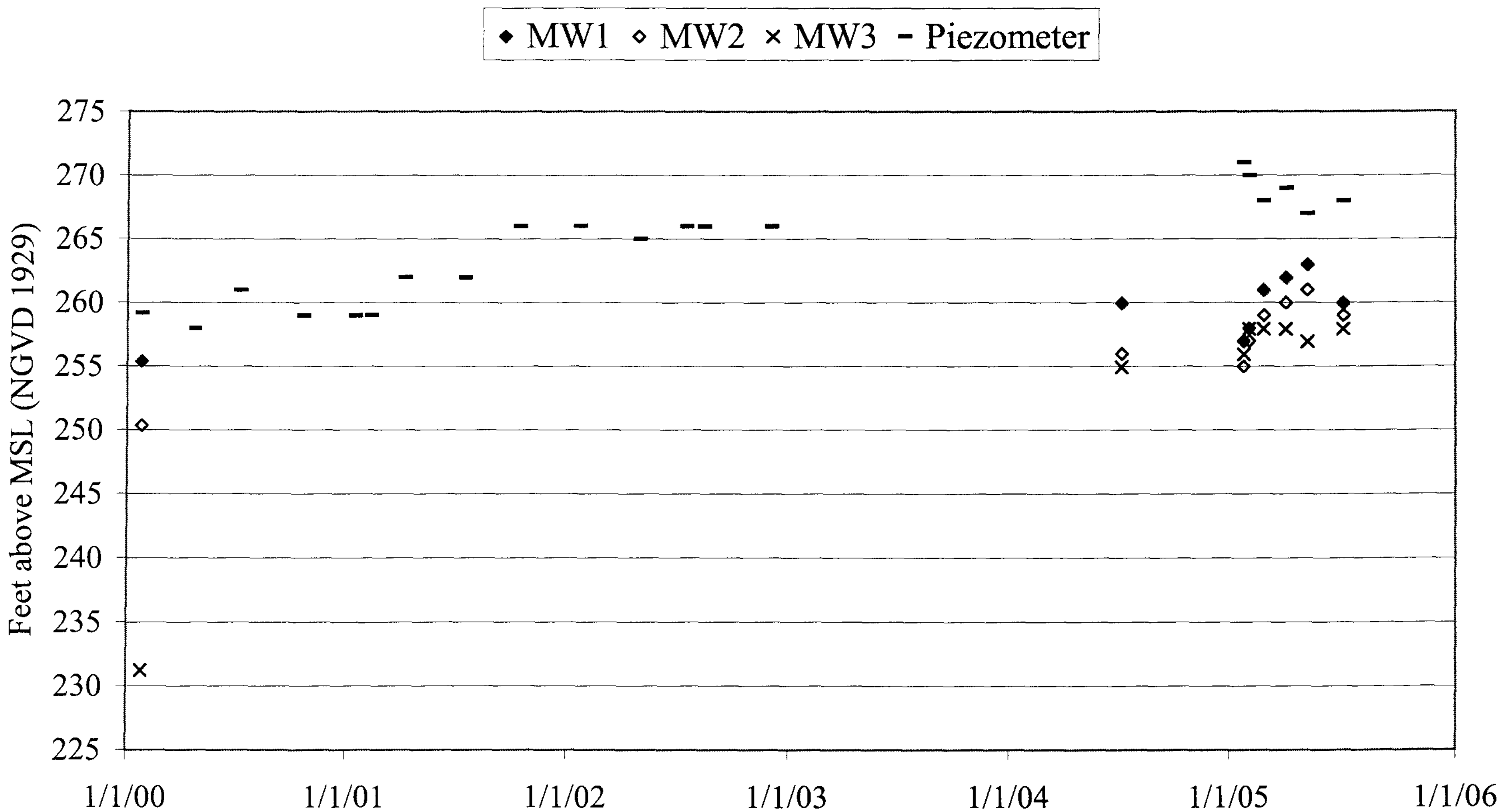


Base map: USGS Topo, Nipomo
Map Scale: 1 inch = 500 feet

Figure 3

Proposed monitoring well locations
Nipomo CSD Percolation Ponds
Cleath & Associates

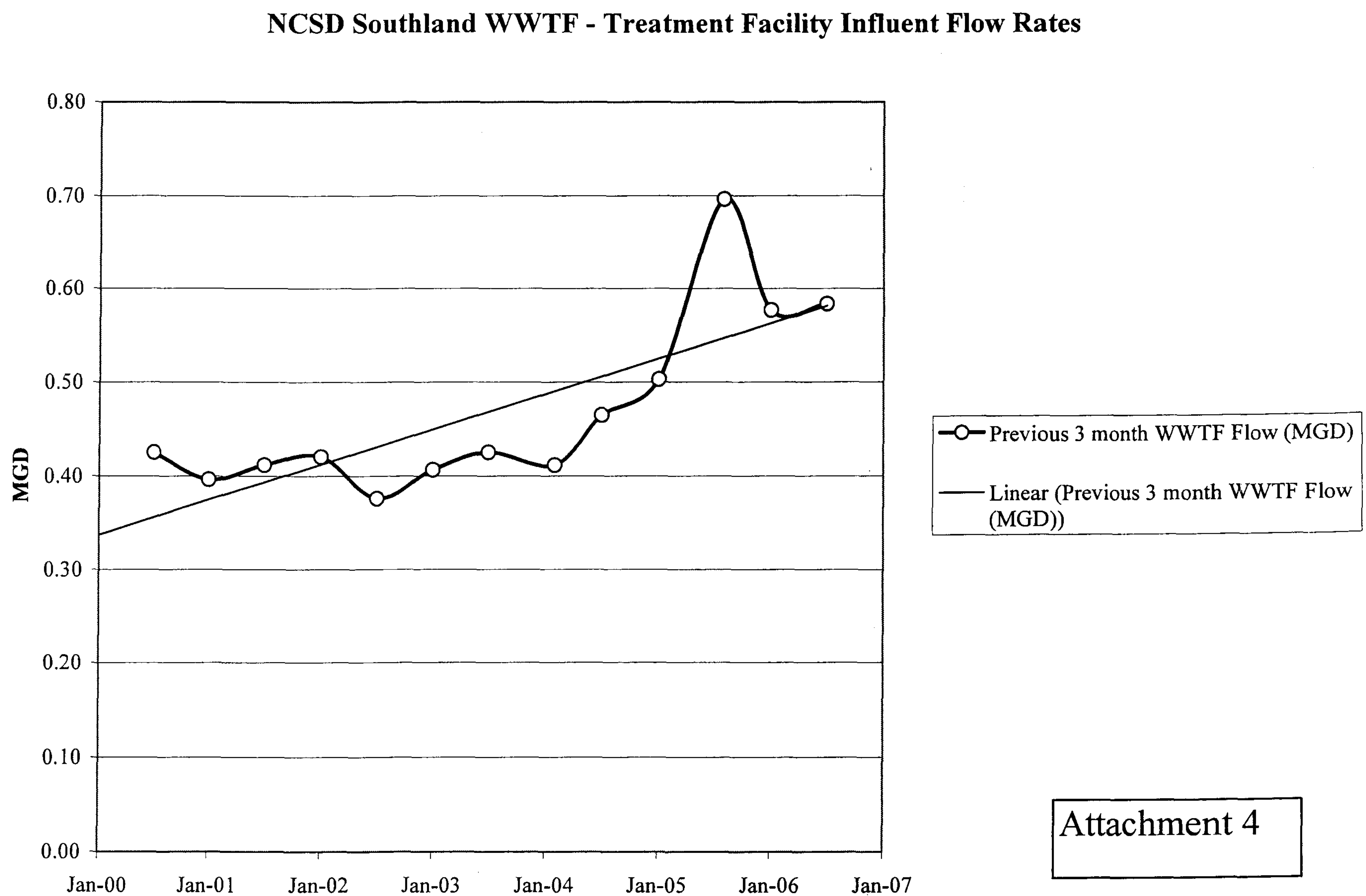
Water Surface Elevations - Shallow GW Monitoring since 2000



Approximate water surface elevations were calculated from depths reported by NCSD, and by approximate ground elevations at monitoring wells:
MW1: 300 ft, MW2: 300 ft, MW3 302 ft, PZ 298 ft.

Attachment 3

WWTF Flow vs Time



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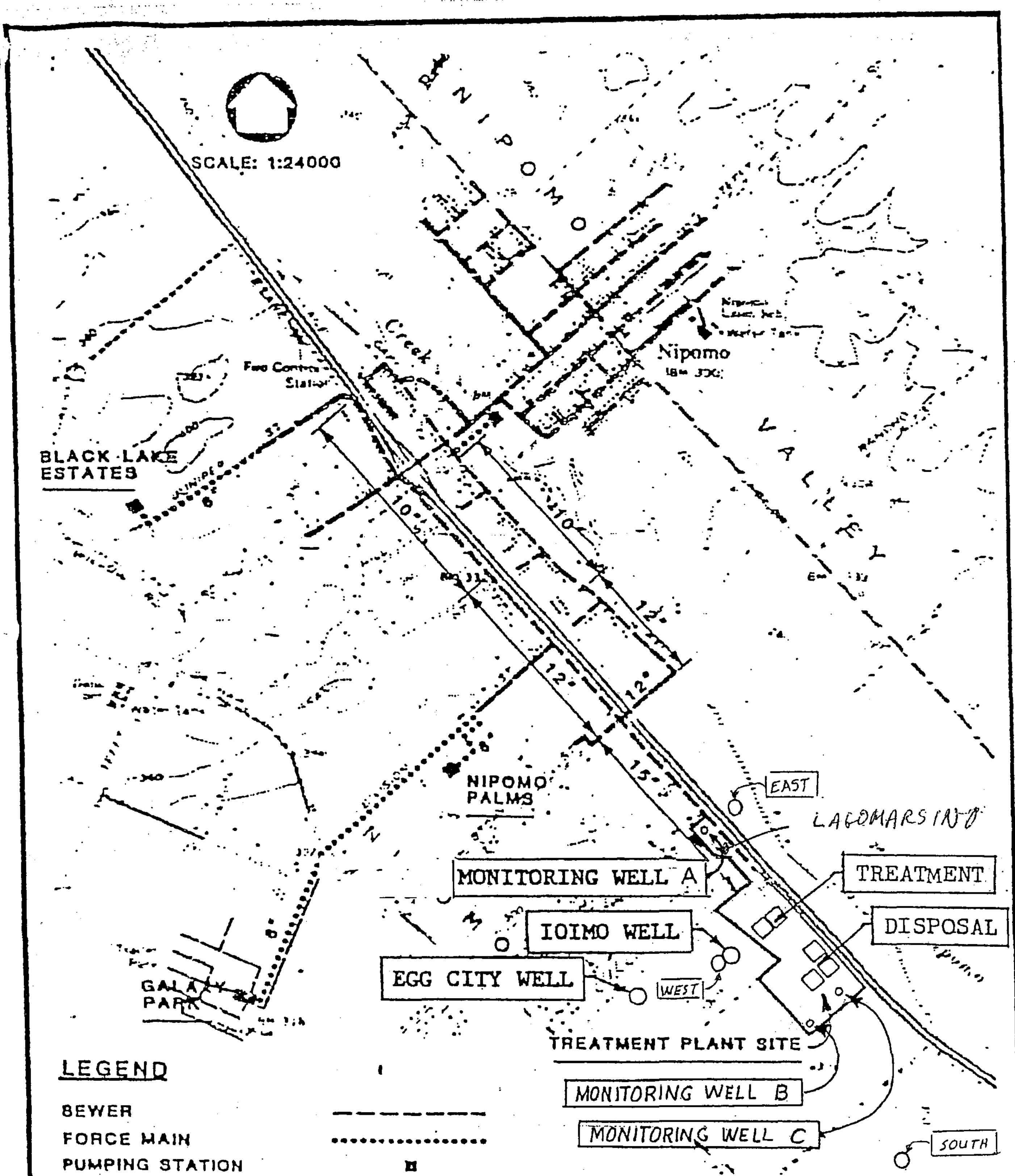


NIPOMO COMMUNITY SERVICES DISTRICT

Attachment 5

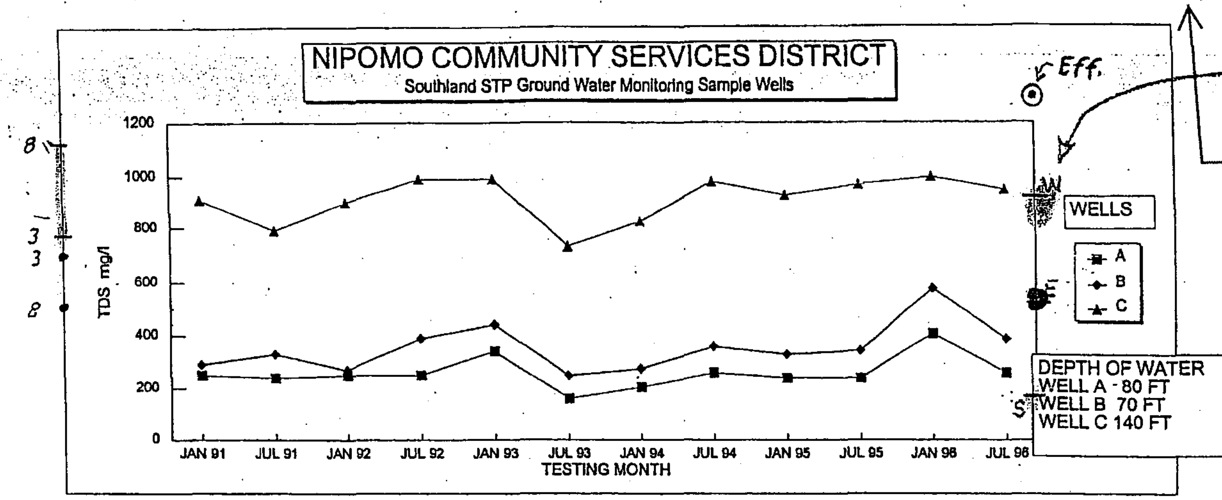
Source: Attachment to Letter from Cleath & Associates to Doug Jones, 5/22/97

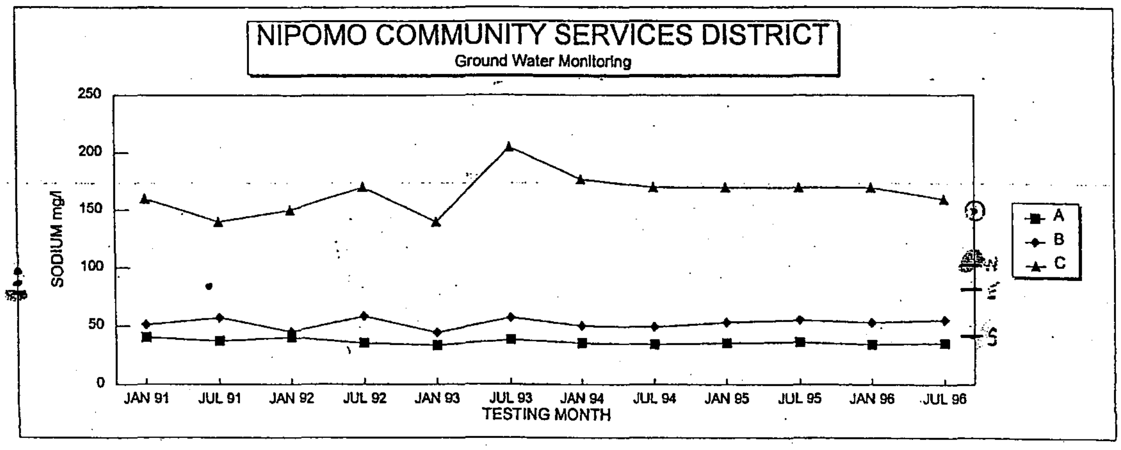
IOMIO WELL
• EGG CITY WELL } Sample in 198? ; MARCH(3) & AUG(8).

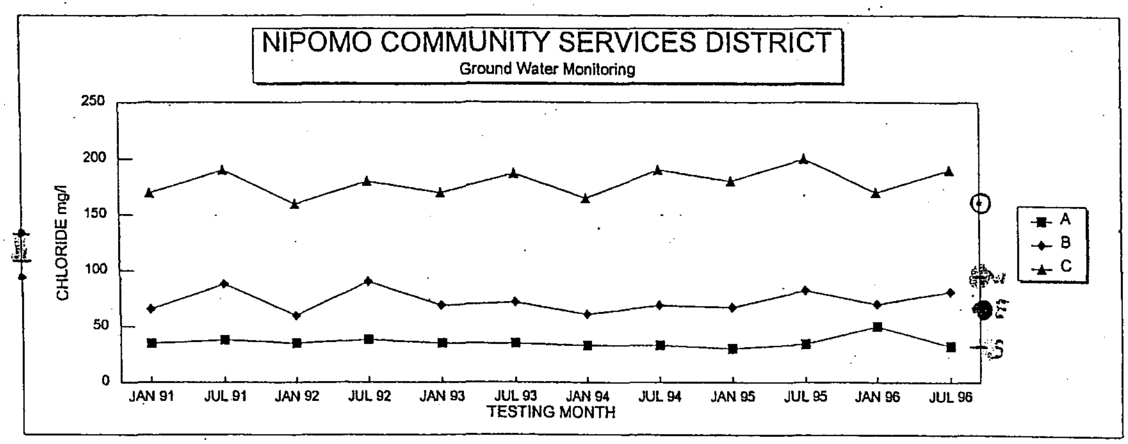
Attachment 5

Sample of off site wells (East, West & South)

See Attachment 5 map



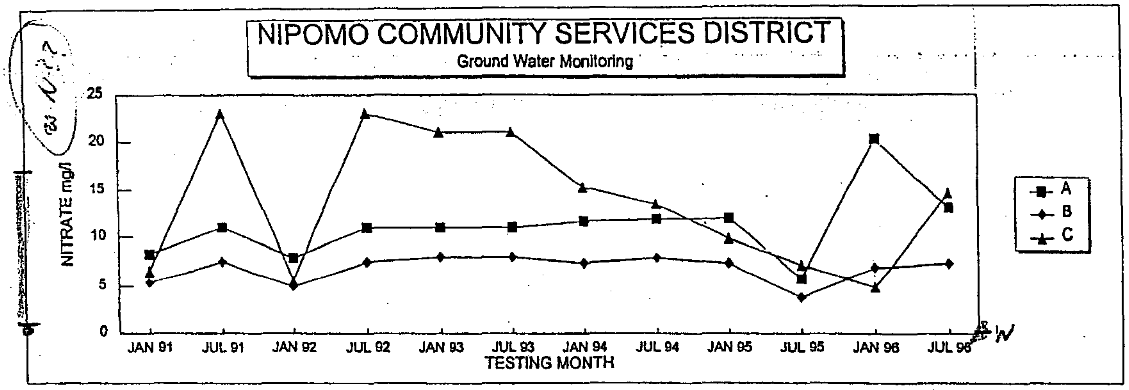


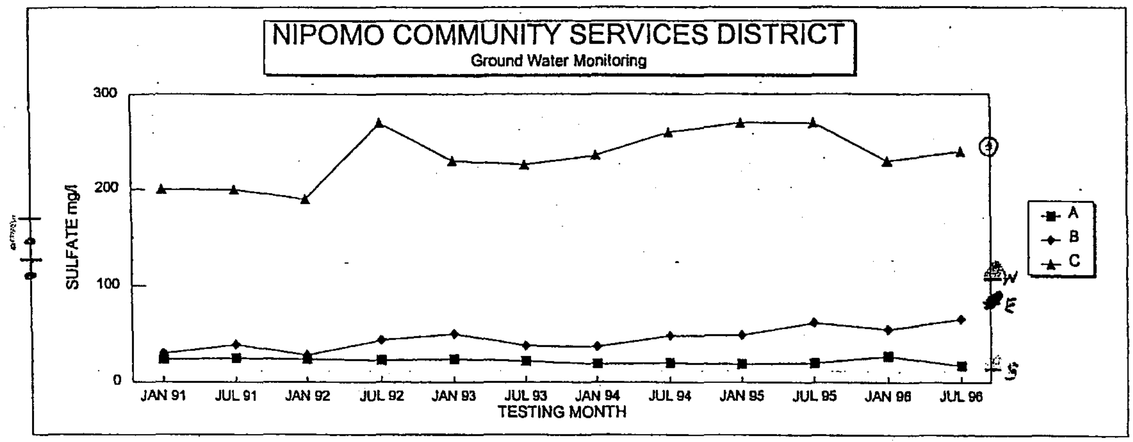


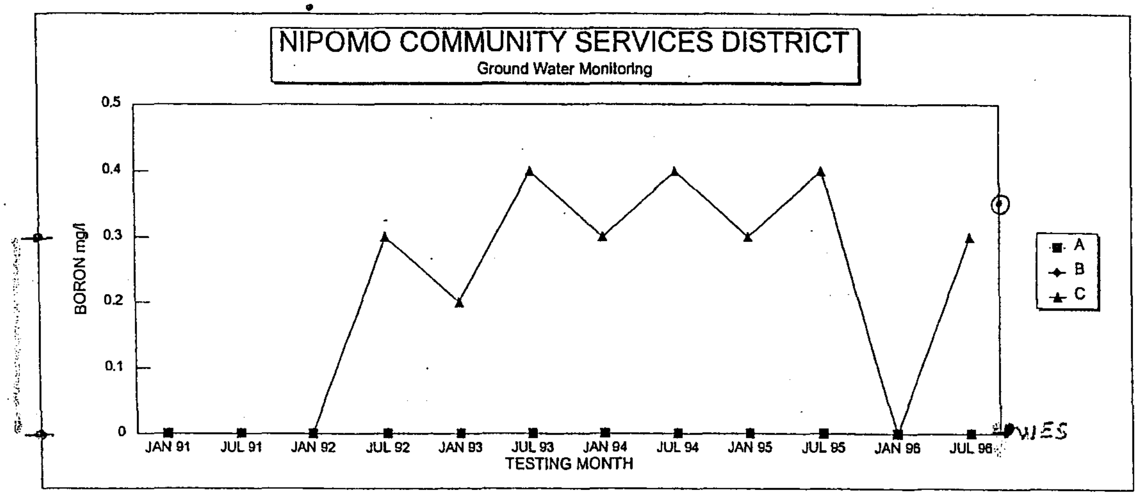
Egg City well

41 S Eff. (As NO_3)

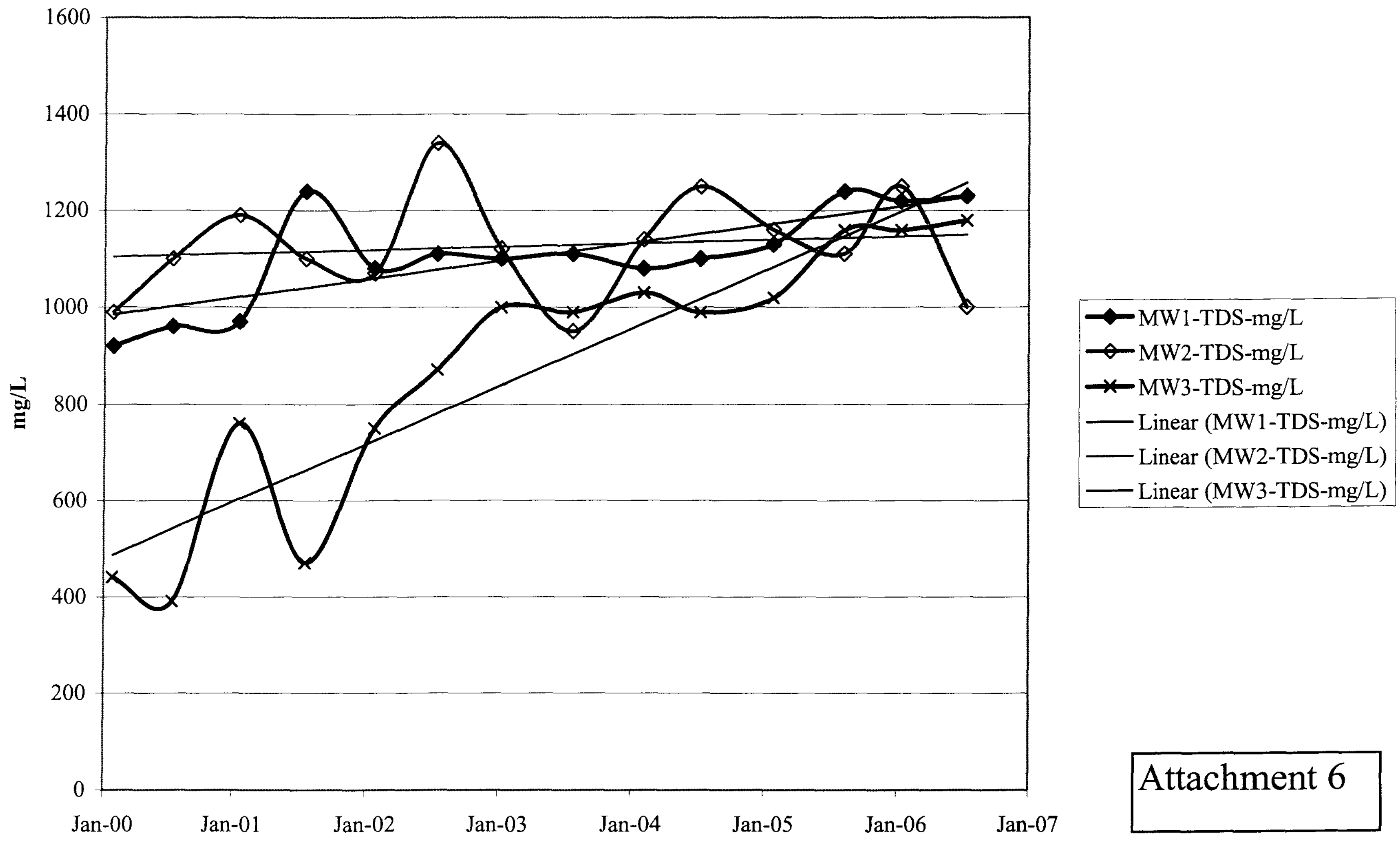
Attachment 5





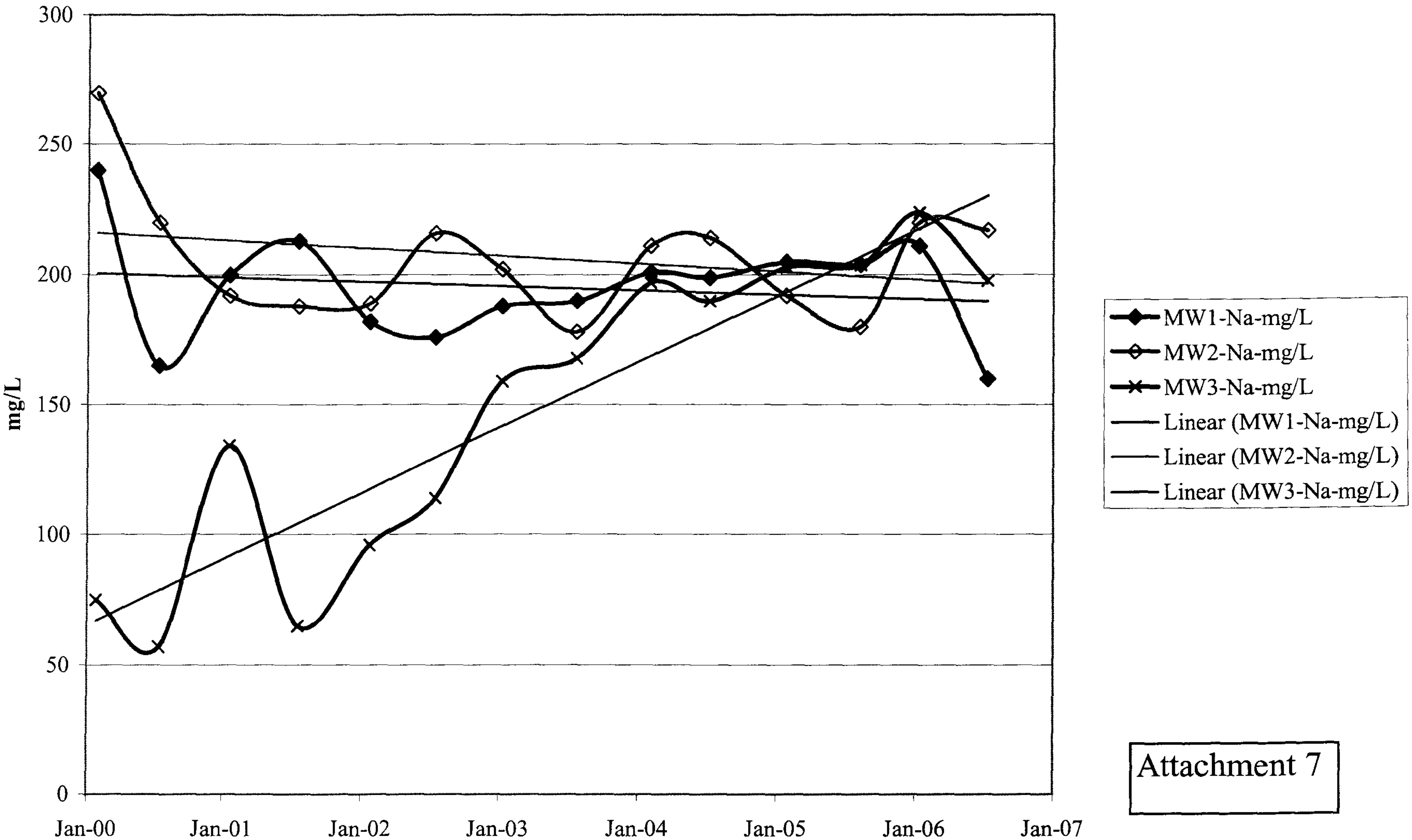


NCSD Southland WWTF - Ground Water Total Dissolved Solids (TDS)



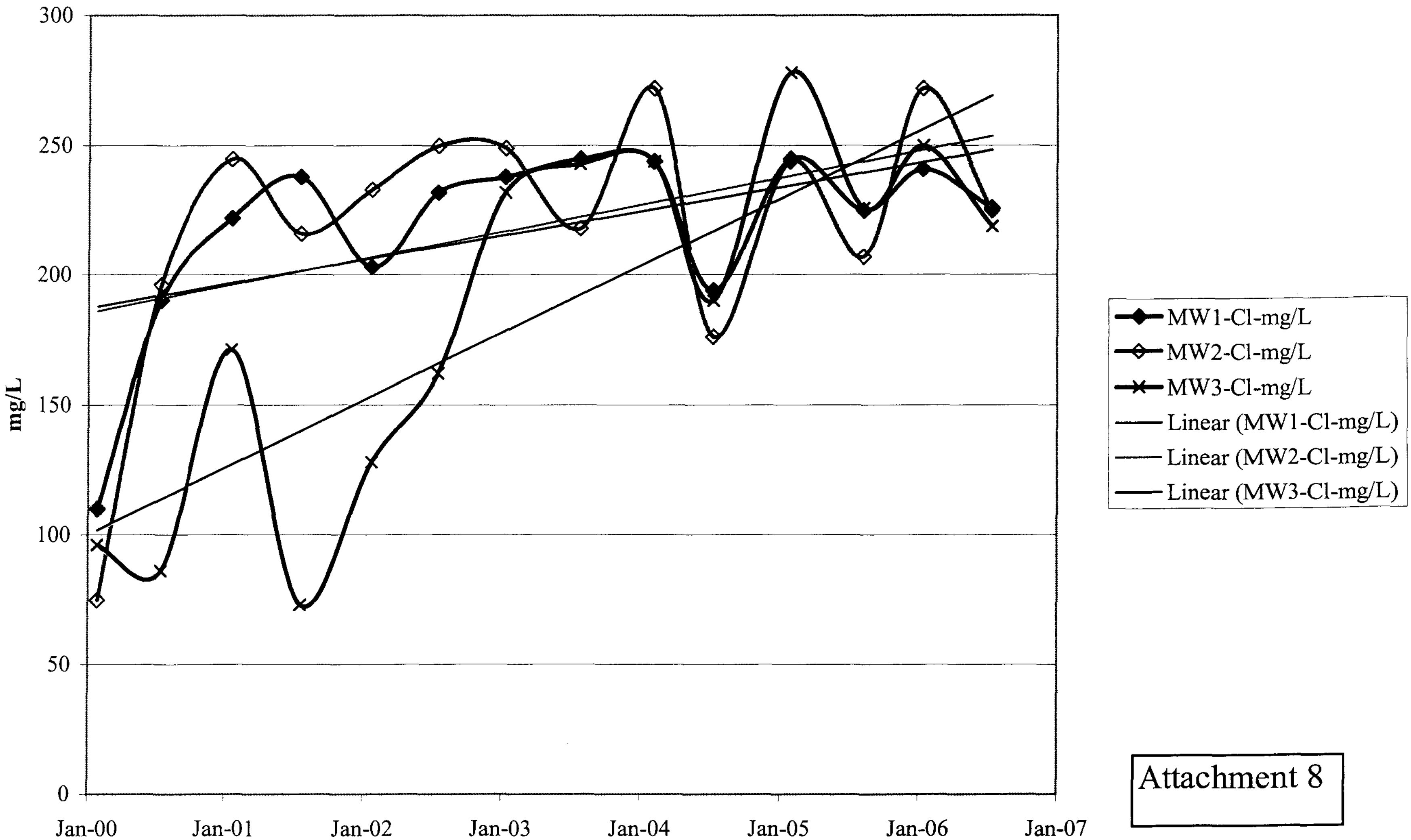
Attachment 6

NCSD Southland WWTF - Ground Water Sodium (Na)



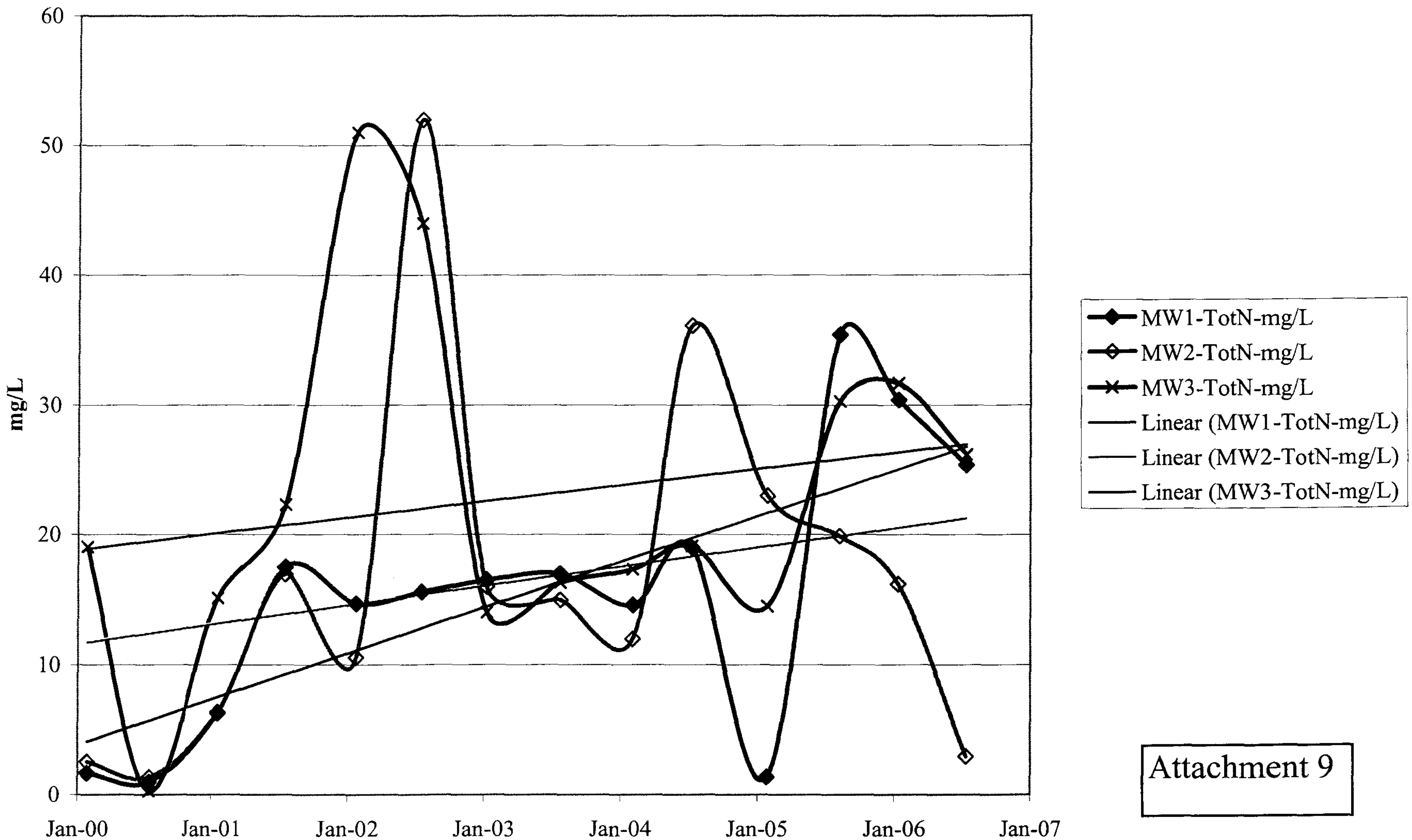
Attachment 7

NCSD Southland WWTF - Ground Water Chlorides (Cl)



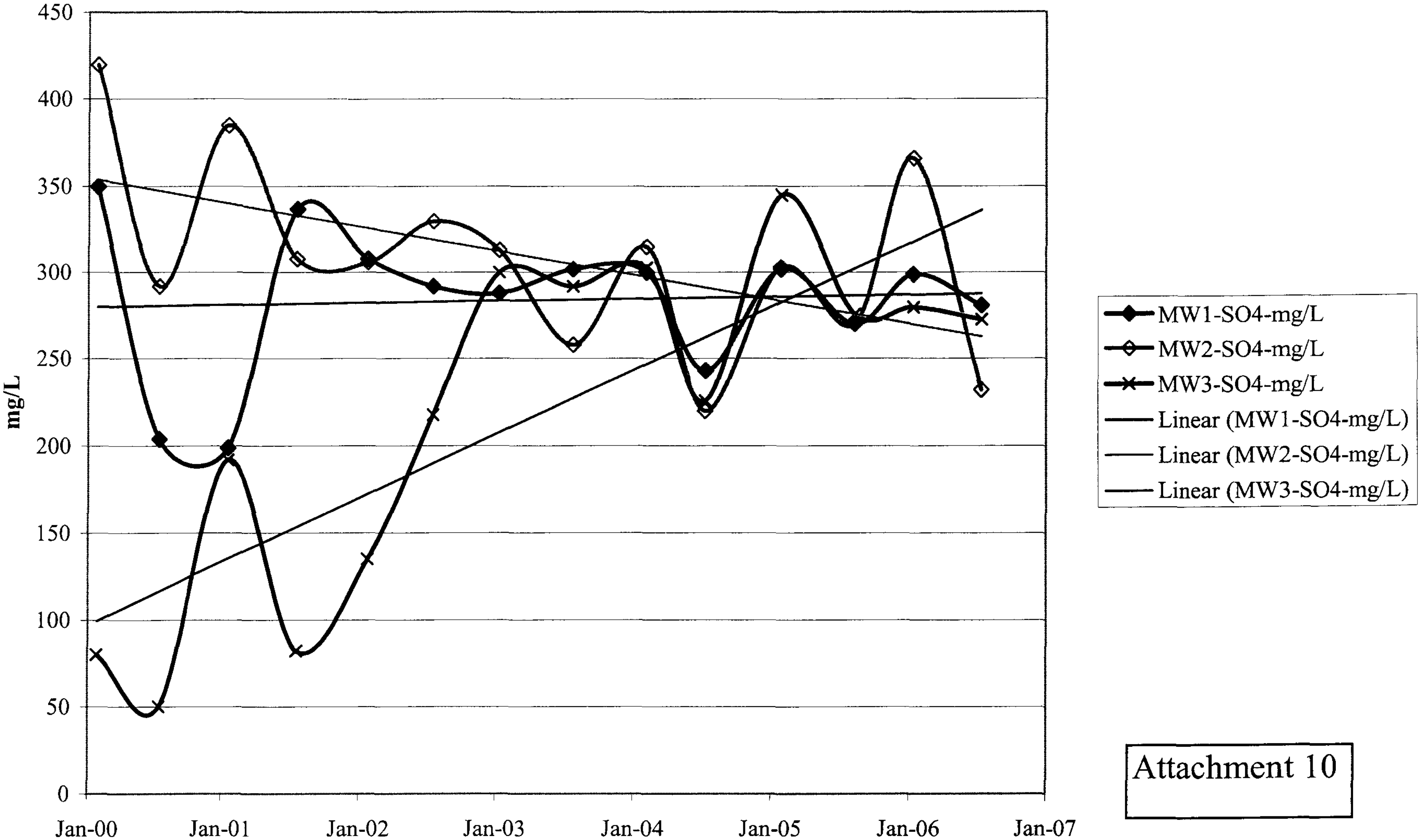
Attachment 8

NCSD Southland WWTF - Ground Water Total Nitrogen (TotN)



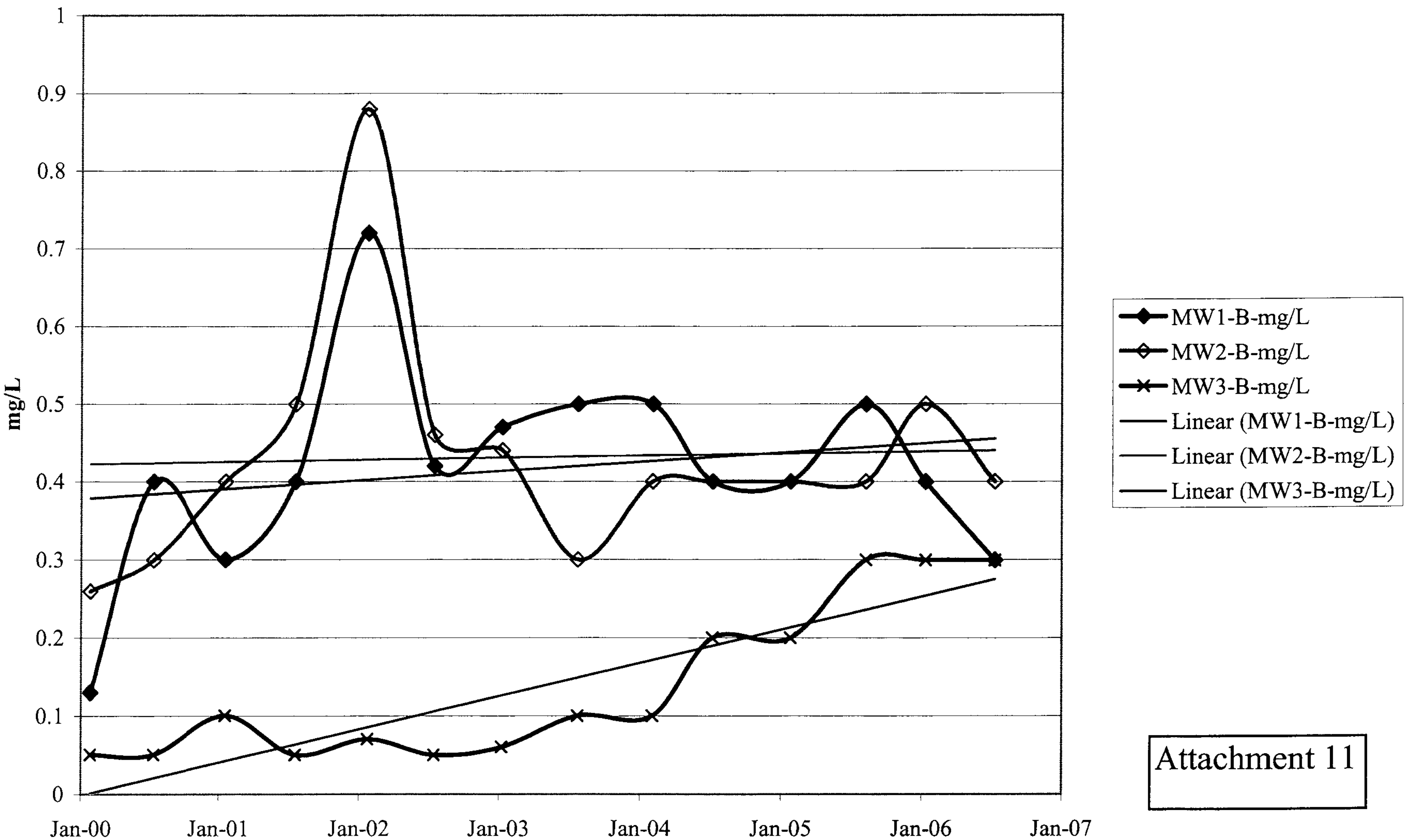
Attachment 9

NCSD Southland WWTF - Ground Water Sulfate (SO_4)



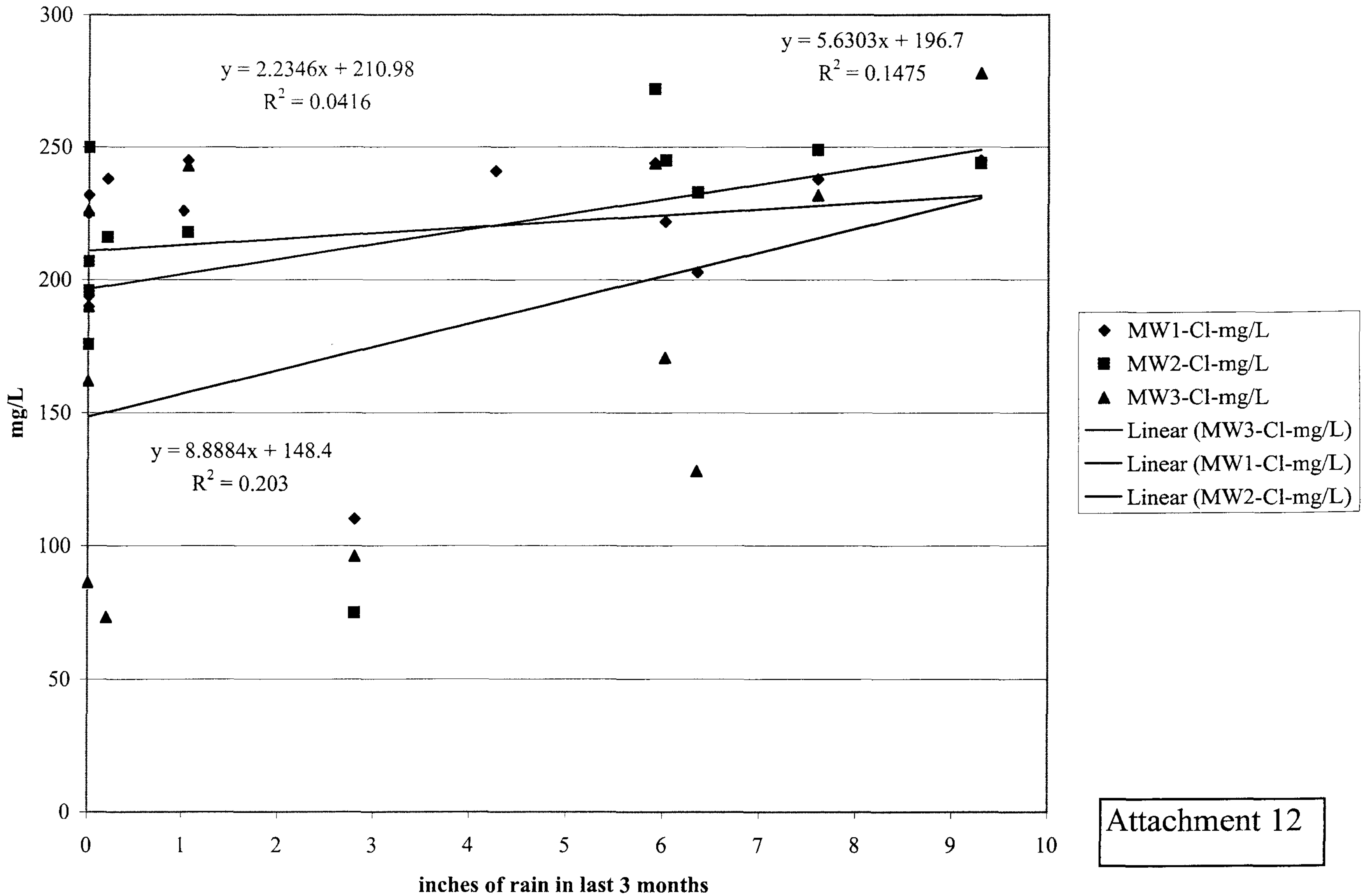
Attachment 10

NCSD Southland WWTF - Ground Water Boron (B)



Attachment 11

GW Cl vs Rainfall



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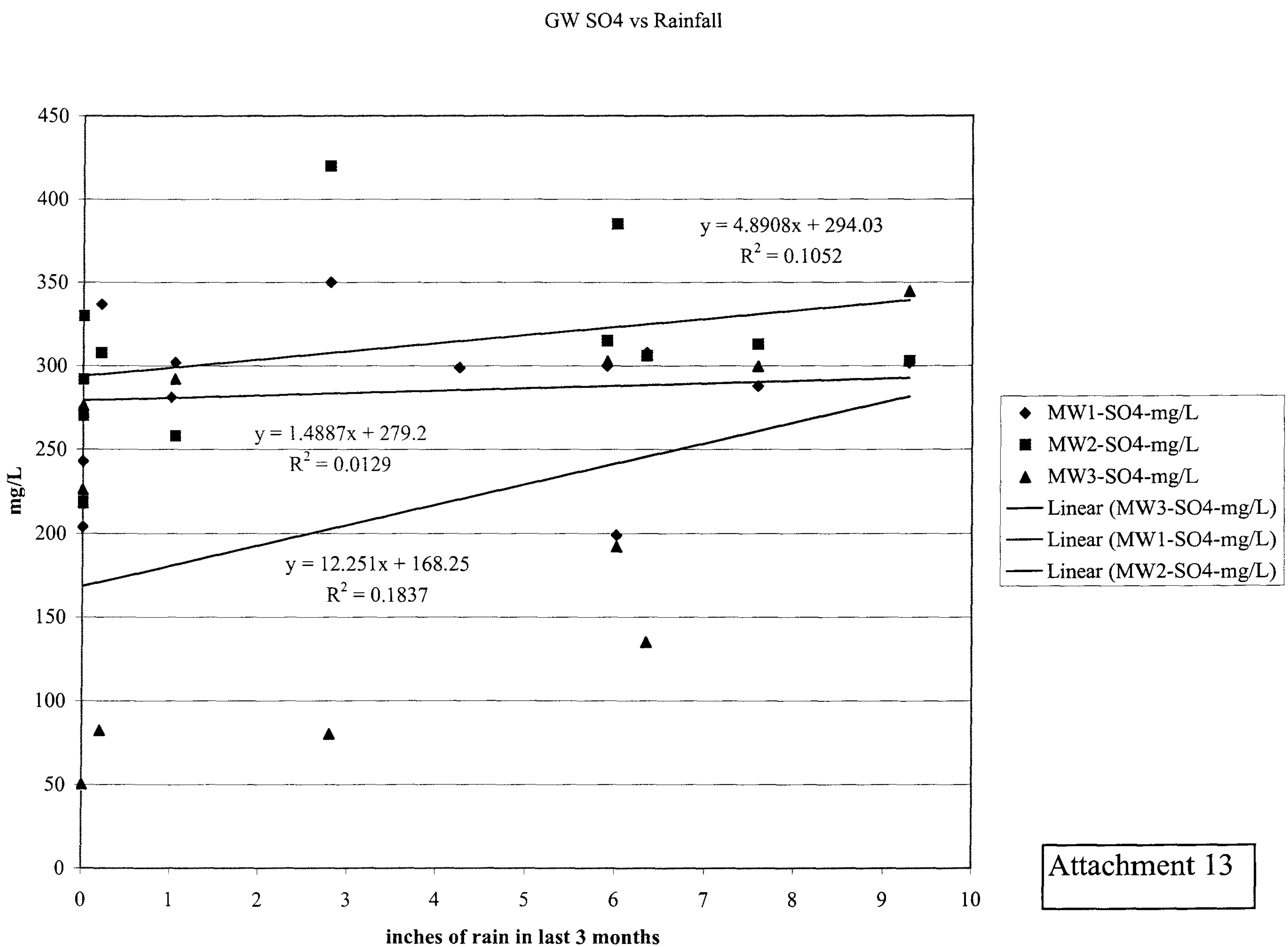
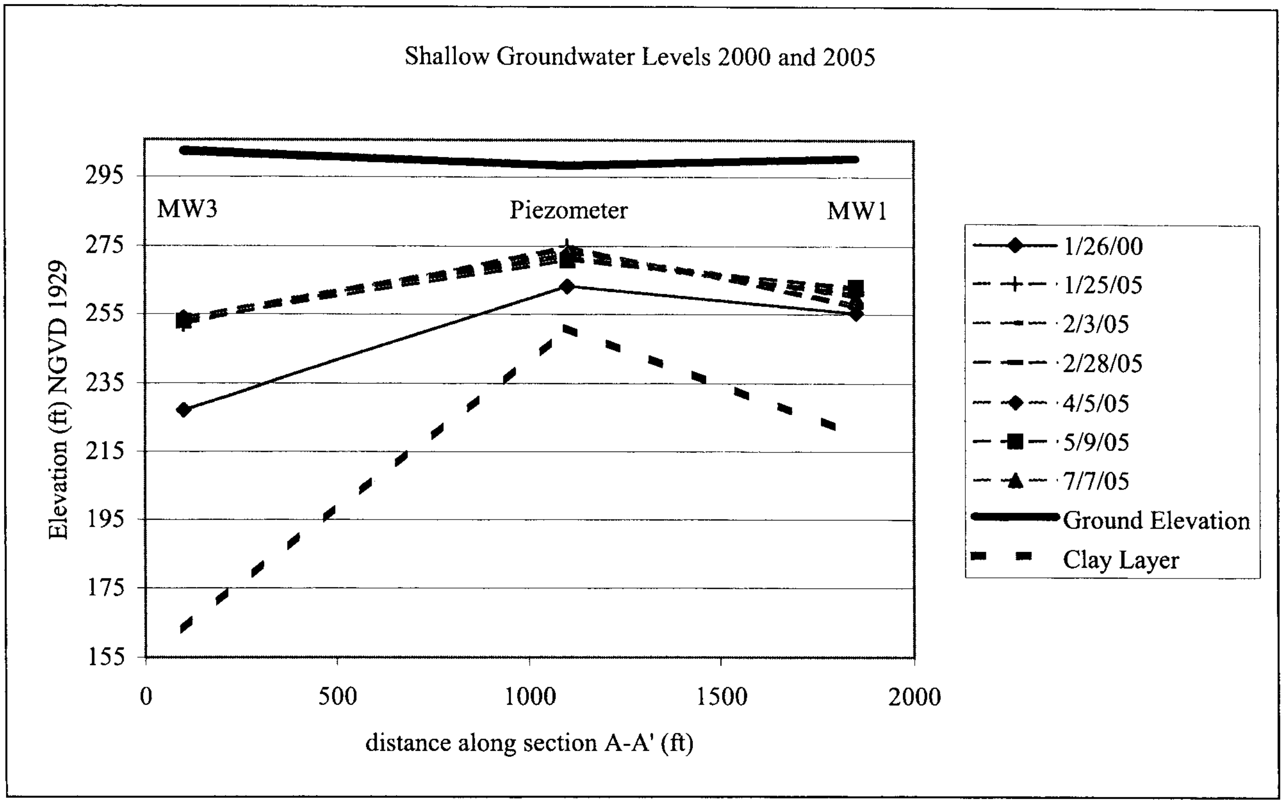
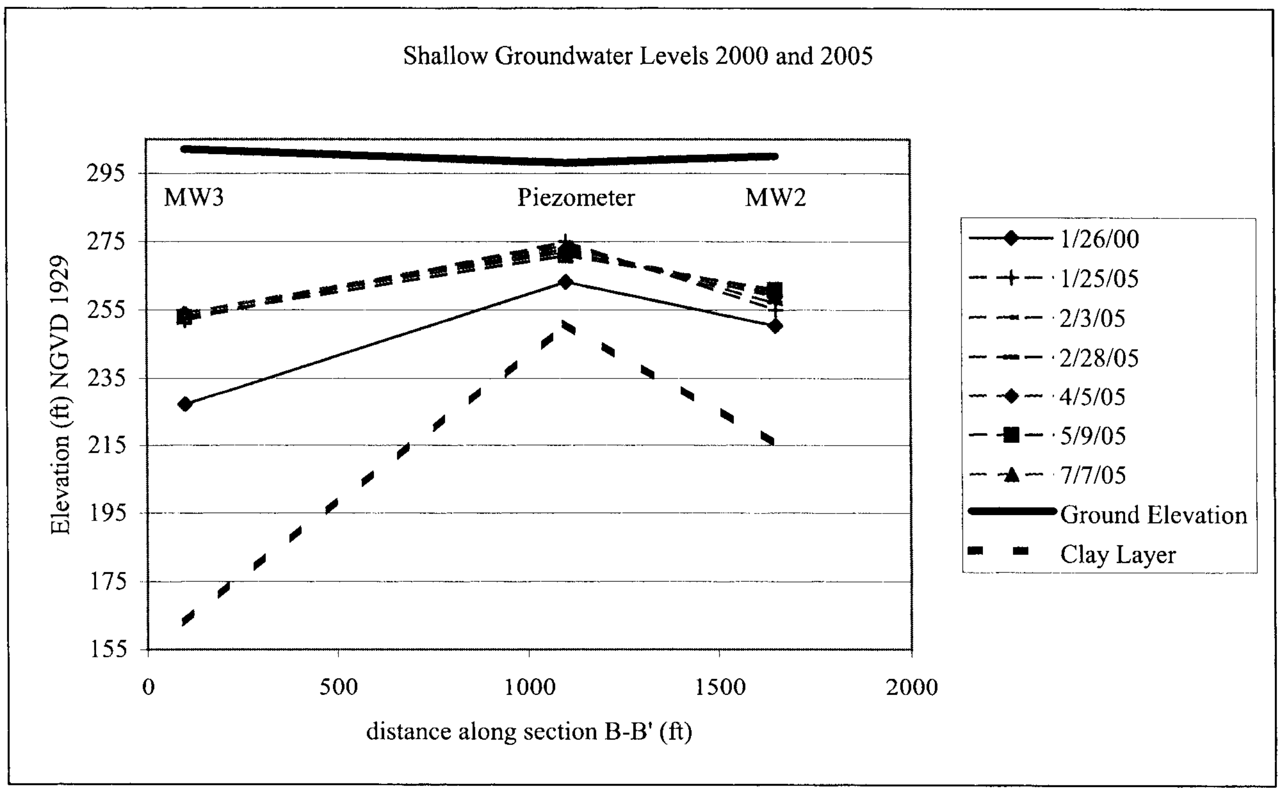


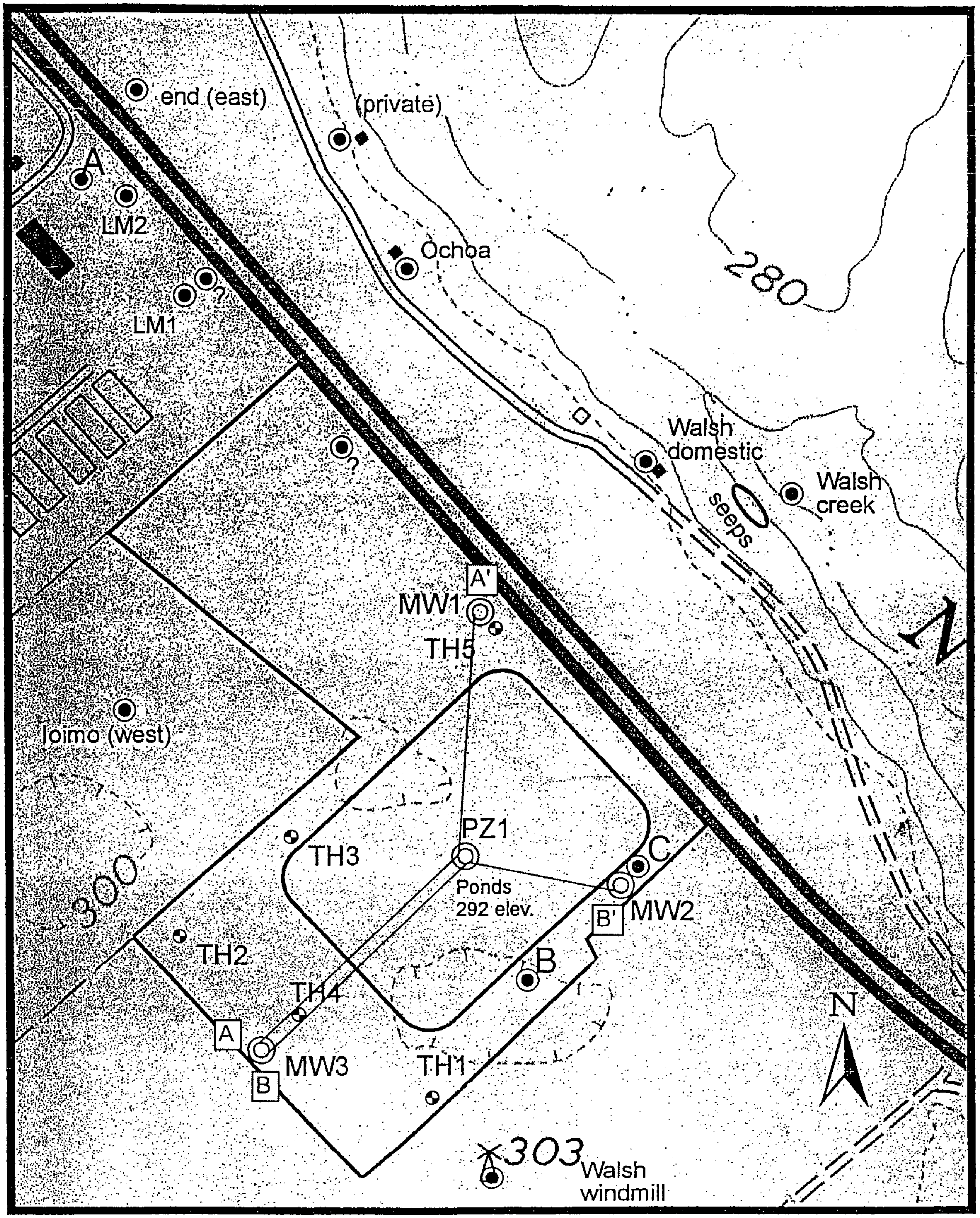
Attachment 13

Attachment 14





Attachment 15



Base map: USGS Topo, Nipomo
Map Scale: 1 inch = 500 feet

Section Lines for Displaying Shallow Ground Water Elevations, 2000 and 2005

Figure 3

Proposed monitoring well locations
Nipomo CSD Percolation Ponds
Cleath & Associates