TO: Bruce Buel, General Manager Nipomo Community Services District
FROM: Joel Degner, Brad Newton, Ph.D., P.G., Bob Beeby, P.E.
RE: Spring 2009 Groundwater in Storage above Mean Sea Level
DATE: June 4, 2009

INTRODUCTION

Groundwater surface elevations (GSE) underlying the Nipomo Mesa are regularly measured at many places (wells) across the mesa. Presented herein is the Spring 2009 groundwater in storage above mean sea level (GWS) estimate along with estimates of historical GWS from 1975 to 2008 based on groundwater surface elevation measurements collected during Spring and Fall across the Nipomo Mesa. Limited measurements of GSE were available for the years 1982, 1983, 1984, 1994 and 1997, thus precluding a reliable estimate of GWS for those years.

During the process of preparing the NMMA 1st Annual Report Calendar Year 2008 the NMMA Technical Group (TG) collected and analyzed additional data for the NMMA, including a ground elevation survey for the key wells. These updated reference points were not incorporated into the GWS estimate to preserve consistency in the historical calculations and presentations.

The TG has not reviewed this technical memorandum, its findings, or any presentation of this evaluation.

RESULTS

Estimated Spring 2009 GWS is 76,000 acre-feet (AF), which is 7,000 AF less than Spring 2008 (Table 1, Figure 1). The key well index from NMMA 1st Annual Report Calendar Year 2008 generally follows the same historical trends as the GWS estimates (Figure 1).

METHODOLOGY

The annual estimates of Spring and Fall GWS are based on GSE measurements regularly made by San Luis Obispo County Department of Public Works (SLO DPW), NCSD, USGS, and Woodlands. The integration of GSE data is accomplished by using computer software to interpolate between measurements and calculate GWS within the principal production aquifer assuming an unconfined aquifer and a specific yield of 11.7 percent. Limited measurements of GSE were available for the years 1982, 1983, 1984, 1994 and 1997, precluding a reliable estimate of GWS for those years.

The amount of GWS under the Nipomo Mesa Management Area (NMMA) was computed by multiplying the saturated volume above sea level with the aerially weighted specific yield (DWR, 2002), excluding bedrock (Figure 11: Base of Potential Water-Bearing Sediments, presented in the report, Water Resources of the Arroyo Grande – Nipomo Mesa Area [DWR 2002]). The amount of GWS under the NMMA was constrained to the boundary determined in Phase III of the trial.

Data provided by DWR, consisting of well completion reports, lithographic logs, electronic logs, and pump tests, were used to develop an understanding of the hydrogeologic conditions underlying the NMMA. A systematic review of these data pertaining to wells used for storage calculations was conducted in order to verify that each well's screened interval is within the principal production aquifer (Paso Robles Formation).

Groundwater Surface Elevation Measurements

Groundwater surface elevation data were obtained from SLO DPW, NCSD, USGS, and Woodlands. SLO DPW measures GSE in monitoring wells during the spring and the fall of each year. Woodlands and NCSD measures GSE in their monitoring wells monthly. For the years 1975 to 1999, available representative GSE data were used to estimate GWS. For the years 2000 to 2008, only GSE data from the same 45 wells were used to estimate GWS.

The GSE data was reviewed in combination with well completion reports and historical hydrographic records in order to exclude measurements that do not accurately represent static water levels within the principal production aquifer. Wells that do not access the principal production aquifer or were otherwise determined to not accurately represent static water levels within the aquifer were not included in analysis.

Groundwater Surface Interpolation

The individual GSE measurements from each year were used to produce a GSE field by interpolation using the inverse distance weighting (IDW) method.

Groundwater Volume Estimate

The amount of groundwater in storage under the Nipomo Mesa was estimated for the boundary determined in Phase III of the trial. The GWS was estimated by subtracting both the mean sea level surface (elevation equals zero) and the volume of bedrock above sea level from the saturated volume. The bedrock surface elevation is based on Figure 11: Base of Potential Water-Bearing Sediments, presented in the report, Water Resources of the Arroyo Grande – Nipomo Mesa Area (DWR 2002). The bedrock surface elevation was preliminarily verified by reviewing driller reports obtained from DWR. The saturated volume above sea level was multiplied by a specific yield of 11.7% to estimate the recoverable amount of GWS. The specific yield is based on the average weighted specific yield for the Nipomo Mesa Hydrologic Sub-Area (DWR 2002, pg. 86).

Key Well Index

The TG selected the data from eight inland key wells to represent the whole of the NMMA. The average Spring groundwater elevation of these key wells is used to calculate the Key Wells Index ("Index").

The Index was calculated annually using Spring groundwater elevation measurements from 1975 to 2008. The Key Wells were selected to represent various portions of the groundwater basin within the NMMA. In selecting the eight key wells, the following criteria were applied so that the wells generally represent the NMMA as a whole:

(1) The wells are geographically distributed,

(2) No single well overly influences the Index.

The first criterion was met in the selection of the wells, such that no well represented a disproportionate area. To meet the second criterion, groundwater elevations from each well were normalized so that any well where elevations were on the average higher or lower than the other wells did not overly influence the magnitude of the Index. This normalization was accomplished by dividing each Spring groundwater elevation measurement by the sum of all the Spring groundwater elevation data for that well.

The Index was defined for each year as the average of the normalized Spring groundwater data from each well. The lowest value of the Index could be considered the "historical low" within the NMMA.

REFERENCES

Department of Water Resources (DWR). 2002. Water Resources of the Arroyo Grande – Nipomo Mesa Area, Southern District Report.

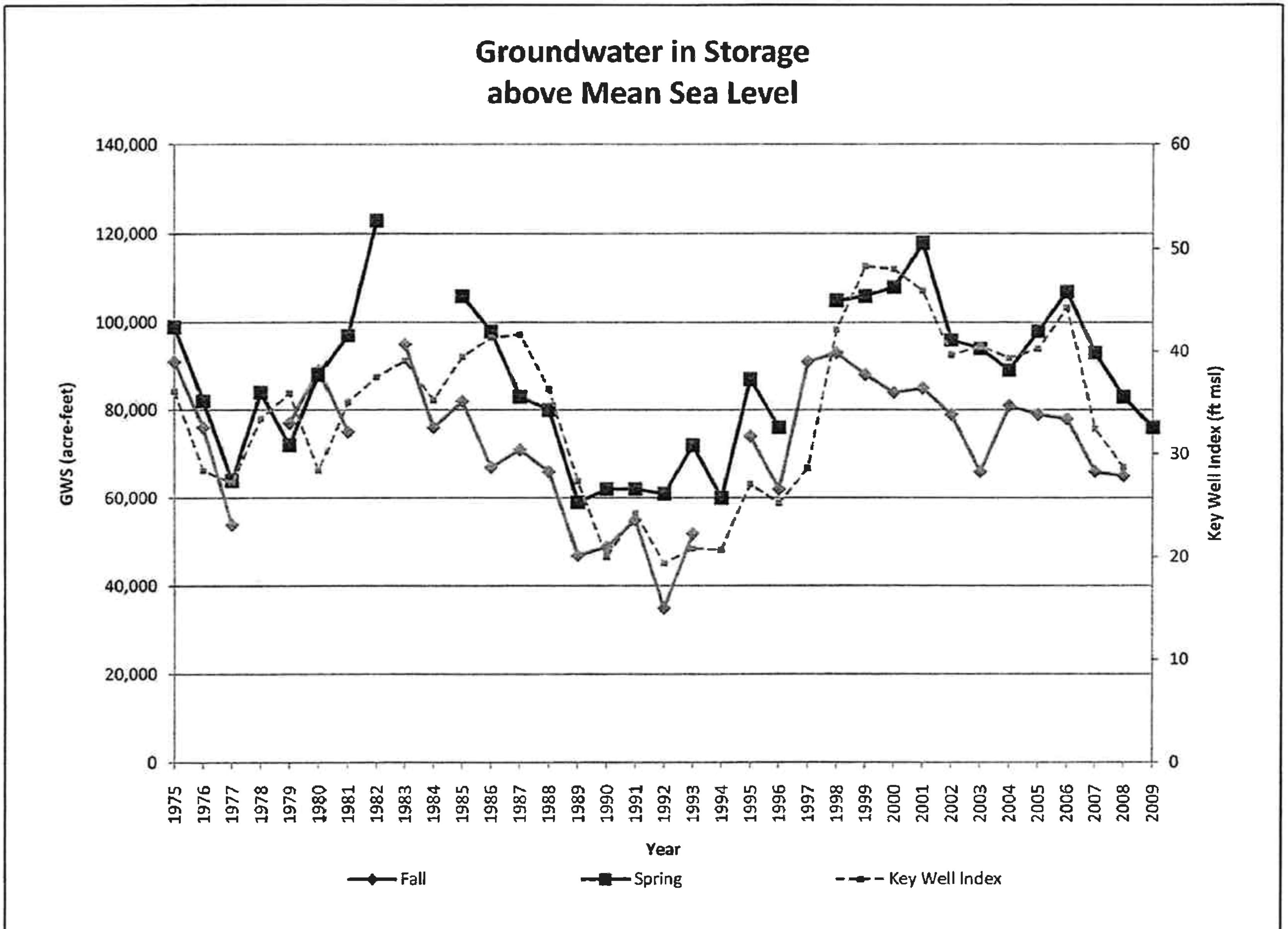
Table 1

Spring and Fall
Groundwater in Storage above Mean Sea Level
for Phase III Boundary

Year	Rainfall (inches)	Spring GWS (Acre-Feet)	Number of Wells	Fall GWS (Acre-Feet)	Number of Wells	Spring to Fall Difference (Acre-Feet)
1975	17.29	99,000	54	91,000	54	8,000
1976	13.45	82,000	45	76,000	65	6,000
1977	10.23	64,000	59	54,000	63	10,000
1978	30.66	84,000	62	---	35	---
1979	15.80	72,000	57	77,000	63	(5,000)
1980	16.57	88,000	55	89,000	46	(1,000)
1981	13.39	97,000	46	75,000	47	22,000
1982	18.58	123,000	42	---	31	---
1983	33.21	---	35	95,000	42	---
1984	11.22	---	14	76,000	37	---
1985	12.20	106,000	37	82,000	41	24,000
1986	16.85	98,000	51	67,000	51	31,000
1987	11.29	83,000	48	71,000	52	12,000
1988	12.66	80,000	51	66,000	49	14,000
1989	12.22	59,000	47	47,000	57	12,000
1990	7.12	62,000	55	49,000	53	13,000
1991	13.06	62,000	52	55,000	54	7,000
1992	15.66	61,000	52	35,000	48	26,000
1993	20.17	72,000	54	52,000	61	20,000
1994	12.15	60,000	54	---	36	---
1995	25.47	87,000	35	74,000	52	25,000
1996	16.54	76,000	45	62,000	57	14,000
1997	20.50	---	20	91,000	48	---
1998	33.67	105,000	41	93,000	44	12,000
1999	12.98	106,000	56	88,000	49	18,000
2000	14.47	108,000	44	84,000	41	24,000
2001	18.78	118,000	43	85,000	35	33,000
2002	8.86	96,000	29	79,000	41	17,000
2003	11.39	94,000	37	66,000	42	28,000
2004	12.57	89,000	42	81,000	35	8,000
2005	22.23	98,000	38	79,000	39	19,000
2006	20.83	107,000	44	78,000	41	29,000
2007	6.96	93,000	44	66,000	42	27,000
2008	15.18	83,000	43	65,000	42	18,000
2009	7.91	76,000	44			

---: insufficient for evaluation

Figure 1


Groundwater in Storage
above Mean Sea Level
GWS (acre-feet)
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
Key Well Index (ft msl)
60
50
40
30
20
10
0
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year
Fall
Spring
Key Well Index