

1 **TECHNICAL MEMORANDUM**
2

3 **TO:** NCSD Board of Directors
4 **FROM:** Brad Newton, Ph.D., P.G.; Jesse Herbert
5 **RE:** Spring 2011 Groundwater Index
6 **DATE:** June 13, 2011

7 **INTRODUCTION**

8 Groundwater surface elevations (GSE) underlying the Nipomo Mesa are regularly
9 measured at many places (wells) across the mesa. The Spring 2011 Groundwater Index (GWI)
10 has been computed and presented herein along with historical GWI from 1975 to present based
11 on these groundwater surface elevation measurements collected during spring and fall across
12 the Nipomo Mesa. Limited measurements of GSE were available for the years 1982, 1983, 1984,
13 1994 and 1997, thus precluding a reliable calculation of GWI for those years.

14 Ground elevation surveys for the key wells were conducted in preparation of the 1st
15 Annual Report - Calendar Year 2008 for the Nipomo Mesa Management Area (NMMA). These
16 updated reference points were not incorporated into the GWI to preserve consistency in the
17 historical calculations and presentations.

18 The NMMA Technical Group has not reviewed this technical memorandum, its findings,
19 or any presentation of this evaluation.

20
21 **RESULTS**

22 Spring 2011 GWI is 87,000 acre-feet (AF), which is 7,000 AF greater than the Spring 2010
23 GWI (Table 1, Figure 1). The Key Well Index from NMMA 3rd Annual Report - Calendar Year
24 2010 generally follows the same historical trends as the GWI (Figure 1).

25
26 **METHODOLOGY**

27 The calculation of spring and fall GWI are based on GSE measurements regularly made by
28 San Luis Obispo County Department of Public Works (SLO DPW), NCSD, USGS, and
29 Woodlands. The integration of GSE data is accomplished by using computer software to
30 interpolate between measurements and calculate GWI within the principal production aquifer
31 assuming an unconfined aquifer and a specific yield of 11.7 percent. Limited measurements of
32 GSE were available for the years 1982, 1983, 1984, 1994 and 1997, precluding a reliable
33 calculation of GWI for those years.

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1 **Groundwater Surface Elevation Measurements**

2 Groundwater surface elevation data were obtained from SLO DPW, NCS D, USGS, and
3 Woodlands. SLO DPW measures GSE in monitoring wells during the spring (April) and the fall
4 (October) of each year. Woodlands and NCS D measures GSE in their monitoring wells
5 monthly. For the years 1975 to 1999, available representative GSE data were used to compute
6 GWI. For the years 2000 to 2011, only GSE data from the same 45 wells were used to compute
7 GWI.

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

13 **Groundwater Surface Interpolation**

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

16 **Groundwater Index**

17 The GWI is defined as the saturated volume above sea level and bedrock multiplied by the
18 specific yield of 11.7 percent. The value of the groundwater index was computed for the area
19 defined in Phase III of the trial. The base of the saturated volume is mean sea level surface
20 (elevation equals zero) or the bedrock above sea level, whichever is higher. The bedrock surface
21 elevation is based on Figure 11: Base of Potential Water-Bearing Sediments, presented in the
22 report, Water Resources of the Arroyo Grande - Nipomo Mesa Area (DWR 2002). The bedrock
23 surface elevation was preliminarily verified by reviewing driller reports obtained from DWR
24 (Figure 2). The specific yield is based on the average weighted specific yield measurement
25 made at wells within the Nipomo Mesa Hydrologic Sub-Area (DWR 2002, pg. 86).

26 **Key Well Index**

27 The NMMA Technical Group selected the data from eight inland key wells to represent
28 the whole of the NMMA. The Key Well Index was calculated annually using spring GSE
29 measurements from 1975 to 2010. The key wells were selected to represent various portions of
30 the groundwater basin within the NMMA. In selecting the eight key wells, the following
31 criteria were applied so that the wells generally represent the NMMA as a whole:

- 32 (1) The wells are geographically distributed,
- 33 (2) No single well overly influences the Key Well Index.

34 The first criterion was met in the selection of the wells, such that no well represented a
35 disproportionate area. To meet the second criterion, groundwater elevations from each well
36 were normalized so that any well where elevations were on the average higher or lower than

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1 the other wells did not overly influence the magnitude of the Key Well Index. This
2 normalization was accomplished by dividing each spring groundwater elevation measurement
3 by the sum of all the Spring GSE data for that well.

4 The Key Well Index was defined for each year as the average of the normalized spring
5 groundwater data from each well. The lowest value of the Key Well Index could be considered
6 the "historical low" within the NMMA.

7

8 **REFERENCES**

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

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**Spring and Fall
Groundwater Index
(GWI)**

Year	Rainfall (inches)	Spring GWI (Acre-Feet)	Number of Wells	Fall GWI (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	30.00	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	14.32	97,000	46	75,000	47	22,000
1982	18.58	123,000	42	--	31	--
1983	33.09	--	35	95,000	42	--
1984	10.38	--	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	12.25	59,000	47	47,000	57	12,000
1990	7.12	62,000	55	49,000	53	13,000
1991	13.18	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	25.87	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	7.11	93,000	44	66,000	42	27,000
2008	15.18	83,000	43	65,000	42	18,000
2009	10.31	76,000	44	65,000	43	11,000
2010	20.07	80,000	45	67,000	42	13,000
2011	26.04*	87,000	43			

--: Insufficient for evaluation

*: Preliminary value

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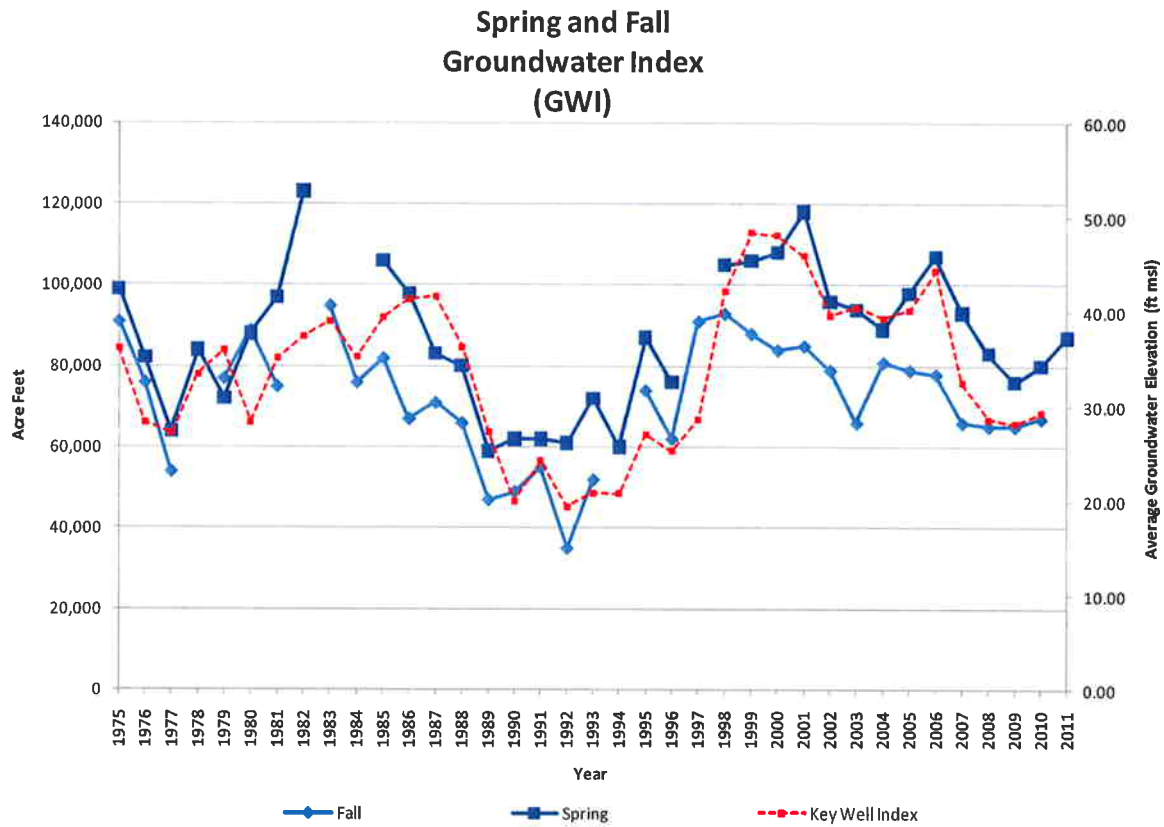
Table 1: Groundwater Index computed from Spring 1975 to Spring 2011.

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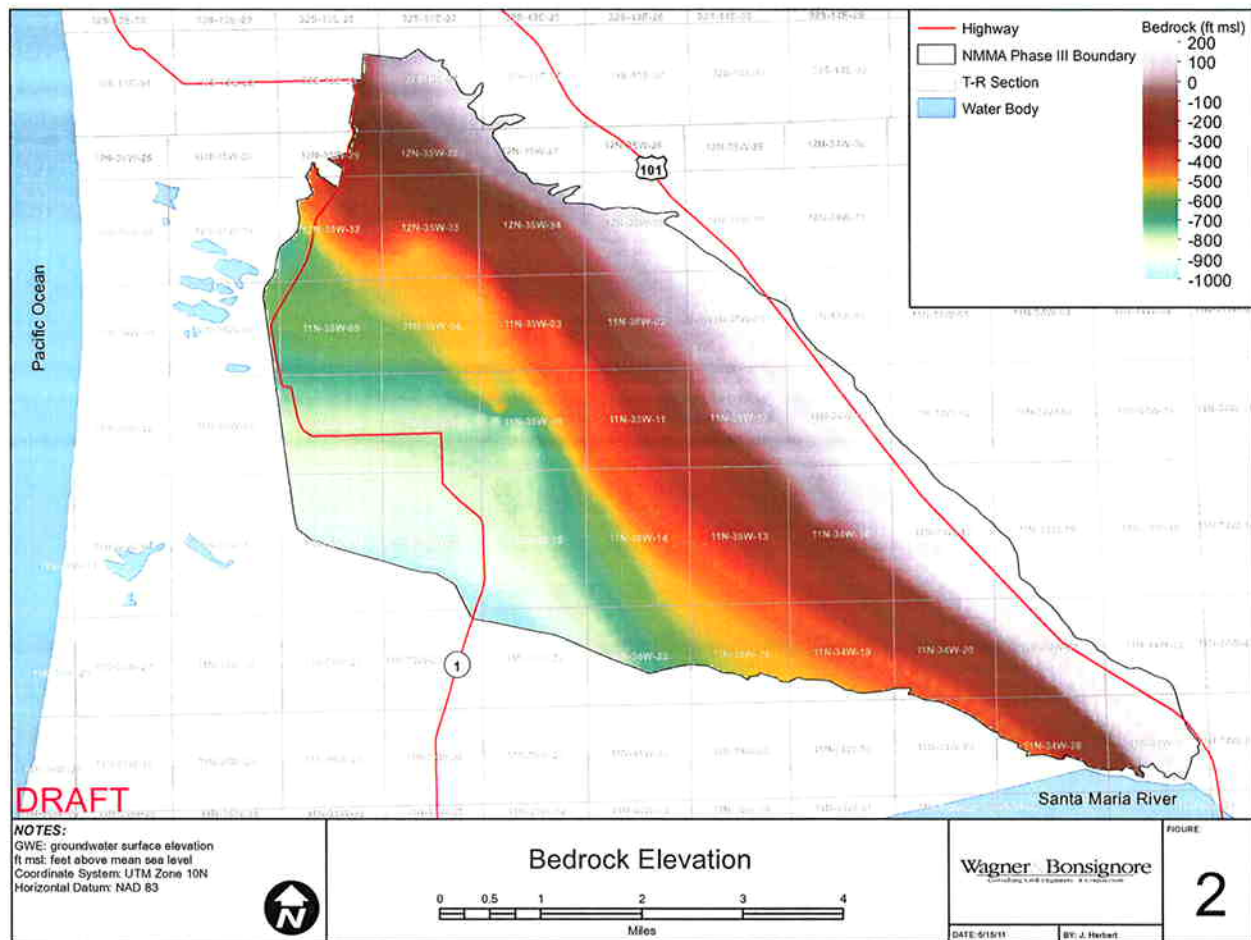
Figure 1: Groundwater Index and the Key Well Index computed from Spring 1975 to Spring 2011.

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Figure 2: Elevation of bedrock underlying the NMMA.