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June 27, 2006

Project No.: H0562C

California Regional Water Quality Control Board

Central Coast Region

895 Aero Vista Drive, Suite 101

San Luis Obispo, CA 93401

VIA FACSIMILE

Attn: *Mr. Hector Hernandez*

Re: Review of Olin First Quarter 2006 Groundwater Monitoring Report.

Dear Mr. Hernandez:

On behalf of the City of Morgan Hill (City), WorleyParsons Komex has reviewed the report by Olin Corporation (Olin) titled "First Quarter 2006 Groundwater Monitoring Report, Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California" (the Report). Our review focused on the components of the report related to the northeast flow situation wherein perchlorate from the Olin/Standard Fusee site (the Site) has impacted the municipal water supply of the City of Morgan Hill ("City"). Our review does not reference the various other potential perchlorate sources which at this time have not been shown to either exist, impact groundwater (in particular the Deep Aquifer), or impact any well operated by the City. In particular we reviewed in detail Appendix E, Northeast Groundwater Flow Assessment – Update (Appendix E). The main findings of our review are discussed below. For reader convenience, cited figures from the Report are included in **Attachment A** of this document.

The data in the First Quarter Report serve to further substantiate that not only does groundwater flow to the northeast occur in the Middle Deep Aquifer, but new data only now available in this quarter show that northeasterly flow is even stronger in the Lower Deep Aquifer than in the Middle Deep Aquifer. Given this, in combination with historical data dating back to 1916 indicating northeast groundwater flow even before city pumping began; the increasing numbers of wells northeast of the Site with perchlorate detections above 4 micrograms per liter ($\mu\text{g/L}$); and, rising perchlorate concentrations in the northeast monitoring wells, a substantial amount of data has and does now exist to confirm the northeast migration of perchlorate in groundwater originating from the Olin Site.



Additional investigation is not needed to prove this northeast migration, however the northeast plume of perchlorate from the Olin Site does require additional delineation in the Deep Aquifer zones in order to characterize the full extent of contamination, and to develop a remedial strategy.

Our review of the Report data has identified several key findings, which are summarized below:

- a) Perchlorate was detected at, or above 4 micrograms per liter (ug/L) in the Deep Aquifer Zone in the following four wells (Figure E19): MP-04-251 (4.0 ug/L), MP-04-273 (4.2 ug/L), PZ-02-315 (4.0 ug/L) and PZ-03-427 (4.4 ug/L). The plume of perchlorate in Deep Aquifer Zone groundwater to the northeast of the Olin Site has not been delineated to the north, northeast, or northwest of the present detections of perchlorate.

- b) Perchlorate concentrations in the multiport wells and piezometers in the northeast area are clearly increasing. In the Upper Deep Aquifer Zone, concentrations are increasing in seven of nine multiport wells; in the Middle Deep Aquifer Zone, concentrations are increasing in three of four multiport wells and/or piezometers, and also in one of two piezometers in the Lower Deep Aquifer Zone. The trends are clear in the detailed summary of perchlorate data provided in the following Table:

NORTHEAST PERCHLORATE RESULTS MORGAN HILL

Well	Aquifer	2005Q3	2005Q4	2006Q1	TREND
MP-01-245	Deep Upper	ND	4.1	ND	?
MP-01-262	Deep Upper	ND	2.6J	3.8J	Increasing
MP-02-235	Deep Upper	ND	ND	2.7	Increasing
MP-02-255	Deep Upper	ND	2.9J	3.8J	Increasing
MP-02-285	Deep Upper	ND	ND	ND	?
MP-03-255	Deep Upper	ND	ND	2.8J	Increasing
MP-03-280	Deep Upper	ND	ND	3.4J	Increasing
MP-04-251	Deep Upper	ND	2.3J	4.0	Increasing
MP-04-273	Deep Upper	ND	3.3J	4.2	Increasing
MP-04-291	Deep Middle	ND	2.1J	3.5J	Increasing
PZ-01-333	Deep Middle	3.5J	3.5J	3.6J	Increasing
PZ-02-315	Deep Middle	ND	3.6J	4.0	Increasing
PZ-03-325	Deep Middle	ND	2.4J	ND	?
PZ-02-415	Deep Lower	ND	3.0J	2.8J	?
PZ-03-427	Deep Lower	ND	3.2J	4.4	Increasing

Notes: Perchlorate concentrations in ug/L; values above 4 ug/L PQL shaded

- c) Olin's use of groundwater level data from the City's long-screened supply wells in the Report is inappropriate and does not acknowledge the limitation in the use of such data, and



therefore provides a misleading representation of groundwater flow conditions to the northeast of the Olin Site.

- The City's water supply wells, as noted by Olin, are screened over multiple aquifer-zones, with overall screened intervals typically between 200 and 300 feet in length (including the gravel-packed interval between screens). Wells Main #2 and Diana #1 are exceptions, with screened interval lengths of 45 and 106 feet, respectively. Consequently, water level measurements and corresponding hydraulic head data from these wells reflect an average over a relatively large depth interval. In contrast, the Olin multiport wells and piezometers represent hydraulic head measurements for a discrete depth since their screened intervals are only 10 feet or less. Under conditions of low vertical hydraulic gradient, the hydraulic head measurement from a long-screened well represents an average value that corresponds approximately to the mid-point of the screened interval. Consequently, the measured head value can be most reliably attributed to the mid-point elevation of the screened interval.
- In the Report, Olin has attributed hydraulic head values from the City's wells to multiple aquifer zones, rather than to the one best represented by the mid-point elevation. For example, Olin uses groundwater elevation data for the Diana #1, Dunne #2, San Pedro, and Nordstrom Park wells to represent hydraulic heads for the Upper, Middle and Lower Deep Aquifer Zones on Figures E5a, E5b, and E5c, respectively. This misrepresents the groundwater elevation in aquifer zones that are a substantial depth above or below the mid-point of the screened interval.
- As shown in the north-south cross section, Figure E20, major aquifer units to the Northeast of the Olin Site are relatively horizontal, and generally laterally continuous. Consequently, the elevation of the screened interval mid-point of the City's wells can be used as a check on whether a well is being appropriately included in mapping of groundwater elevations. In the Middle Deep Aquifer zone, as mapped in Figure E5b, the Olin wells and piezometers to the northeast of the site have screen midpoint elevations within a 35 foot interval, ranging from 2.06 ft above mean sea level (MSL; PZ-01-333) to 37.38 ft MSL (MP-04-291). City wells whose screened interval mid-points fall in this range include Dunne #1 (37.88 ft MSL), San Pedro (38.07 ft MSL), and Tennant (22.85 ft MSL). All other city wells except Condit (45.59 ft MSL), are completed at substantially higher elevations (in terms of screened interval mid-point), for example, Dunne #2 (87.93 ft MSL) and Nordstrom Park (94.56 ft (MSL). The screened interval midpoint elevations of the



other City wells used in this figure are all above 110 ft MSL. All of the City wells with higher screened interval midpoint elevations correspond to anomalously high groundwater elevations that bias the apparent groundwater flow direction to the south, and are clearly not appropriate for plotting on the same figure as the wells in the 2.06 ft to 37.38 ft MSL completion interval. Consideration of only the appropriate wells in this figure reveals an area of exceptionally flat hydraulic gradient to the northeast of the Olin site, to at least the area of the Dunne #1 well. With the exception of the Condit well, at a slightly higher screen mid-point elevation than the applicable range, groundwater elevations in this flat gradient area vary by less than three feet over a distance of at least 6000 feet. Groundwater flow in a northwesterly direction from the Olin Site on March 1, 2006 (the date corresponding to Figure E5b) is confirmed in Figure E16, which plots the resultant horizontal hydraulic gradient magnitude and direction for the three Middle Deep Aquifer piezometers PZ-01-333, PZ-02-315 and PZ-03-325. This flow direction is consistent with that considering only the screen-elevation appropriate data in Figure E5c. Figure E16 also shows continuous flow to the northwest and west of the Olin Site throughout the quarterly monitoring period for the above ternary of piezometers.

- d) The absence of additional groundwater monitoring points beyond the current northeast ternary sites (MP/PZ-01, MP/PZ-02 and MP/PZ-03) limits Olin's ability to adequately map both groundwater flow patterns and the perchlorate plume extent in the Deep Aquifer Zone. As WorleyParsons Komex has pointed out numerous times, additional piezometers in the Deep Aquifer zones to the north and east of PZ-3/MP-3 location must be installed to assist in both groundwater flow evaluation and perchlorate delineation in the Deep Aquifer Zone. The current proposal by Olin to advance CPT borings in the Intermediate Aquifer Zone primarily east of the Site will not resolve this issue.
- e) The Lower Deep Aquifer Zone, now with more monitoring points (wells MW-16-363 and MW-52-347) shows a steep northeast gradient from the Site, during a period of little City pumping (Figure E5c). Since the City's wells largely penetrate to this zone, the Lower Deep Aquifer Zone must also be considered as a potential conduit for migration of perchlorate from the Olin site to the City's wells.
- f) Olin states that "Groundwater mounding is apparent beneath the San Pedro ponds...." (Report, Page E-4). However, clear evidence of mounding is not presented in the report. The Olin statement appears to be based on Figure E3, which shows groundwater levels in the Shallow Aquifer Zone in March 2006. This Figure shows one well near the San Pedro Ponds



with an abnormally high groundwater level (09S03E23L007, 333.93 ft MSL), whereas other wells equally near the ponds show no evidence of mounding at all (i.e, 09S03E23L006, 328.34 ft MSL; 09S03E23P005, 327.41 ft MSL; 09S03E23N011, 322.38 ft MSL).

- g) The rationale behind Olin's suggestion that operation of the City's well will induce vertical flow from the Lower Intermediate into Upper Deep Aquifer zones through the well bore is unsupported. During pumping, the well bore is a hydraulic sink, causing flow from across all screened aquifer zones into the well bore. It is unclear how vertical flow can occur between zones in a well when all of the flow entering the well is pumped out by the pump, with no flow out of the well into any screened zone. Olin's suggestion that "This vertical flow system would be greatly exacerbated when each well was operated, resulting in a groundwater divide [a trough] in the lower-intermediate and upper-deep aquifers..." (Report, page E5) appears to describe the hypothetical development of a cone of depression in the Lower Intermediate and Upper Deep Aquifer zones in response to pumping of the City's wells. This is not surprising when one considers that the pumping groundwater level in the City's wells is from 86 to 146 feet lower than surrounding groundwater levels in the Lower Intermediate Aquifer zone, whereas the difference in groundwater level between the Olin Site and the Nordstrom Park well is less than 10 feet, based on Olin's groundwater level mapping in Figure E4c. Even if one considers, as Olin notes, "...that actual drawdown just beyond the well screen may be less than half of that measured inside the well" (Report page E5) the remaining head difference of 43 to 73 feet below the surrounding Lower Intermediate Zone groundwater levels, is still far more drawdown than would be required to reverse the southerly hydraulic gradient that corresponds to the 10 feet of head difference between the Site and Nordstrom Park well.
- h) It is likely that the cone of depression around the City's pumping wells forms the locus of a groundwater elevation trough to the northeast of the Olin Site, trending from the Condit well to at least the Nordstrom Park well. Each of the wells along this trend (Condit, San Pedro, Dunne #1 and #2, and Nordstrom Park) will draw some of its water from the direction of the Olin Site, eastward across Highway 101 to individual City wells to the northeast of the Olin Site. However, it is not clear which of the City's wells will intercept which portion of the perchlorate plume from the Olin Site, although we maintain that the Nordstrom Park well has clearly intercepted the greatest proportion of the plume to date.
- i) Detailed technical issues in the Report include:



- Missing on Page E-7 is an explanation for groundwater rise in piezometer transducer water levels. The Report states “The amount of time necessary for this induced groundwater rise to subside will be further evaluated for the First Quarter 2006 Report”, however, the stated evaluation is not provided.
- In Figure E5b, piezometer PZ-03-325 (291.91 feet) is located between the 292 and 294 contour lines. It should be inside the 292 contour line.
- Multiport well MP-01-245 is mapped as an Upper Deep Zone monitoring point in Figure E5a. However, in Table E2a this multiport well is listed as being completed in the Lower Intermediate Zone, as is the deeper multiport well at this location, MP-01-262. It is not clear why this inappropriate data point is included in Figure E5a.
- Multiport MP-04 monitoring locations are not included on Figure E5a. Even though water elevations were not available for these wells, the well locations should be identified in relation to the other wells.

It is clear from the above comments on Olin’s First Quarter 2006 Groundwater Monitoring Report that a growing body of evidence corroborates the occurrence and migration of perchlorate in groundwater to the northeast of the Olin Site. This perchlorate plume in the Deep Aquifer Zone forms an ongoing and future threat to the City’s groundwater supply from its northeast wells.

WorleyParsons Komex is pleased to provide these comments to the RWQCB and we are at your disposal to discuss any of the responses above. If you have any questions or need additional information please call Mark Trudell at (714) 379-1157 extension 161 or Jon Rohrer at extension 241.

Sincerely,
WorleyParsons Komex

Mark Trudell, Ph.D., PG, CHG
Senior Groundwater Modeler

Jon Rohrer, PG, CHG
Senior Hydrogeologist

cc: Mr. Steven L. Hoch, Hatch & Parent
Mr. Jim Ashcraft, City of Morgan Hill
Mr. Tom Mohr, Santa Clara Valley Water District

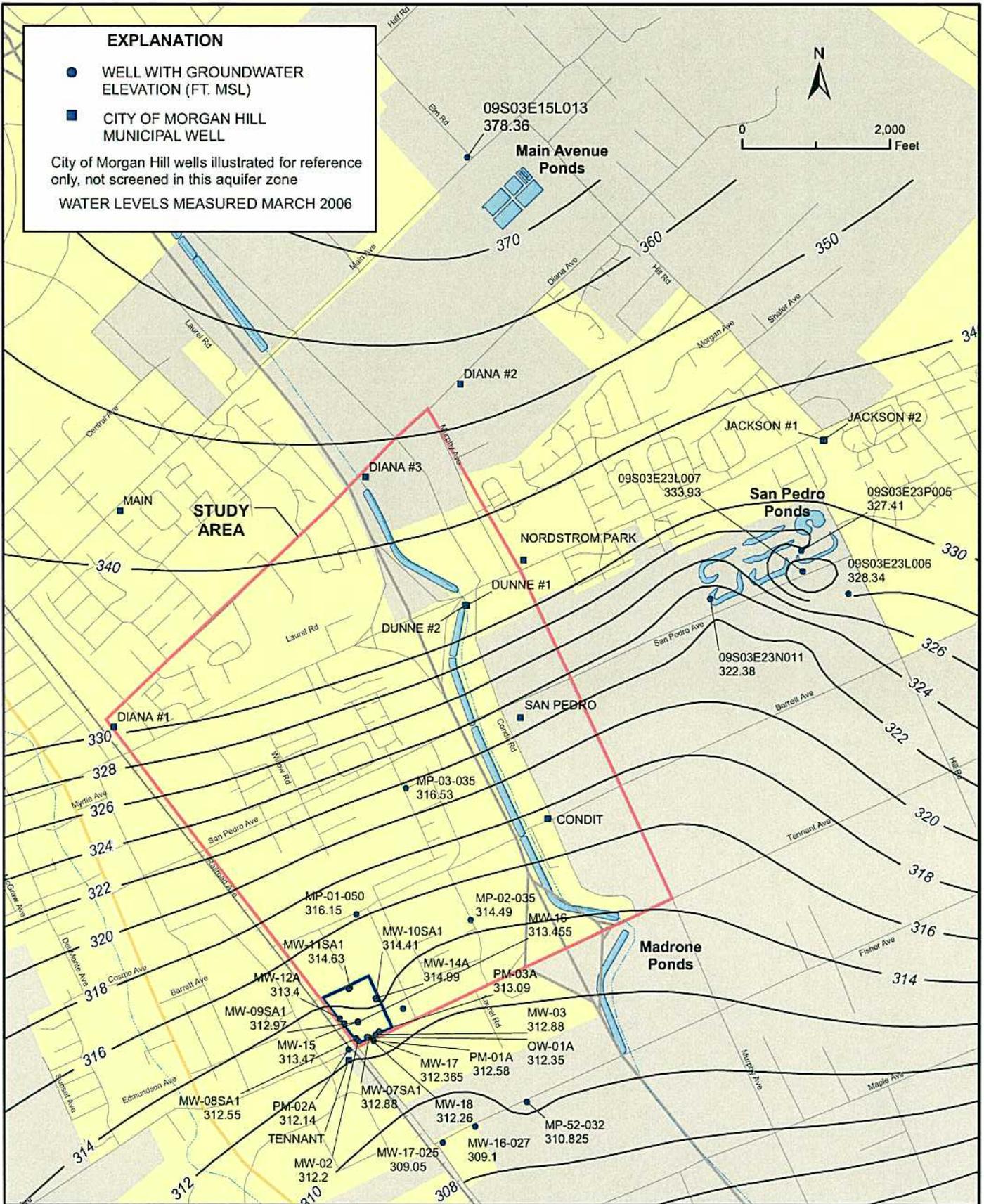
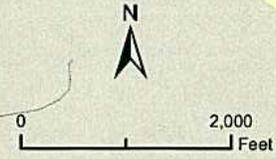
ATTACHMENT A

CITED FIGURES FROM OLIN FIRST QUARTER 2006 REPORT

EXPLANATION

- WELL WITH GROUNDWATER ELEVATION (FT. MSL)
- CITY OF MORGAN HILL MUNICIPAL WELL

City of Morgan Hill wells illustrated for reference only, not screened in this aquifer zone
 WATER LEVELS MEASURED MARCH 2006

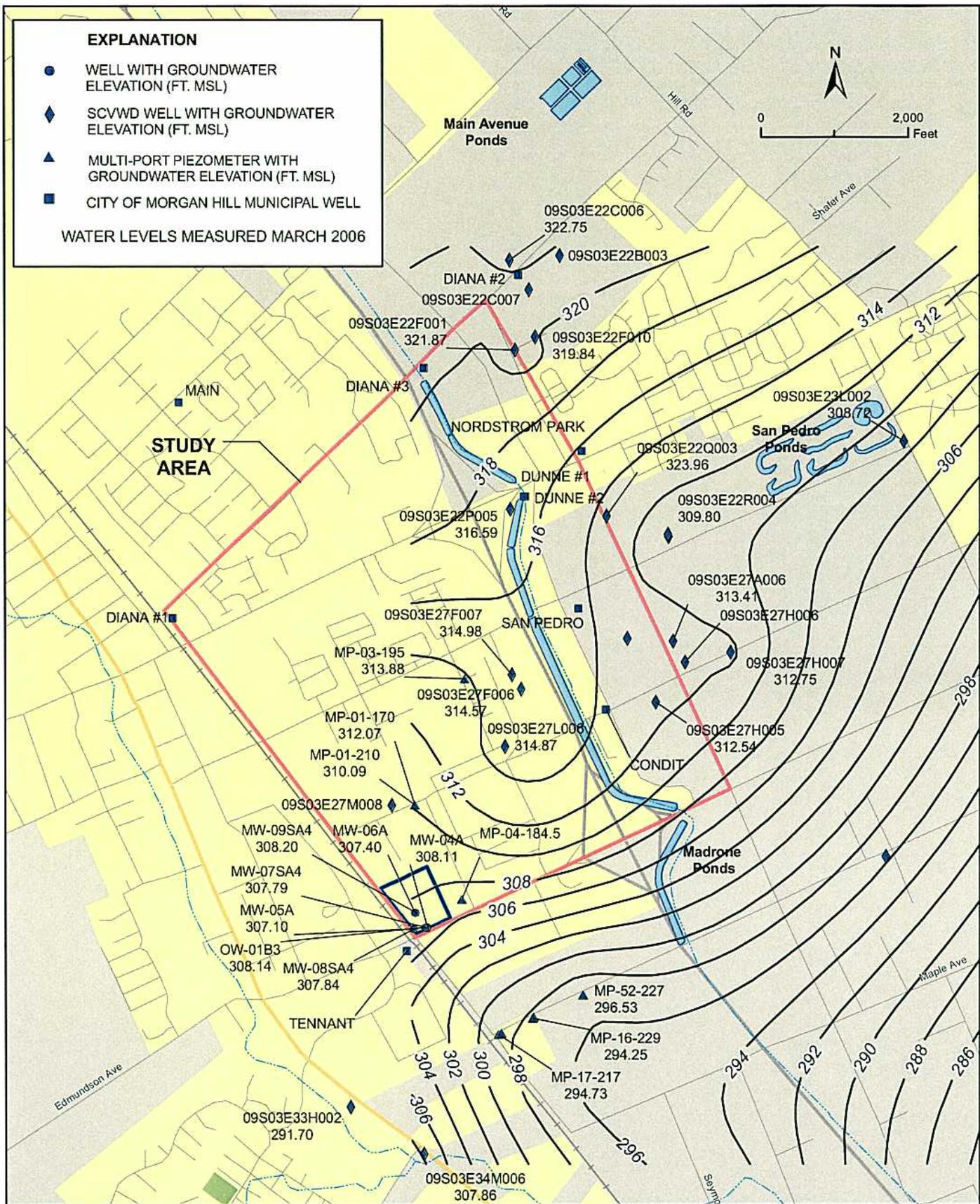


Groundwater Elevations - Shallow Zone
 First Quarter 2006 Groundwater Monitoring Report
 Olin/Standard Fusee Site
 Morgan Hill, California

FIGURE
E3

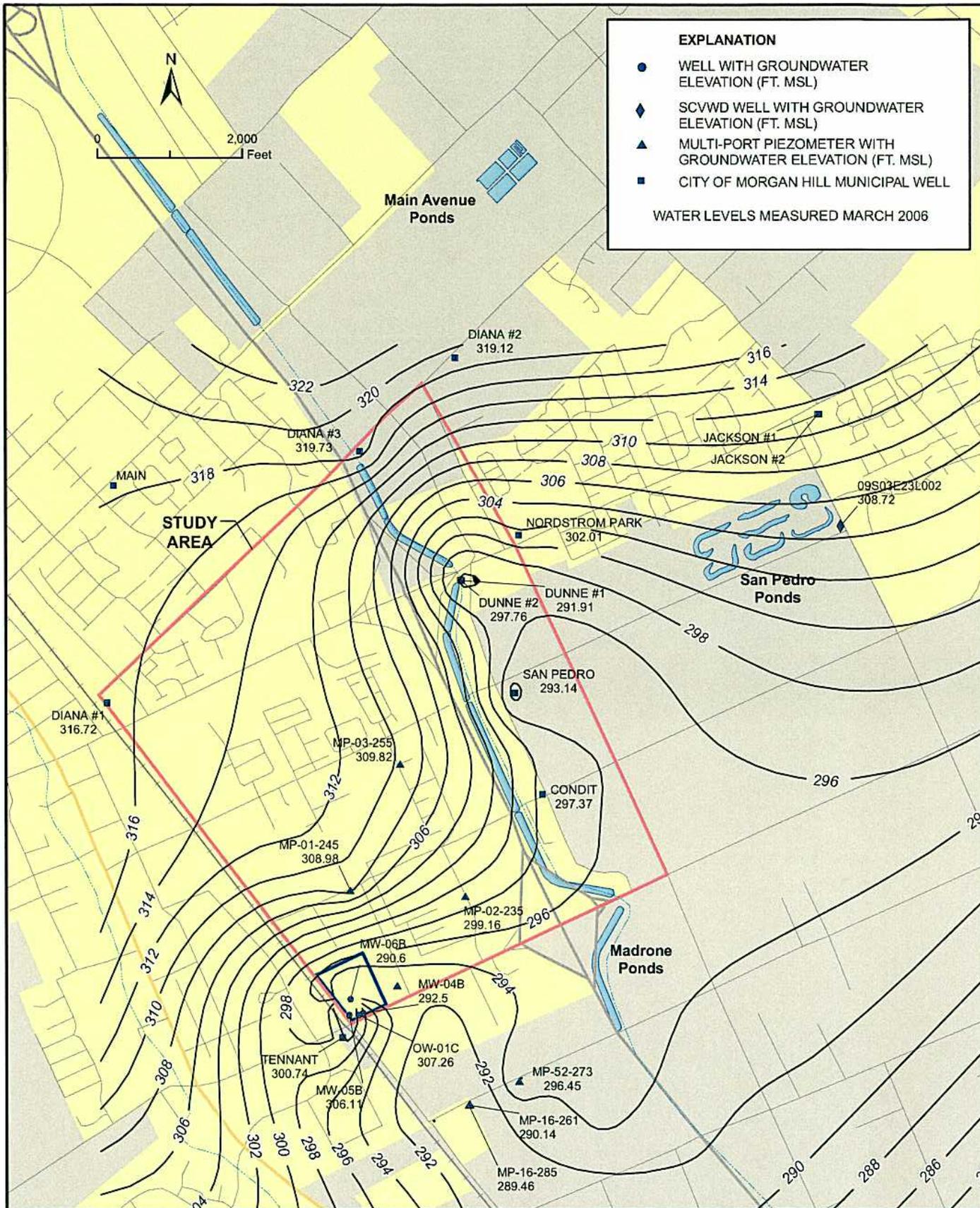
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FigureE3.mxd - 4/18/06



	Groundwater Elevations - Intermediate Zone (Lower) First Quarter 2006 Groundwater Monitoring Report Olin/Standard Fusee Site Morgan Hill, California				FIGURE E4c
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FigureE4c.mxd - 4/18/06



Groundwater Elevations - Deep Zone (Upper)
 First Quarter 2006 Groundwater Monitoring Report
 Olin/Standard Fusee Site
 Morgan Hill, California

FIGURE
E5a

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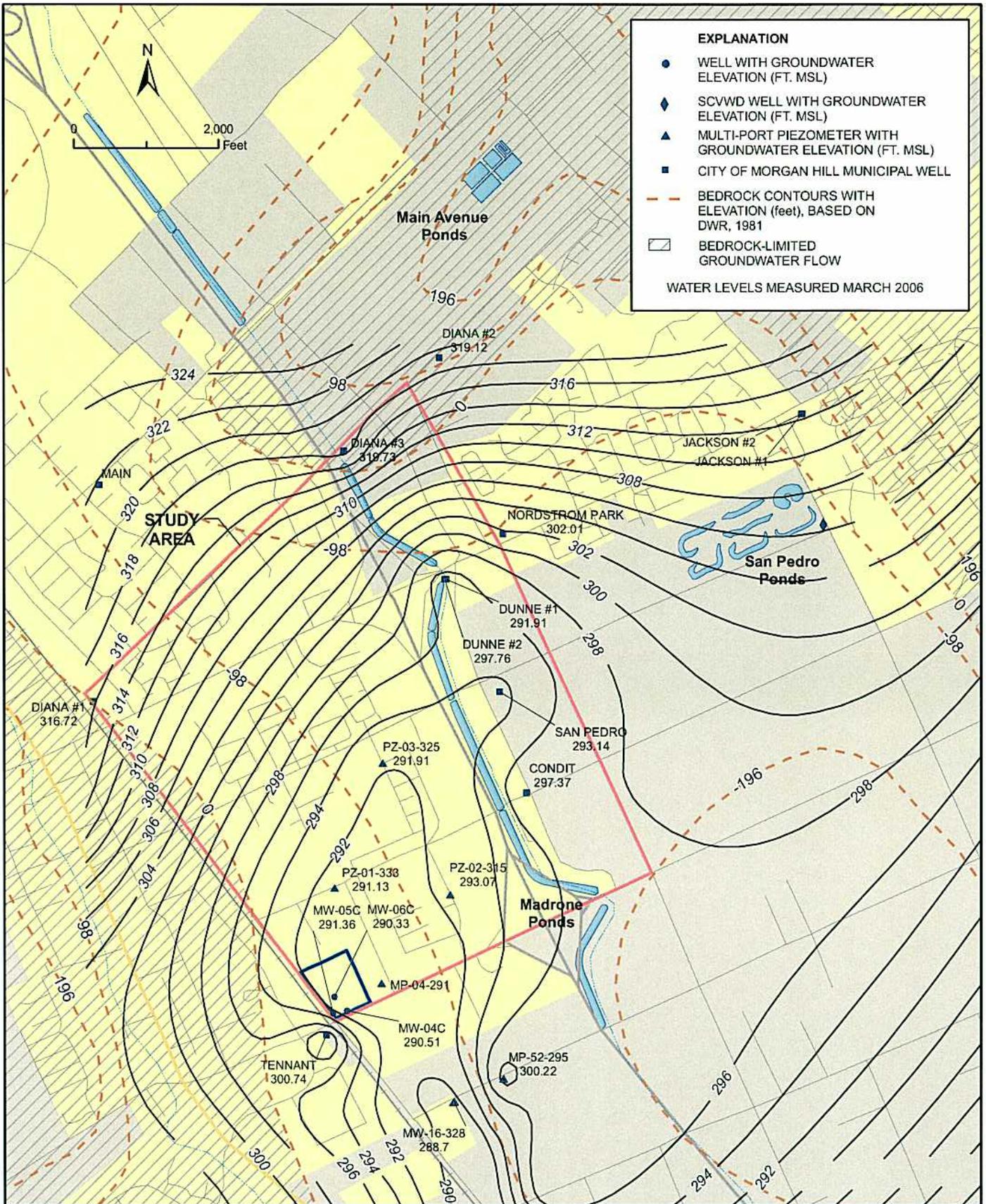
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FigureE5a.mxd - 4/18/06

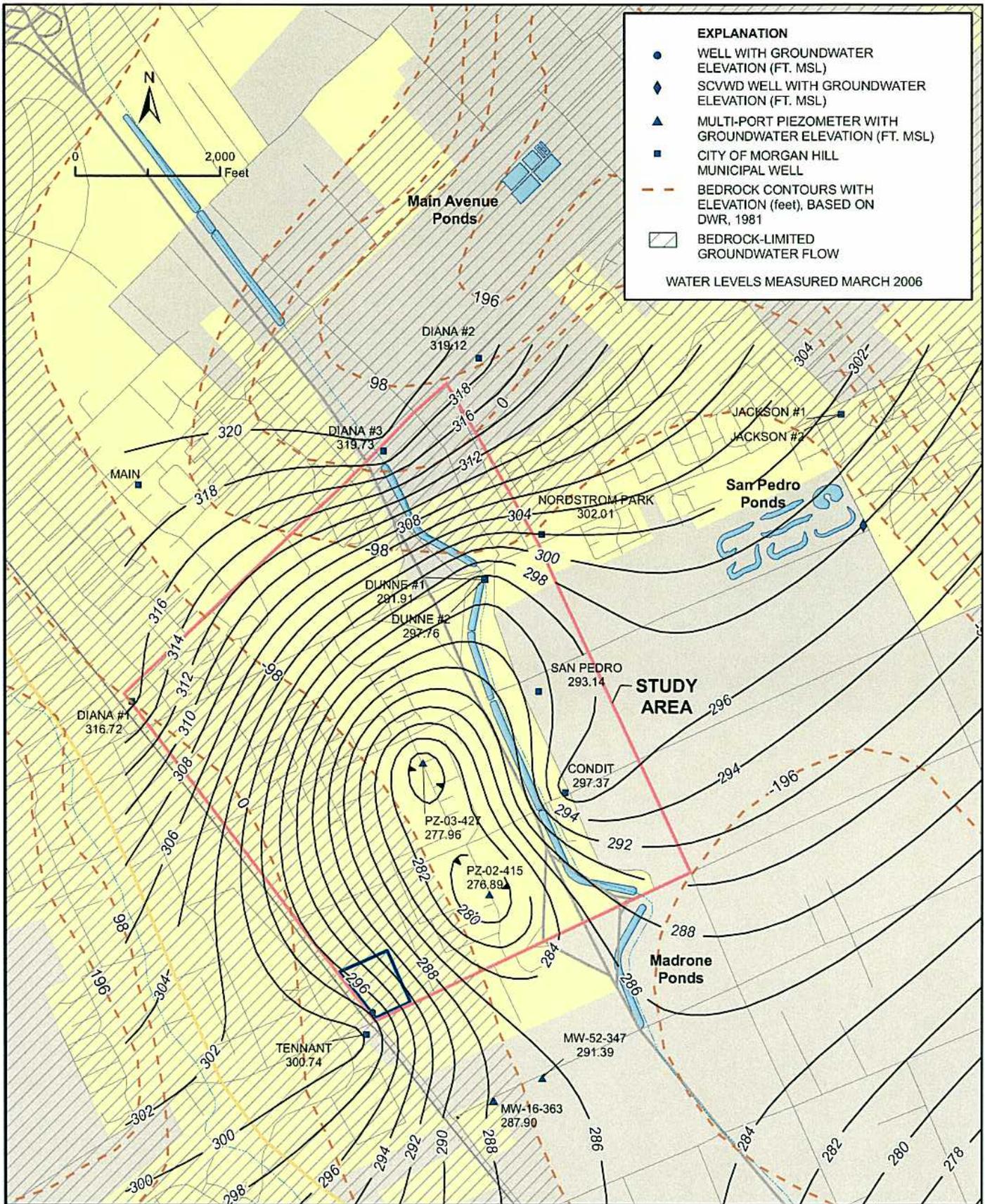


Groundwater Elevations - Deep Zone (Middle)
 First Quarter 2006 Groundwater Monitoring Report
 Olin/Standard Fusee Site
 Morgan Hill, California

FIGURE
E5b

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FigureE5b-MARCH.mxd - 4/19/06



EXPLANATION

- WELL WITH GROUNDWATER ELEVATION (FT. MSL)
- ◆ SCVWD WELL WITH GROUNDWATER ELEVATION (FT. MSL)
- ▲ MULTI-PORT PIEZOMETER WITH GROUNDWATER ELEVATION (FT. MSL)
- CITY OF MORGAN HILL MUNICIPAL WELL
- - - BEDROCK CONTOURS WITH ELEVATION (feet), BASED ON DWR, 1981
- ▨ BEDROCK-LIMITED GROUNDWATER FLOW

WATER LEVELS MEASURED MARCH 2006



Groundwater Elevations - Deep Zone (Lower)
 First Quarter 2006 Groundwater Monitoring Report
 Olin/Standard Fusee Site
 Morgan Hill, California

FIGURE
E5c

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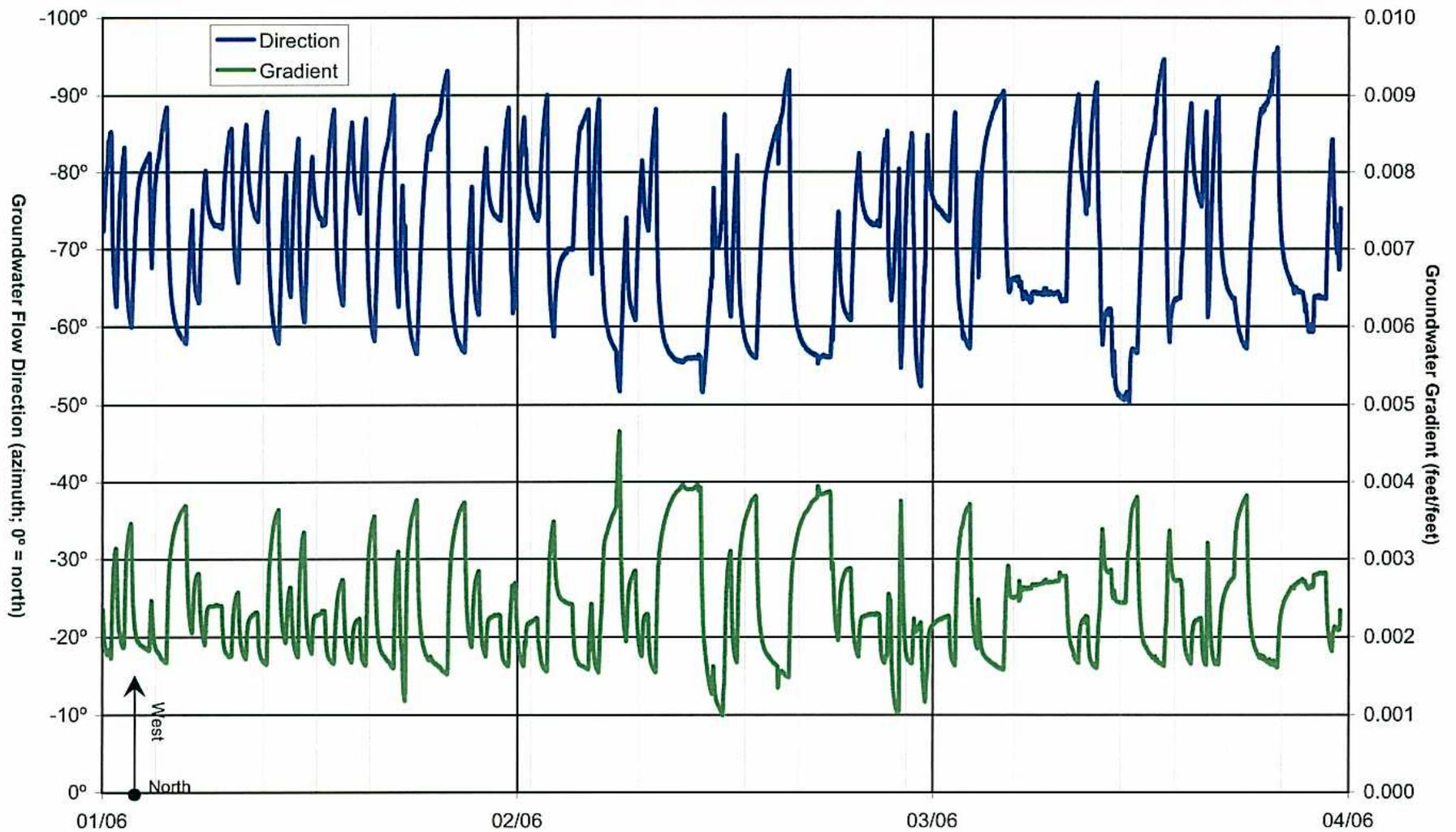
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Groundwater Flow Directions and Gradients
Upper 180-Foot Aquifer
 First Quarter 2006 Groundwater Monitoring Report
 Olin/Standard Fusee Site
 Morgan Hill, California

FIGURE

E16

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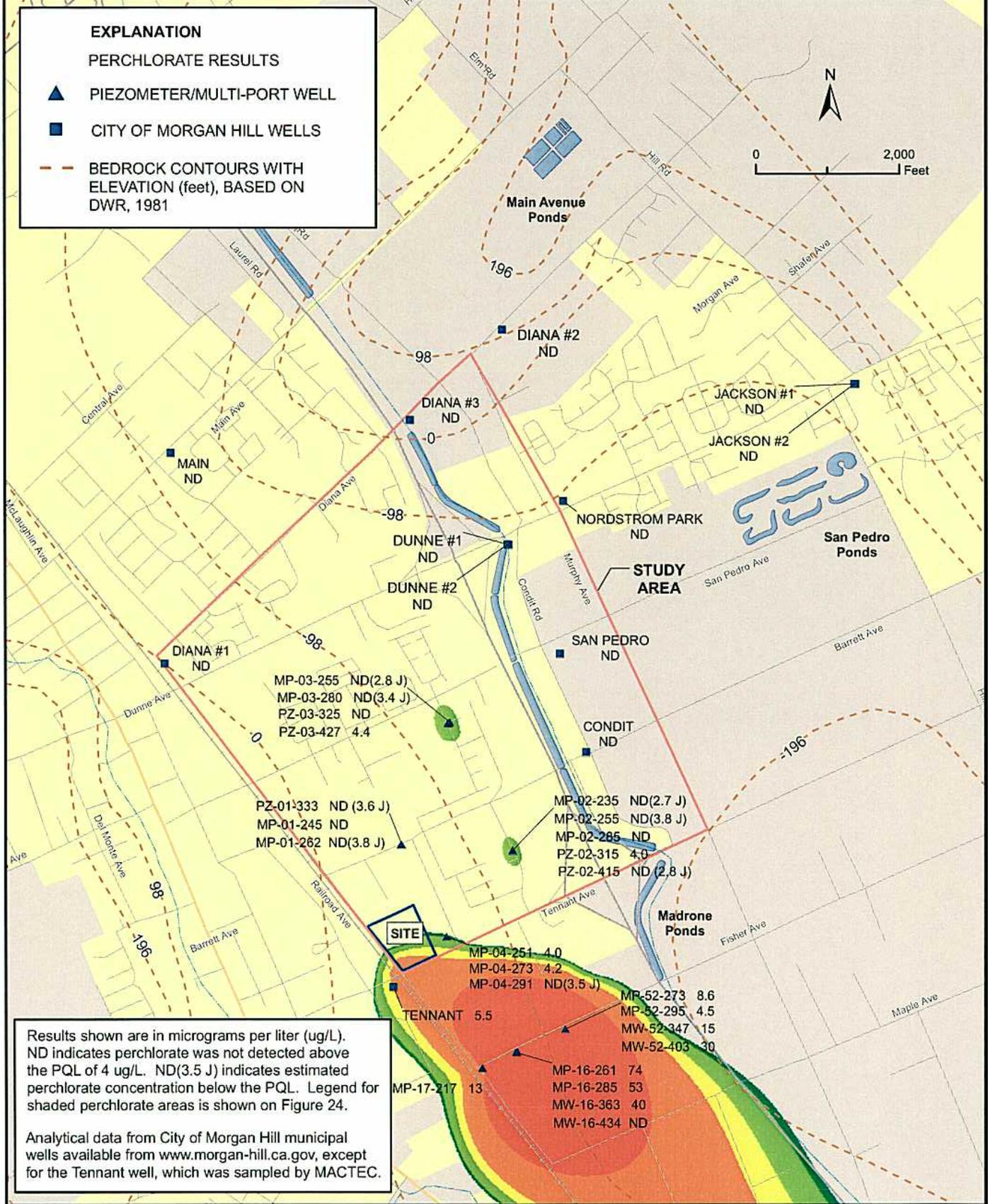
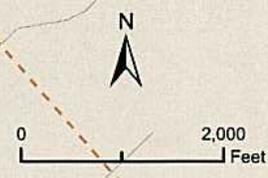
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EXPLANATION

PERCHLORATE RESULTS

-  PIEZOMETER/MULTI-PORT WELL
-  CITY OF MORGAN HILL WELLS
-  BEDROCK CONTOURS WITH ELEVATION (feet), BASED ON DWR, 1981



Results shown are in micrograms per liter (ug/L). ND indicates perchlorate was not detected above the PQL of 4 ug/L. ND(3.5 J) indicates estimated perchlorate concentration below the PQL. Legend for shaded perchlorate areas is shown on Figure 24.

Analytical data from City of Morgan Hill municipal wells available from www.morgan-hill.ca.gov, except for the Tennant well, which was sampled by MACTEC.

MP-03-255	ND(2.8 J)
MP-03-280	ND(3.4 J)
PZ-03-325	ND
PZ-03-427	4.4
PZ-01-333	ND (3.6 J)
MP-01-245	ND
MP-01-262	ND(3.8 J)
MP-02-235	ND(2.7 J)
MP-02-255	ND(3.8 J)
MP-02-285	ND
PZ-02-315	4.0
PZ-02-415	ND (2.8 J)
MP-04-251	4.0
MP-04-273	4.2
MP-04-291	ND(3.5 J)
MP-52-273	8.6
MP-52-295	4.5
MW-52-347	15
MW-52-403	30
TENNANT	5.5
MP-16-261	74
MP-16-285	53
MW-16-363	40
MW-16-434	ND
MP-17-217	13



Perchlorate Results - Deep Aquifer
 First Quarter 2006 Groundwater Monitoring Report
 Olin/Standard Fusee Site
 Morgan Hill, California

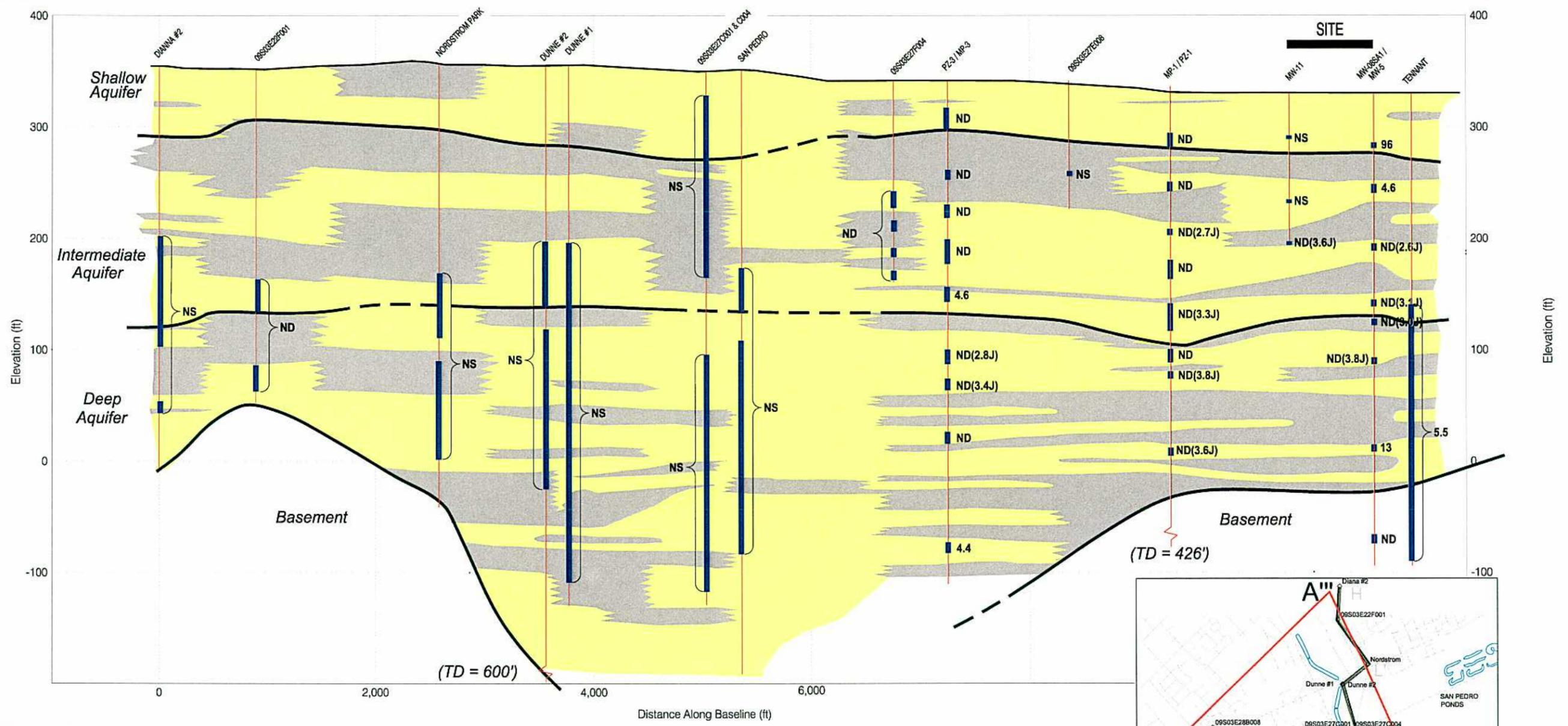
FIGURE
E19

DRAWN TJH	JOB NUMBER 6300060006 01.0	CHECKED	CHECKED DATE 3/2006 <i>hwd</i> 4/28/2006	APPROVED MDT	APPROVED DATE 4-29-06
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FigureE19Perchlorate-intermediate.mxd - 4/27/06

A''' North

South A

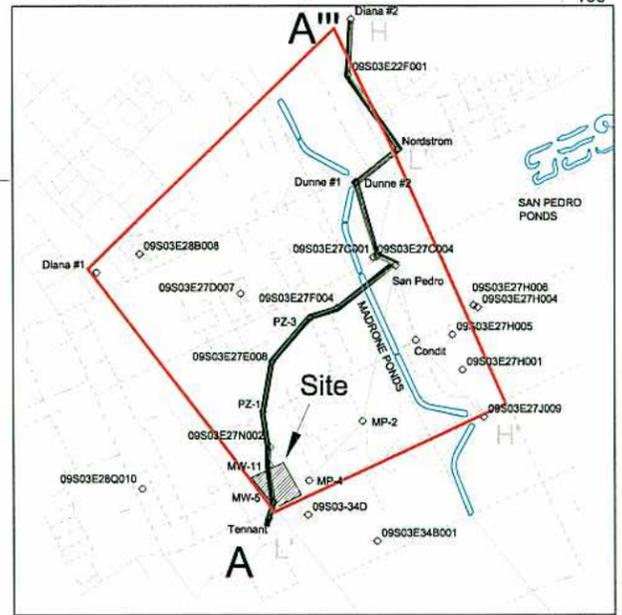


EXPLANATION

Geologic Units (as described on driller's logs):
 [Yellow Box] Course Material (Sand/Gravel)
 [Grey Box] Fine Material (Clay/Silt)

Well Location and Depth
 Screen Interval
 6.8 Perchlorate Concentration (ug/l)
 ND(2.3J) Estimated Perchlorate Concentration Below the PQL (ug/l)
 ND Perchlorate not detected at PQL of 4 ug/l
 NS Not Sampled

Piezometers and supply wells were sampled between October 2 - December 29, 2005.



INDEX MAP SHOWING SECTION LOCATION

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ENGINEER:	SCALE: as shown
CHECKED:	DATE: 4/28/06
APPROVED:	DATE: 4/28/2006



Olin/Standard Fusee Site
Morgan Hill, California

Geologic Cross Section A''' - A
with Most Recent Perchlorate Concentration
First Quarter 2006
Groundwater Monitoring Report

FIGURE
E20

6300060006056.DWG 40
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