SOUTHWEST WELL FIELD

RECHARGE FEASIBILITY STUDY

INDIAN WELLS VALLEY WATER DISTRICT
P. O. Box 1329
Ridgecrest, California 93556-1329

November 2005

SOUTHWEST WELL FIELD RECHARGE FEASIBILITY STUDY

HISTORY:

The Indian Wells Valley Water District (IWVWD) is located within the Indian Wells Valley in the eastern part of Kern County and is surrounded by the Sierra Nevada Mountains to the west, the El Paso Mountains to the south, Coso Mountains to the north and the Argus Mountains to the east. The water shed for the Indian Wells Valley is approximately 860 square miles consisting of 500 square miles in the mountains and approximately 360 square miles on the valley floor. About 200,000 acre-feet (AF) of precipitation falls annually on the surrounding mountains and 100,000 AF of precipitation falls on the valley floor.

The Indian Wells Valley's only water source is from ground water extracted from the Indian Wells Valley Basin, so designated by the California Department of Water resources (see CDWR Bulletin 118-75). The ground water aquifer has been pumped by all Valley water producers for many years and the valley has experienced a growing population. Also, water is pumped from the Indian Wells Valley and exported to Searles Valley for use in the Trona and Argus communities. Well monitoring programs indicate the static ground water surface is declining about one foot to one and a half feet per year. This information was presented in detail in the "Preliminary Project Analysis and Detailed Project Work Plan" October 2003. Should the ground water become critically in an overdraft state, other water sources would have to be found. The new source of water would have to be treated and put into the distribution system or banked and used as an addition to the existing ground water. A grant was secured from the Department of Water Resources by IWVWD under the Safe Drinking Water, Watershed Protection and Flood Protection Act, commonly referred to as Proposition 13, for a feasibility study for recharging water into the ground in the Southwest Well Field which is within the Indian Wells Valley water aquifer.

PURPOSE:

The District's annual water production required to service the District's area has increased steadily since it inception in 1955. The District pumped about 1300 AF in 1965 to serve its customers and now pumps approximately 9500 AF. With an anticipated population growth, required pumping to service the District will be about 14,000 AF in the year 2030. With a declining ground water, other measures will be required.

The purpose of the Southwest Well Field Recharge Feasibility Study was to determine if water can be percolated into the ground in the Southwest Well Field to supplement the existing ground water by creating a localized ground water mound. Should the recharged water not form a localized mound, it would mean that it might be scattered throughout the aquifer or distributed in a manner that the efficiency of recovery would be less than desired. Also, should the water not reach the existing ground water and for some reason stay in the vadose zone, it would be useless as a supplemental source of water.

Any water for recharging the aquifer would come from a source outside of the Indian Wells Valley.

The most likely source of imported water would be water pumped through the Los Angeles Aqueduct. The imported water could possibly originate from outside Kern County or result from an exchange with Los Angeles Department of Water and Power for State project water and be wheeled to a place in Indian Wells Canyon, which is the closest location to the IWVWD's transmission lines. This water would be piped from the canyon to the Southwest Well Field and placed in percolation ponds. The feasibility pilot study would determine whether or not the water added to the recharge ponds will reach the existing ground water and exist in such a manner that it can be reasonably and efficiently extracted.

PROJECT:

To supplement the Detailed Project Work Plan as submitted to the California Department of Water Resources, the following is provided.

The project was begun by providing a CEQA document to clear and grub a two plus acre area for the construction of two percolation/recharge ponds. The location of the ponds are adjacent to existing Well 18 in the Southwest Well Field. The accompanying picture entitled "The Project Area" shows the ponds monitoring wells and production well and their location to one another. They are approximately one-acre each. They are designated as the East and West ponds. The total area was fenced using a six-foot high chain-link fence with tortoise fencing as required by CEQA. Piping to the pond are an 8-inch pipe from the transmission line between Wells 18 and 33. The outlets of the pipes are located at the north end of each pond. The outlets consist of stand pipes with a 180° bends at the top so the water impinges on a surface of broken concrete rip rap, see accompanying photos. The rip rap is used as an energy dissipater. The ponds were constructed with flat bottoms and 1 ½ to 1 side slopes with 10-foot wide berms. Floats were installed in each pond for the purpose of sensing the height of the water for the on/off switch to the well motor. The height settings were between one and two feet. A corrugated metal pipe surrounded the float to prevent wave action. A depth gauge was set adjacent to the float, outside the corrugated pipe so that the depth could be physically read.

Two 6-inch monitoring wells were constructed to 440 feet below ground surface which were perforated from 360 to 420 feet below ground surface and had an annular seal from 0 to 350 feet below ground surface. Monitoring well at the surface in shown in the accompanying photos. These wells are located on the north and south end of the recharge ponds outside the ponds along the centerline between the ponds. They were located in the immediate vicinity to identify when recharge water reaches the existing saturation zone. The monitoring wells are equipped with continuous data loggers that record water pressure at the probe setting, barometric pressure, pH, and conductance. The data loggers are down loaded once a week.

A weather station was installed to record wind speed, atmospheric temperature, and rainfall. An evaporation pan was constructed to estimate the onsite evaporation rate and was supplied with water from a source that replenished the evaporated water daily at midnight, see accompanying photos. Total evaporation is determined from the evaporation pan and is correlated with the depth of the ponds to determine surface area effected by the evaporation.

The original grading and clearing began in 1999-2000. The feasibility study began October 16, 2003 by pumping water into the west recharge pond. It was concluded that the well could only pump during the periods of low water demand months and would have to be returned to supplying the District distribution system during the spring and summer months or periods of heavy water demands. A spreadsheet is utilize to track data for the quantities of water pumped in the ponds, pond depths, evaporation, and rainfall and compute the net evaporation and infiltration rates, see Tables. The water was supplied continuously, stopping only when the water level of the pond reached 2 feet actuating the float switch. On February 6, 2004, the District switched from the west recharge pond to the east recharge pond because the rate of infiltration in the west pond had slowed significantly. A net total of 260 acre-feet of water percolated into the ground in the west pond. This pond was then disced after it had dried out. The discing was necessary to rework the bottom surface of the pond to eliminate or reduce algae buildup.

Water was pumped into the east recharge pond from February 6, 2004 until March 31, 2004 with a total net quantity of 190 acre-feet of water. During this time there was no indications of recharge water reaching the existing ground water. On March 31, 2004 the recharge water was again switched to the west pond and pumped into the west pond until April 30, 2004. Recharge operations were then discontinued because the District's distribution system demands required Well 18 to supply water into the distribution system. The accumulative total net quantity of water pumped into the west recharge pond was 337 acre-feet. The total net quantity of water pumped into the recharge ponds was 527 acre-feet. The data collectors in the two monitoring wells are read each week and are still monitored after many months of not pumping into the ponds. The data loggers indicate that the ground water elevation has not risen.

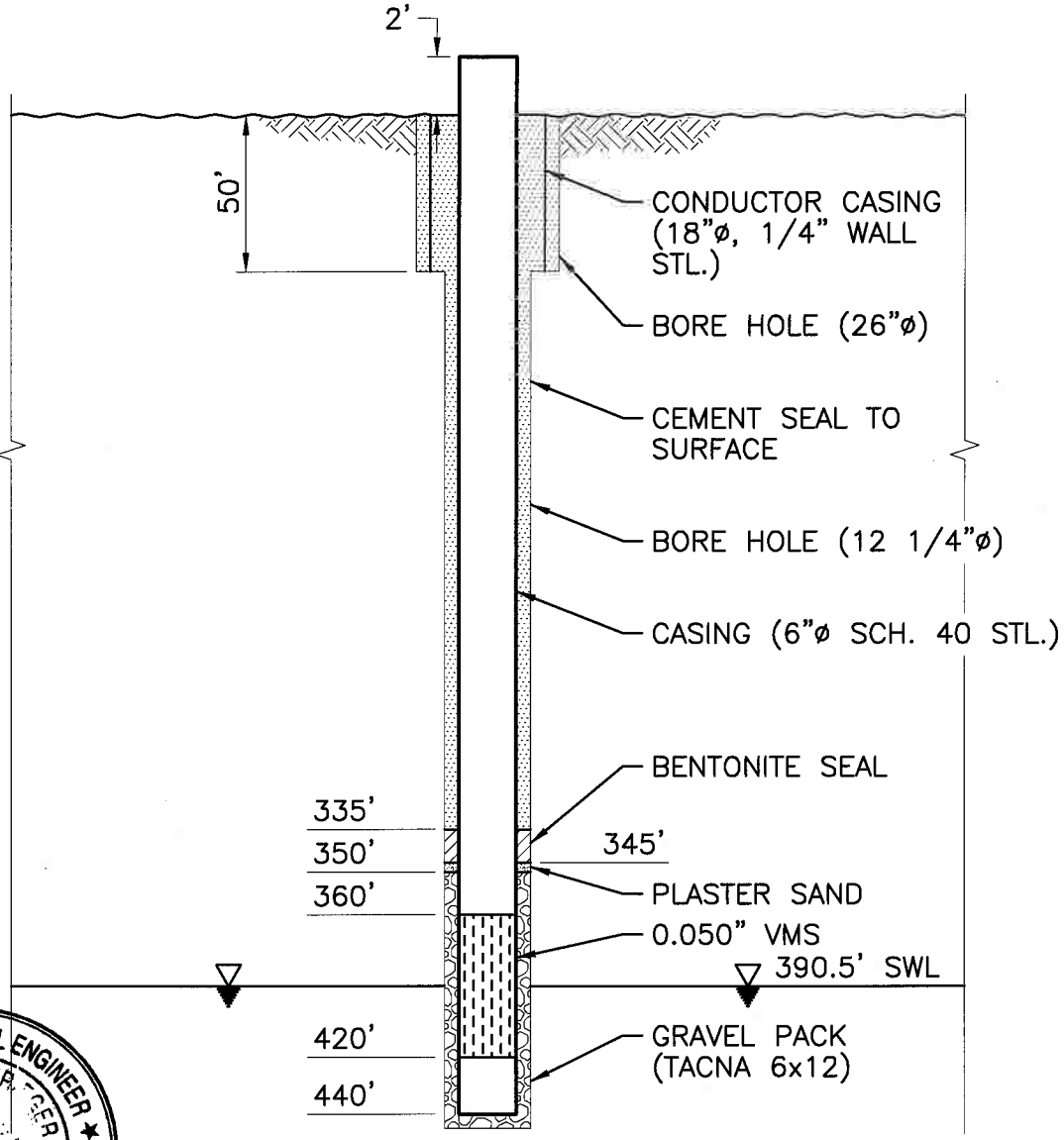
DISCUSSION:

There has been no reaction from the probes in the monitoring wells which would indicate the water has not reached the aquifer. Has the water gone down to a certain elevation and encountered a clay layer? Has the water found that the path of least resistance was to spread out in a porous coarse sand/gravel zone? Is the surface tension of the water between sand particles greater that the force of gravity? Or does it take a very long time for the percolated water to reach the water table? The only one of these questions that is significant is the later; the rest are academic. If it does not reach the water table, you can not pump it.

The water has not reached the water table at the time of writing this report. The District could drill a series of small diameter shallow monitoring wells around the pond in an effort to determine where the water went. This would be an expensive effort for an academic exercise in "nice to know" which would not add to the ultimate question "is it feasible to bank water in the Southwest Well Field?".

CONCLUSIONS:

The water has not reach the saturation zone and may take a long time to percolate to the zone. The distance from the surface to the saturation zone is greater than most percolation projects. The monitoring wells with data loggers will be continually monitored now and into the future.



REGISTERED PROFESSIONAL ENGINEER
CHARLES ARTHUR KRIEGER
No. [illegible]
Exp. 06/30/2008
CIVIL
STATE OF CALIFORNIA

RECORD DRAWING

BY: CAK DATE: 9.5.07

KRIEGER & STEWART, INCORPORATED

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INDIAN WELLS VALLEY WATER DISTRICT

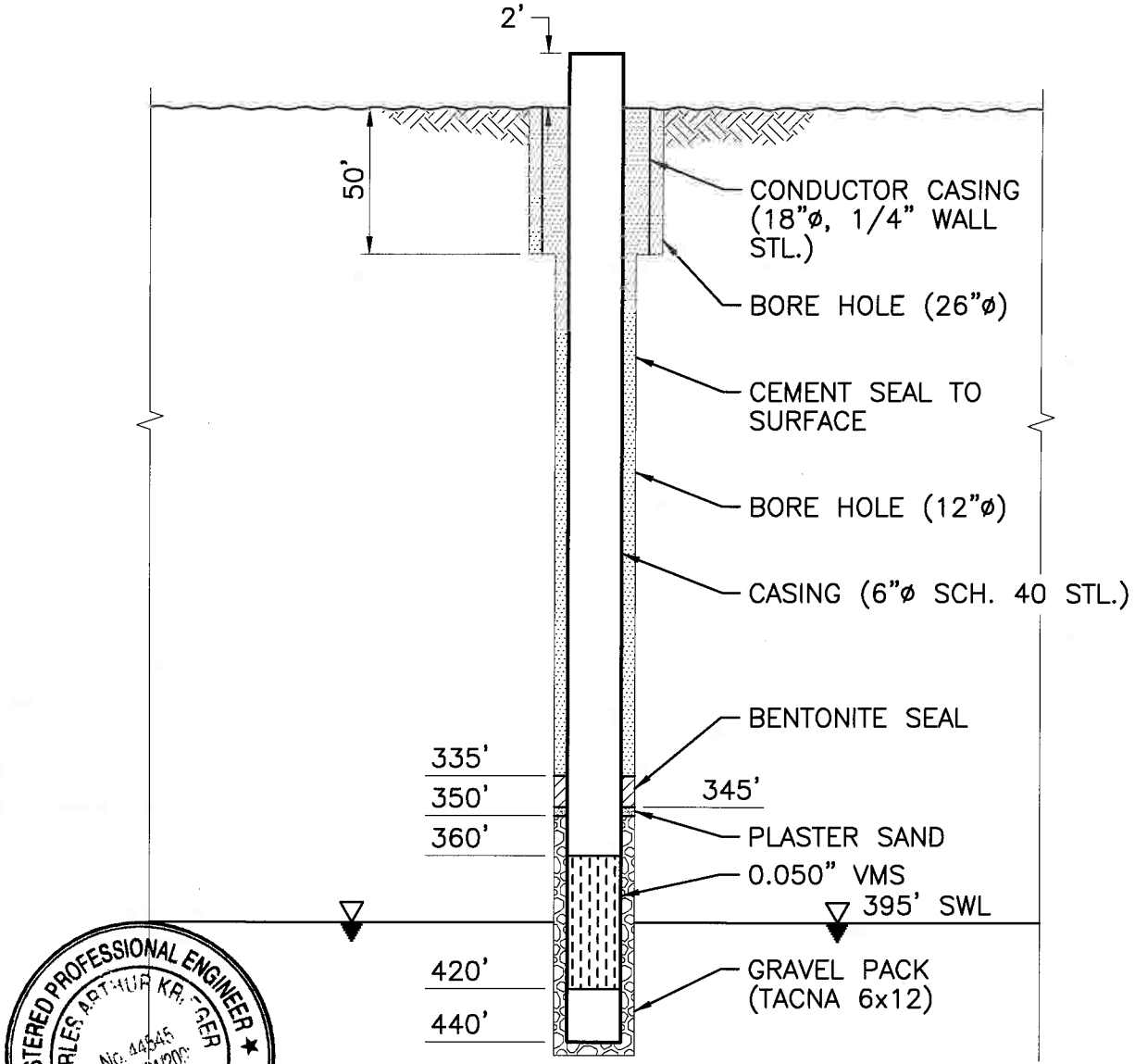
SOUTHWEST PILOT RECHARGE PROGRAM

MONITORING WELL 4, NORTHERLY CASING SCHEDULE

FIGURE 1 OF 4

SCALE: N.T.S. DATE: 8/31/07 DRAWN BY: PMD CHECKED BY: SS W.O.: 178-107.6

178-107f1-r.DWG



REGISTERED PROFESSIONAL ENGINEER
CHARLES ARTHUR KRIEGER
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STATE OF CALIFORNIA

RECORD DRAWING

BY: CAK DATE: 9.5.07

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INDIAN WELLS VALLEY WATER DISTRICT

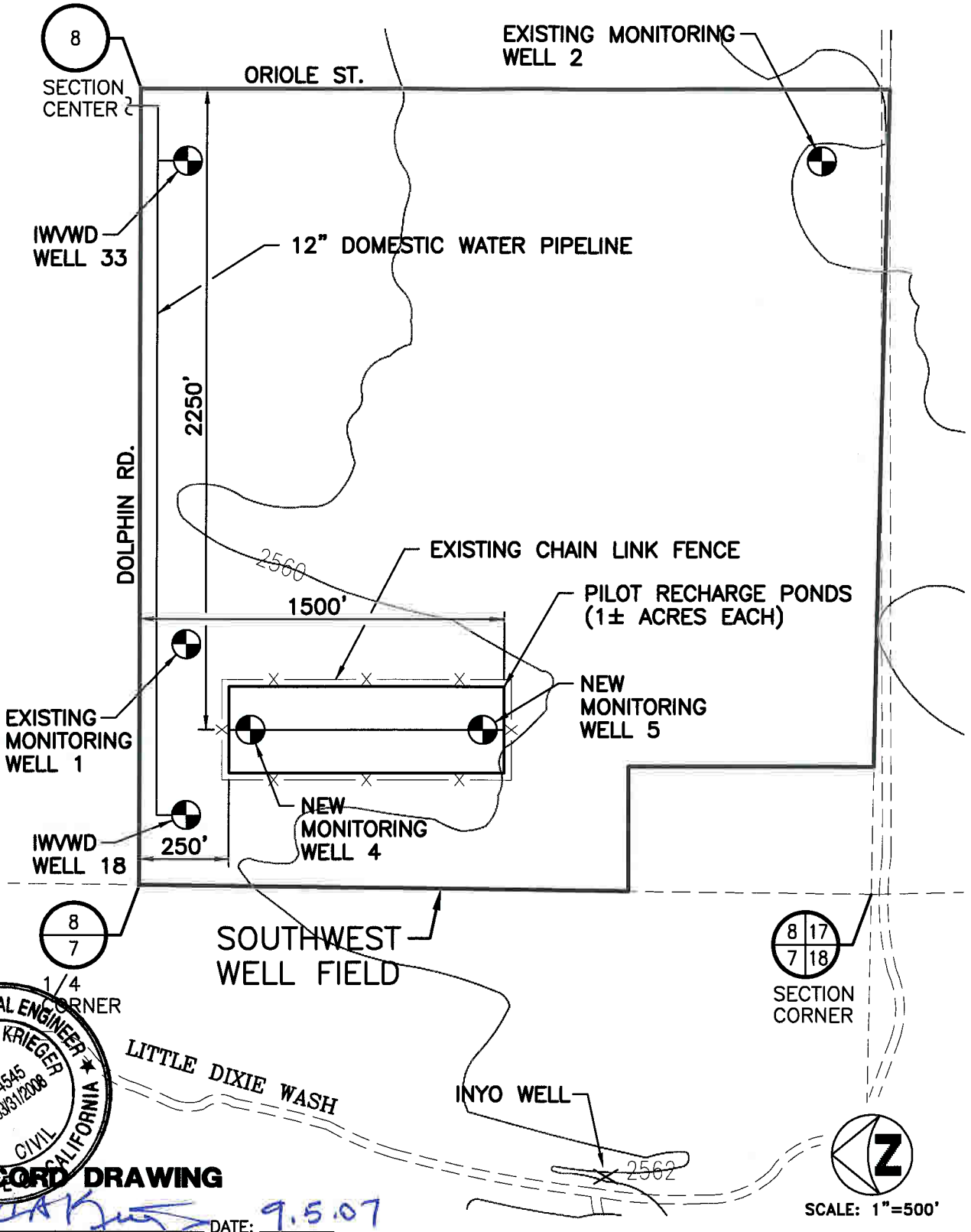
SOUTHWEST PILOT RECHARGE PROGRAM

MONITORING WELL 5, SOUTHERLY CASING SCHEDULE

FIGURE 2 OF 4

SCALE: N.T.S. DATE: 8/31/07 DRAWN BY: PMD CHECKED BY: SS W.O.: 178-107.6

178-107f2-r.dwg



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INDIAN WELLS VALLEY WATER DISTRICT

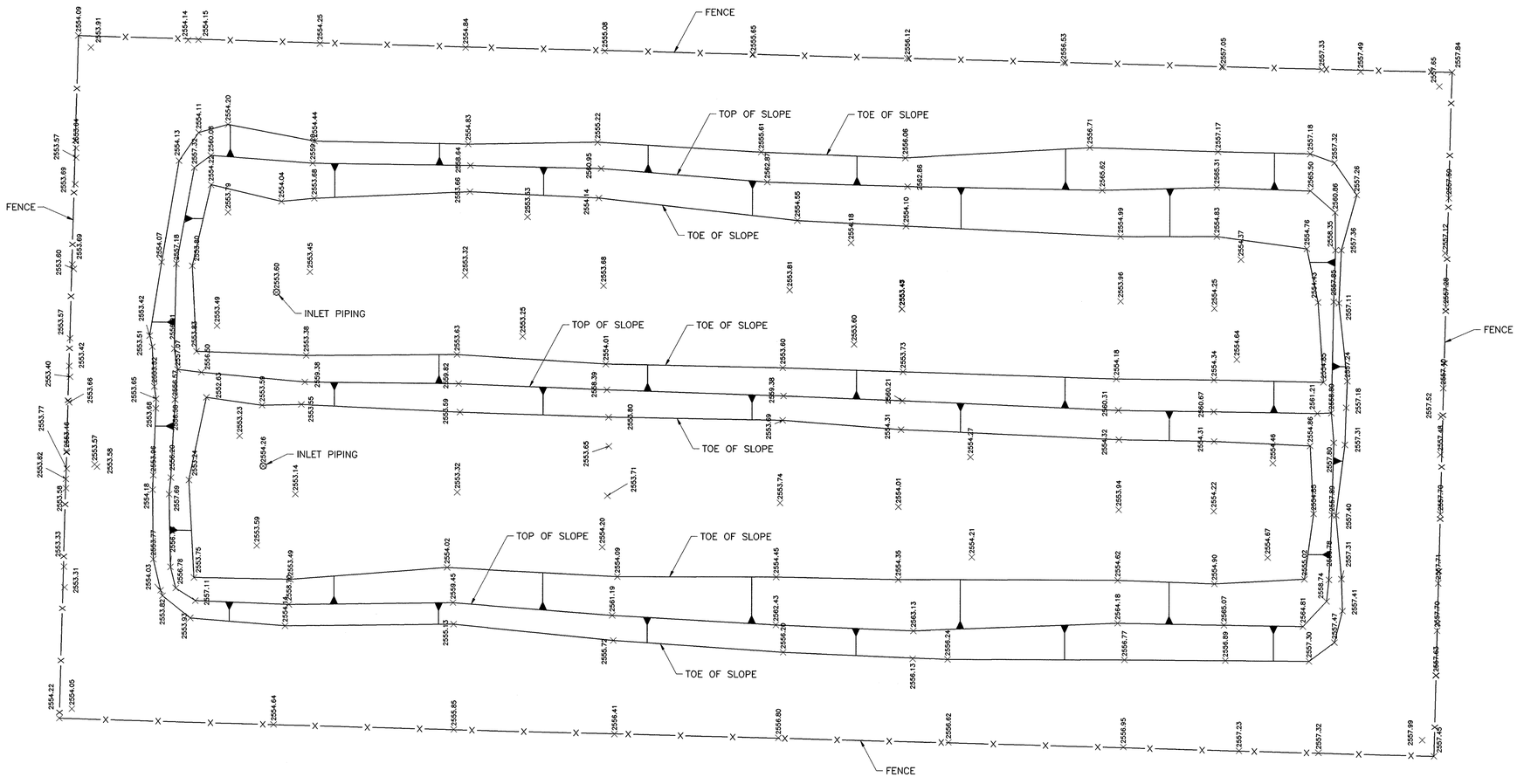
SOUTHWEST PILOT RECHARGE PROGRAM

MONITORING WELLS SITE MAP

FIGURE 3 OF 4

SCALE: 1"=500' DATE: 8/31/07 DRAWN BY: TMW CHECKED BY: CAK W.O.: 178-107.6

178-107f3-r.dwg



SCALE: 1"=30'

REGISTERED PROFESSIONAL ENGINEER
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RECORD DRAWING
BY: _____ DATE: 9.5.07
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INDIAN WELLS VALLEY WATER DISTRICT

SOUTHWEST PILOT RECHARGE PROGRAM
RECHARGE PONDS
TOPOGRAPHIC RECORD

FIGURE 4 OF 4

SCALE: 1"=30' | DATE: 09/05/07 | DRAWN BY: TMW | CHECKED BY: CAK | W.O.: 178-107.6

DWG. NO.: 178-10714-r FILE NO.: 178-107 UPDATE BY: SPK PROJ. ENG.: CAK PLOT DATE: 09/05/07 PLOT TIME: 3:16PM PLOT SCALE: 1=1

The Project Area

East Pond Discharge Pipe and Depth Gauge with Float Switch

East Pond Looking North

East Pond Float Switch and Depth Gauge

East Pond Discharge Pipe with Rip Rap in the Bottom

West Pond Drying out after Recharge
Water Rotated to East Pond

Construction of Monitoring Well

North Monitoring Well

Evaporation Pan and Weather Station

Evaporation Pan and Water Supply Tank

Propane Cannon

- This is part of the CEQA Mitigation for the protection of young tortoise from ravens.

SOUTHWEST WELL FIELD RECHARGE PILOT PROJECT

DATE	DAY	WELL 18 METER (GAL)		WEST BASIN									INFILTRATION				CITY OF RIDGECREST DATA (FOR COMPARISON)		
								EVAPORATION		PRECIPITATION		CUMULATIVE NET EVAPORATION (1)	CUMULATIVE NET (2)			RATE			
		DAILY	CUMULATIVE	DEPTH (IN)	DEPTH (FT)	SURFACE AREA (FT^2)	VOL (FT^3)	(IN)	(GAL)	(IN)	(GAL)	(GAL)	(GAL)	(CF)	(AF)	(FT/DAY)	EVAP (IN)	PAN : CITY RATIO	RAIN (IN)
10/10/03	FRIDAY	1405000	1405000	0	0.00	0	0		0	0.00	0	0	1405000	187834	4	4.93	0.41		
10/11/03	SATURDAY		1405000	0	0.00	0	0	0.798	0	0.00	0	0	1405000	187834	4		0.35	2.3	
10/12/03	SUNDAY		1405000	0	0.00	0	0	0.265	0	0.00	0	0	1405000	187834	4		0.31	0.8	
10/13/03	MONDAY		1405000	0	0.00	0	0	0.266	0	0.00	0	0	1405000	187834	4		0.24	1.1	
10/14/03	TUESDAY		1405000	0	0.00	0	0	0.289	0	0.00	0	0	1405000	187834	4		0.30	1.0	
10/15/03	WEDNESDAY		1405000	0	0.00	0	0	0.407	0	0.00	0	0	1405000	187834	4	?	0.25	1.6	
10/16/03	THURSDAY	1414000	2819000	0	0.00	0	0	0.397	0	0.00	0	0	2819000	376872	9	4.96	0.30	1.3	
10/17/03	FRIDAY	805000	3624000	0	0.00	0	0	0.254	0	0.00	0	0	3624000	484492	11	2.82	0.20	1.3	
10/18/03	SATURDAY	691333	4315333	0	0.00	0	0	0.252	0	0.00	0	0	4315333	576916	13	2.43	0.25	1.0	
10/19/03	SUNDAY	691333	5006666	0	0.00	0	0	0.260	0	0.00	0	0	5006666	669340	15	2.43	0.20	1.3	
10/20/03	MONDAY	691333	5697999	0	0.00	0	0	0.279	0	0.00	0	0	5697999	761765	17	2.43	0.20	1.4	
10/21/03	TUESDAY	710000	6407999	0	0.00	0	0	0.252	0	0.00	0	0	6407999	856684	20	2.49	0.20	1.3	
10/22/03	WEDNESDAY	780000	7195999	21	1.75	42230	70274	0.285	7528	0.00	0	7528	7188471	961025	22	2.74	0.25	1.1	
10/23/03	THURSDAY	632000	7827999	20	1.67	42031	66764	0.327	8567	0.00	0	16096	7811903	1044372	24	2.19	0.21	1.6	
10/24/03	FRIDAY	756000	8583999	22	1.83	42429	73802	0.256	6771	0.00	0	22866	8561133	1144536	26	2.63	0.20	1.3	
10/25/03	SATURDAY	753867	9337866	22.5	1.86	42529	75572	0.332	8801	0.00	0	31667	9305999	1244117	29	2.61	0.25	1.3	
10/26/03	SUNDAY	753867	10091333	22.5	1.86	42529	75572	0.363	9623	0.00	0	41290	10050043	1343589	31	2.61	0.25	1.5	
10/27/03	MONDAY	753667	10845000	23	1.92	42628	77346	0.256	6902	0.00	0	48093	10798907	1443437	33	2.62	0.20	1.3	
10/28/03	TUESDAY	729000	11574000	23	1.92	42628	77346	0.217	5766	0.00	0	53859	11520141	1540126	35	2.54	0.25	0.9	
10/29/03	WEDNESDAY	673000	12247000	20	1.67	42031	66764	0.288	7545	0.00	0	61404	12185596	1629090	37	2.34	0.45	0.6	
10/30/03	THURSDAY	824000	13071000	23	1.92	42628	77346	0.422	11213	0.00	0	72618	12998382	1737752	40	2.85	0.30	1.4	
10/31/03	FRIDAY	677000	13748000	21.5	1.79	42330	72036	0.357	9420	0.20	5277	76750	13671240	1827706	42	2.36	0.20	1.8	0.20
11/1/03	SATURDAY	750667	14498667	21.25	1.77	42280	71155	0.123	3242	0.00	0	80002	14418665	1927629	44	2.62	0.09	1.4	
11/2/03	SUNDAY	750667	15249334	21.25	1.77	42280	71155	0.052	1370	0.00	0	81372	15167962	2027802	47	2.63	0.16	0.3	
11/3/03	MONDAY	750667	16000001	21	1.75	42230	70274	0.164	4317	0.00	0	85689	15914312	2127582	49	2.62	0.15	1.1	
11/4/03	TUESDAY	669000	16669001	20	1.67	42031	66764	0.168	4401	0.00	0	90091	16606910	2220443	51	2.44	0.10	1.7	
11/5/03	WEDNESDAY	812000	17511001	23	1.92	42628	77346	0.112	2976	0.00	0	93067	17417934	2328601	53	2.84	0.15	0.7	
11/6/03	THURSDAY	805000	18316001	21.25	1.77	42280	71155	0.115	3031	0.00	0	96097	18219904	2435916	56	2.81	0.12	1.0	
11/7/03	FRIDAY	729000	19045001	20.25	1.69	42081	67640	0.147	3856	0.00	0	99953	18945048	2532760	58	2.54	0.12	1.2	
11/8/03	SATURDAY	896000	19941001	22.125	1.84	42454	74244	0.134	3546	0.04	1059	102441	19838560	2652214	61		0.07	1.9	0.04
11/9/03	SUNDAY	896000	20837001	22.125	1.84	42454	74244	0.090	2382	0.00	0	104822	20732179	2771882	64	?	0.09	1.0	
11/10/03	MONDAY	896000	21733001	24	2.00	42828	80907	0.052	1388	0.00	0	106211	21626790	2891282	66	1.05	0.11	0.5	
11/11/03	TUESDAY	782000	22495001	23.625	1.97	42753	79569	0.124	3305	0.00	0	109515	22385486	2992712	69	1.35	0.10	1.2	
11/12/03	WEDNESDAY	762000	23257001	23.25	1.94	42678	78235	0.141	3751	0.50	13301	99965	23157036	3095860	71		0.05	2.8	0.50
11/13/03	THURSDAY	960000	24217001	23	1.92	42628	77346	0.000	0	0.00	0	99965	24117036	3224203	74	3.37	0.10	0.0	
11/14/03	FRIDAY	605000	24822001	21	1.75	42230	70274	-0.002	0	0.00	0	99965	24722036	3305086	76	2.12	0.11	0.0	
11/15/03	SATURDAY	829000	25651001	20.625	1.72	42155	68956	-0.002	0	0.00	0	99965	25551036	3415914	78	2.91	0.07	0.0	
11/16/03	SUNDAY	829000	26480001	20.625	1.72	42155	68956	0.071	1866	0.00	0	101830	26378171	3526493	81	2.90	0.05	1.2	
11/17/03	MONDAY	829000	27309001	20.25	1.69	42081	67640	0.089	2335	0.00	0	104165	27204836	3637010	83	2.90	0.10	0.9	
11/18/03	TUESDAY	853000	28162001	19.75	1.65	41981	65888	0.068	1779	0.00	0	105944	28056057	3750810	86	2.99	0.11	0.6	
11/19/03	WEDNESDAY	935000	29097001	21.375	1.78	42305	71595	0.086	2268	0.00	0	108212	28988789	3875507	89	1.64	0.06	1.4	
11/20/03	THURSDAY	935000	30032001	23	1.92	42628	77346	0.078	2073	0.00	0	110285	29921716	4000229	92		0.10	0.8	
11/21/03	FRIDAY	808000	30840001	21	1.75	42230	70274	0.003	79	0.00	0	110364	30729637	4106240	94	2.83	0.29	0.0	
11/22/03	SATURDAY	857000	31697001	20.75	1.73	42180	69395	0.240	6310	0.00	0	116674	31580327	4221969	97	2.99	0.13	1.8	
11/23/03	SUNDAY	857000	32554001	20.75	1.73	42180	69395	0.138	3628	0.00	0	120302	32433699	4336056	100	2.99	0.10	1.4	
11/24/03	MONDAY	857000	33411001	20.5	1.71	42131	68517	0.053	1392	0.00	0	121694	33289307	4450442	102	3.00	0.05	1.1	
11/25/03	TUESDAY	969000	34380001	21	1.75	42230	70274	0.044	1158	0.00	0	122852	34257149	4579833	105	3.40	0.05	0.9	
11/26/03	WEDNESDAY	791000	35171001	21.25	1.77	42280	71155	0.077	2029	0.00	0	124882	35046119	4685310	108	2.77	0.05	1.5	
11/27/03	THURSDAY	832000	36003001	21	1.75	42230	70274	0.054	1421	0.00	0	126303	35876698	4796350	110	2.91	0.06	0.9	
11/28/03	FRIDAY	1048000	37051001	23	1.92	42628	77346	0.087	2312	0.00	0	128815	36922386	4936148	113	3.67	0.08	1.5	
11/29/03	SATURDAY	911000	37962001	21.375	1.78	42305	71595	0.021	554	0.00	0	129169	37832832	5057865	116	3.19	0.05	0.4	
11/30/03	SUNDAY	876000	38838001	21.375	1.78	42305	71595	0.112	2953	0.00	0	132122	38705879	5174583	119	3.06	0.05	1.9	
12/1/03	MONDAY	877000	39715001	19.75	1.65	41981	65888	0.020	523	0.00	0	132645	39582356	5291759	121	3.06			
12/2/03	TUESDAY	1092000	40807001	23.75	1.98	42778	80015	0.111	2960	0.00	0	135605	40671396	5437352	125	3.82			
12/3/03	WEDNESDAY	961000	41768001	23.25	1.94	42678	78235	0.090	2394	0.00	0	137999	41630002	5565508	128	3.36			
12/4/03	THURSDAY	913000	42681001	23.5	1.96	42728	79124	0.066	1758	0.00	0	139757	42541244	5687332	131	3.20			
12/5/03	FRIDAY	1020000	43701001	24	2.00	42828	80907	0.089	2376	0.00	0	142133	43558868	5823378	134	3.57			
12/6/03	SATURDAY	1014667	44715668	23.75	1.98	42778	80015	0.066	1760	0.00	0	143893	44571775	5958793	137	3.55			
12/7/03	SUNDAY	1014667	45730335	23.75	1.98	42778	80015	0.158	4213	0.00	0	148106	45582229	6093881	140	3.55			
12/8/03	MONDAY	1014667	46745002	23.5	1.96	42728	79124	0.291	7750	0.00	0	155857	46589145	6228495	143	3.53			
12/9/03	TUESDAY	985000	47730002	20	1.67	42031	66764	0.109	2856	0.00	0	158712	47571290	6359798	146	3.45			

SOUTHWEST WELL FIELD RECHARGE PILOT PROJECT

DATE	DAY	WELL 18 METER (GAL)		WEST BASIN									INFILTRATION				CITY OF RIDGECREST DATA (FOR COMPARISON)		
				DEPTH	DEPTH	SURFACE AREA	VOL	EVAPORATION		PRECIPITATION		CUMULATIVE NET EVAPORATION (1)	CUMULATIVE NET (2)			RATE			
		DAILY	CUMULATIVE	(IN)	(FT)	(FT^2)	(FT^3)	(IN)	(GAL)	(IN)	(GAL)	(GAL)	(GAL)	(CF)	(AF)	(FT/DAY)	EVAP (IN)	PAN : CITY RATIO	RAIN (IN)
12/10/03	WEDNESDAY	936000	48666002	19.5	1.63	41932	65014	0.095	2248	0.00	0	160960	48505042	6484631	149	3.28			
12/11/03	THURSDAY	1080000	49746002	22.25	1.85	42479	74686	0.201	5322	0.00	0	166282	49579720	6628305	152	3.77			
12/12/03	FRIDAY	995000	50741002	23	1.92	42628	77346	0.107	2843	0.00	0	169126	50571876	6760946	155	3.48			
12/13/03	SATURDAY	983000	51724002	22.75	1.90	42579	76458	-0.002	0	0.00	0	169126	51554876	6892363	158	3.45			
12/14/03	SUNDAY	983000	52707002	22.75	1.90	42579	76458	0.120	3185	0.00	0	172310	52534692	7023354	161	3.44			
12/15/03	MONDAY	983000	53690002	22.5	1.88	42529	75572	0.073	1935	0.00	0	174246	53515756	7154513	164	3.44			
12/16/03	TUESDAY	968000	54658002	20.75	1.73	42180	69995	0.085	2261	0.00	0	176507	54481496	7283622	167	3.39			
12/17/03	WEDNESDAY	968000	55626002	19	1.58	41832	63269	0.005	130	0.00	0	176637	55449365	7413017	170	3.40			
12/18/03	THURSDAY	945000	56571002	19	1.58	41832	63269	0.109	2842	0.00	0	179479	56391523	7538974	173	3.31			
12/19/03	FRIDAY	1010000	57581002	20.5	1.71	42131	66517	0.072	1891	0.00	0	181370	57399632	7673748	176	3.54			
12/20/03	SATURDAY	1008333	58589335	20	1.67	42031	66764	-0.001	0	0.00	0	181370	58407965	7808551	179	3.54			
12/21/03	SUNDAY	1008333	59597668	20	1.67	42031	66764	0.140	3666	0.00	0	185036	59412630	7942886	182	3.53			
12/22/03	MONDAY	1008333	60606001	19.5	1.63	41932	65014	0.020	523	0.00	0	185561	60420440	8077599	185	3.54			
12/23/03	TUESDAY	960000	61566001	19.75	1.65	41981	65888	0.086	2250	0.00	0	187811	61381190	8206041	188	3.37			
12/24/03	WEDNESDAY	1022000	62591001	21	1.75	42230	70274	0.000	0	0.00	0	187811	62403190	8342672	192	3.59			
12/25/03	THURSDAY	937000	63528001	20.5	1.71	42131	66517	-0.002	0	0.00	0	187811	63340190	8467940	194	3.29			
12/26/03	FRIDAY	937000	64465001	20	1.67	42031	66764	0.003	79	0.00	0	187890	64277111	8593197	197	3.29			
12/27/03	SATURDAY	946000	65411001	21.5	1.79	42330	72036	-0.001	0	0.00	0	187890	65223111	8719667	200	3.32			
12/28/03	SUNDAY	946000	66357001	21.5	1.79	42330	72036	0.000	0	0.00	0	187890	66169111	8846138	203	3.32			
12/29/03	MONDAY	946000	67303001	23	1.92	42628	77346	0.000	0	0.00	0	187890	67115111	8972608	206	3.32			
12/30/03	TUESDAY	889000	68192001	24	2.00	42828	80907	0.008	160	0.00	0	188050	68003951	9091437	209	3.12			
12/31/03	WEDNESDAY	585667	68777668	22.25	1.85	42479	74686	-0.001	0	0.00	0	188050	68589618	9169735	211	2.06			
1/1/04	THURSDAY	585667	69363335	22.25	1.85	42479	74686	0.052	1377	0.00	0	189427	69173908	9247849	212	2.05			
1/2/04	FRIDAY	585667	69949002	22.25	1.85	42479	74686	0.168	4448	0.00	0	193875	69755127	9325552	214	2.04			
1/3/04	SATURDAY	743667	70692669	22.625	1.89	42554	76015	0.001	27	0.00	0	193902	70496787	9424969	216	2.61			
1/4/04	SUNDAY	743667	71436336	22.625	1.89	42554	76015	0.039	1034	0.00	0	194936	71241400	9524251	219	2.61			
1/5/04	MONDAY	743667	72180003	23	1.92	42628	77346	0.000	0	0.00	0	194936	71985067	9623672	221	2.61			
1/6/04	TUESDAY	849000	72829003	22.75	1.90	42579	76458	0.000	0	0.00	0	194936	72634067	9710437	223	2.28			
1/7/04	WEDNESDAY	643000	73472003	22.25	1.85	42479	74686	0.000	0	0.00	0	194936	73277067	9796399	225	2.26			
1/8/04	THURSDAY	640000	74112003	21.5	1.79	42330	72036	0.000	0	0.00	0	194936	73917067	9881961	227	2.25			
1/9/04	FRIDAY	570000	74682003	24	2.00	42628	80907	0.000	0	0.00	0	194936	74487067	9958164	229	2.00			
1/10/04	SATURDAY	445000	75127003	21.5	1.79	42330	72036	0.001	26	0.00	0	194963	74932040	10017652	230	1.56			
1/11/04	SUNDAY	445000	75572003	21.5	1.79	42330	72036	0.001	26	0.00	0	194989	75377014	10077141	231	1.56			
1/12/04	MONDAY	445000	76017003	19	1.58	41832	63269	0.002	52	0.00	0	195041	75821962	10136626	233	1.56			
1/13/04	TUESDAY	520000	76537003	24	2.00	42628	80907	0.002	53	0.00	0	195095	76341908	10206137	234	1.82			
1/14/04	WEDNESDAY	344000	76881003	22	1.83	42429	73802	0.002	53	0.00	0	195148	76685855	10252120	235	1.21			
1/15/04	THURSDAY	338000	77219003	20.5	1.71	42131	66517	0.003	79	0.00	0	195226	77023777	10297296	236	1.19			
1/16/04	FRIDAY	446000	77665003	22.5	1.88	42529	75572	0.003	80	0.00	0	195306	77469697	10356911	238	1.56			
1/17/04	SATURDAY	334500	77999503	22.125	1.84	42454	74244	0.003	79	0.00	0	195385	77804118	10401620	239	1.17			
1/18/04	SUNDAY	334500	78334003	22.125	1.84	42454	74244	0.003	79	0.00	0	195465	78138538	10446329	240	1.17			
1/19/04	MONDAY	334500	78668503	22.125	1.84	42454	74244	0.003	79	0.00	0	195544	78472959	10491037	241	1.17			
1/20/04	TUESDAY	334500	79003003	21.75	1.81	42379	72918	0.078	2060	0.00	0	197605	78805398	10535481	242	1.17			
1/21/04	WEDNESDAY	320000	79323003	22	1.83	42429	73802	0.112	2962	0.00	0	200567	79122436	10577866	243	1.11			
1/22/04	THURSDAY	319000	79642003	23	1.92	42628	77346	0.124	3295	0.00	0	203862	79438141	10620072	244	1.11			
1/23/04	FRIDAY	322000	79964003	22	1.83	42429	73802	0.090	2380	0.00	0	206242	79757761	10662802	245	1.12			
1/24/04	SATURDAY	271667	80235670	21	1.75	42230	70274	0.102	2685	0.00	0	208927	80026743	10698762	246	0.94			
1/25/04	SUNDAY	271667	80507337	21	1.75	42230	70274	0.078	2053	0.00	0	210980	80296357	10734807	246	0.95			
1/26/04	MONDAY	271667	80779004	21	1.75	42230	70274	0.043	1132	0.00	0	212112	80568892	10770975	247	0.95			
1/27/04	TUESDAY	314000	81093004	21	1.75	42230	70274	0.068	1790	0.00	0	213902	80879102	10812714	248	1.10			
1/28/04	WEDNESDAY	334000	81427004	21	1.75	42230	70274	0.056	1737	0.00	0	215639	81211365	10857134	249	1.17			
1/29/04	THURSDAY	166000	81593004	20	1.67	42031	66764	0.078	2044	0.00	0	217683	81375321	10879054	250	0.58			
1/30/04	FRIDAY	325000	81918004	21.75	1.81	42379	72918	0.216	5706	0.00	0	223389	81694615	10921740	251	1.12			
1/31/04	SATURDAY	259333	82177337	21.75	1.81	42379	72918	0.139	3672	0.00	0	227061	81950276	10955919	252	0.90			
2/1/04	SUNDAY	259333	82436670	21.75	1.81	42379	72918	0.065	1717	0.00	0	228778	82207892	10990360	252	0.90			
2/2/04	MONDAY	259333	82696003	21.75	1.81	42379	72918	0.066	1743	0.00	0	230521	82465482	11024797	253	0.90			
2/3/04	TUESDAY	269000	82965003	23	1.92	42628	77346	0.113	3003	0.00	0	233524	82731479	11060358	254	0.93			
2/4/04	WEDNESDAY	158000	83123003	20.5	1.71	42131	66517	0.111	2915	0.00	0	236439	82886564	11081091	254	0.54			
2/5/04	THURSDAY	283000	83406003	22	1.83	42429	73802	0.111	2936	0.00	0	239375	83166628	11118533	255	0.98			
2/6/04	FRIDAY	1671000	85077003	15.75	1.31	41188	52027	0.075	1926	0.00	0	241300	84835703	11341672	260	5.86			
2/7/04	SATURDAY	1217666	86294669	20.63	1.72	42156	68974	0.176	4677	0.00	0	245978	86048691	11503836	264	4.26			
2/8/04	SUNDAY	1217666	87512335	20.63	1.72	42156	68974	0.075	1971	0.00	0	241345	87270990	11667245	268	4.29			

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last data entry 3/9/04

INDIAN WELLS VALLEY WATER DISTRICT

SOUTHWEST WELL FIELD RECHARGE PILOT PROJECT

DATE	DAY	WELL 18 METER (GAL)		EAST BASIN									INFILTRATION				CITY OF RIDGECREST DATA (FOR COMPARISON)		
								EVAPORATION		PRECIPITATION		CUMULATIVE NET EVAPORATION (1)	CUMULATIVE NET (2)			RATE			
		DAILY	CUMULATIVE	DEPTH (IN)	DEPTH (FT)	SURFACE AREA (FT^2)	VOL (FT^3)	(IN)	(GAL)	(IN)	(GAL)	(GAL)	(GAL)	(CF)	(AF)	(FT/DAY)	EVAP (IN)	PAN : CITY RATIO	RAIN (IN)
2/6/04	FRIDAY	1671000	85077003	19.75	1.65	41981	69388	0.075	1963	0.00	0	1963	85075040	11373668	261	---			
2/7/04	SATURDAY	1217666	86294669	22.63	1.89	42555	76033	0.178	4722	0.00	0	6684	86287985	11536827	265	4.26			
2/8/04	SUNDAY	1217666	87512335	22.63	1.89	42555	76033	0.075	1989	0.00	0	8674	87503861	11698350	269	4.27			
2/9/04	MONDAY	1217666	88730001	25.5	2.13	43447	86722	0.106	2871	0.00	0	11544	88718457	11860756	272	4.28			
2/10/04	TUESDAY	1152000	89882001	24	2.00	43134	81311	0.118	3173	0.00	0	14717	89867284	12014343	276	4.03			
2/11/04	WEDNESDAY	992000	90874001	24.25	2.02	43186	82210	0.107	2880	0.00	0	17597	90856404	12146578	279	3.47			
2/12/04	THURSDAY	1108000	91982001	25.25	2.10	43396	85817	0.094	2543	0.00	0	20140	91961861	12294366	282	3.88			
2/13/04	FRIDAY	1159000	93141001	25.5	2.21	43656	90351	0.074	2014	0.00	0	22154	93118647	12449044	286	4.06			
2/14/04	SATURDAY	1131000	94272001	25	2.08	43342	84914	0.085	2296	0.00	0	24450	94247551	12599940	289	3.96			
2/15/04	SUNDAY	1131000	95403001	25	2.08	43342	84914	0.107	2891	0.00	0	27341	95375660	12750757	293	3.96			
2/16/04	MONDAY	1131000	96534001	25	2.08	43342	84914	0.187	5052	0.00	0	32393	96501606	12901284	296	3.95			
2/17/04	TUESDAY	1131000	97665001	23.5	1.96	43030	79516	0.152	4077	0.00	0	36470	97628531	13051943	300	3.95			
2/18/04	WEDNESDAY	790000	98455001	10	0.83	40239	32681	0.080	2157	0.00	0	38627	98416374	13157269	302	2.76			
2/19/04	THURSDAY	1515000	99970001	24	2.00	43134	81311	0.119	3200	0.00	0	41827	99928174	13358382	307	5.30			
2/20/04	FRIDAY	1081000	101051001	21.25	1.77	42562	71491	0.000	0	0.00	0	41827	101009174	13503900	310	3.79			
2/21/04	SATURDAY	1175000	102226001	21.13	1.76	42537	71066	0.010	265	0.00	0	42092	102183909	13660950	314	4.12			
2/22/04	SUNDAY	1175000	103401001	21.13	1.76	42537	71066	0.000	0	0.00	0	42092	103358909	13818036	317	4.12			
2/23/04	MONDAY	1175000	104576001	21	1.75	42510	70605	0.001	26	0.00	0	42118	104533883	13975118	321	4.12			
2/24/04	TUESDAY	1255000	105831001	23.5	1.96	43030	79516	0.090	2414	0.00	0	44532	105786469	14142576	325	4.40			
2/25/04	WEDNESDAY	1534000	107365001	24	2.00	43134	81311	0.066	1775	0.00	0	46307	107318994	14347419	329	5.38			
2/26/04	THURSDAY	1046000	108411001	22.5	1.88	42822	75938	0.089	2376	0.00	0	48682	108362319	14486941	333	3.66			
2/27/04	FRIDAY	1074000	109485001	21.25	1.77	42562	71491	0.066	1751	0.00	0	50433	109434566	14630290	336	3.76			
2/28/04	SATURDAY	1281333	110766334	21.25	1.77	42562	71491	0.156	4192	0.00	0	54625	110711709	14801031	340	4.48			
2/29/04	SUNDAY	1281333	112047667	21.25	1.77	42562	71491	0.291	7720	0.00	0	62345	111985322	14971300	344	4.47			
3/1/04	MONDAY	1281333	113329000	23.25	1.94	42978	78620	0.001	27	0.00	0	62372	113266628	15142597	348	4.50			
3/2/04	TUESDAY	1300000	114629000	24	2.00	43134	81311	0.001	27		0	62399	114566601	15316390	352	4.56			
3/3/04	WEDNESDAY	1197000	115826000	22.5	1.88	42822	75938	0.001	27		0	62426	115763574	15476414	355	4.20			
3/4/04	THURSDAY	1554000	117380000	21.75	1.81	42666	73267	0.001	27		0	62452	117317548	15684164	360	5.45			
3/5/04	FRIDAY	1077000	118457000	23.25	1.94	42978	78620	0.002	54		0	62506	118394494	15828141	363	3.78			
3/6/04	SATURDAY	1346000	119803000	23.25	1.94	42978	78620	0.002	54		0	62560	119740440	16006080	367	4.72			
3/7/04	SUNDAY	1346000	121149000	23.25	1.94	42978	78620	0.003	80		0	62640	121086360	16188016	372	4.72			
3/8/04	MONDAY	1346000	122495000	21.25	1.77	42562	71491	0.004	106		0	62746	122432254	16367948	376	4.72			
3/9/04	TUESDAY	1526000	124021000	22	1.83	42718	74156	0.123	3275		0	66021	123954979	16571521	380	5.34			
3/10/04	WEDNESDAY	1314000	125335000	23.5	1.96	43030	79516	0.001	27		0	66048	125268952	16747186	384	4.61			
3/11/04	THURSDAY	1132000	126467000	21	1.75	42510	70605	0.011	291		0	66340	126400660	16898484	388	3.97			
3/12/04	FRIDAY	1248000	127715000	24	2.00	43134	81311	0.004	108		0	66447	127648553	17065315	392	4.38			
3/13/04	SATURDAY	1263000	128978000	24	2.00	43134	81311	0.105	2823		0	69270	128908730	17233787	396	4.42			
3/14/04	SUNDAY	1263000	130241000	24	2.00	43134	81311	0.251	6749		0	76019	130164981	17401735	399	4.41			
3/15/04	MONDAY	1263000	131504000	23.5	1.96	43030	79516	0.157	4211		0	80230	131423770	17570023	403	4.42			
3/16/04	TUESDAY	1329000	132833000	22.5	1.88	42822	75938	0.203	5419		0	85648	132747352	17746972	407	4.64			
3/17/04	WEDNESDAY	1116000	133949000	22.5	1.88	42822	75938	0.224	5979		0	91627	133857373	17895371	411	3.89			
3/18/04	THURSDAY	1116000	135065000	21	1.75	42510	70605	0.176	4717		0	96344	134968656	18043938	414	3.90			
3/19/04	FRIDAY	1178000	136243000	22.25	1.85	42770	75047	0.224	5972		0	102316	136140684	18200626	418	4.11			
3/20/04	SATURDAY	1065000	137308000	22.25	1.85	42770	75047	0.212	5652		0	107968	137200032	18342250	421	3.72			
3/21/04	SUNDAY	1065000	138373000	22.25	1.85	42770	75047	0.197	5252		0	113220	138259780	18483928	424	3.72			
3/22/04	MONDAY	1065000	139438000	22	1.83	42718	74156	0.209	5566		0	118785	139319215	18625564	428	3.72			
3/23/04	TUESDAY	885000	140323000	22.5	1.88	42822	75938	0.285	7607		0	126392	140196608	18742962	430	3.08			
3/24/04	WEDNESDAY	916000	141239000	25	2.08	43342	84914	0.259	6997		0	133389	141106611	18864386	433	3.19			
3/25/04	THURSDAY	731000	141970000	23	1.92	42926	77725	0.230	6154		0	139544	141830456	18961291	435	2.54			
3/26/04	FRIDAY	775000	142745000	24.5	2.04	43238	83110	0.316	8517		0	148060	142596940	19063762	438	2.69			
3/27/04	SATURDAY	708000	143453000	24.8	2.07	43301	84192	0.299	7800		0	155861	143297139	19157372	440	2.46			
3/28/04	SUNDAY	708000	144161000	22.5	1.88	42822	75938	0.132	3523		0	159384	144001616	19251553	442	2.47			
3/29/04	MONDAY	708000	144869000	24.8	2.07	43301	84192	0.229	6181		0	165565	144703435	19345379	444	2.46			
3/30/04	TUESDAY	685000	145554000	22.5	1.88	42822	75938	0.173	4618		0	170183	145383817	19438339	446	2.39			
3/31/04	WEDNESDAY	1197000	146751000	5.5	0.46	39318	17784	0.282	6911		0	177094	146573906	19595442	450	4.19			
3/6/04																			
NOTES:						94652													
(1) cumulative net evaporation = cumulative evaporation-precipitation							707996.96												
(2) cumulative infiltration = cumulative discharge - cumulative net evaporation																			

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SOUTHWEST WELL FIELD RECHARGE PILOT PROJECT

DATE	DAY	WELL 18 METER (GAL)		WEST BASIN									INFILTRATION				CITY OF RIDGECREST DATA (FOR COMPARISON)		
								EVAPORATION		PRECIPITATION		CUMULATIVE NET EVAPORATION (1)	CUMULATIVE NET (2)			RATE			
		DAILY	CUMULATIVE	DEPTH (IN)	DEPTH (FT)	SURFACE AREA (FT^2)	VOL (FT^3)	(IN)	(GAL)	(IN)	(GAL)	(GAL)	(GAL)	(CF)	(AF)	(FT/DAY)	EVAP (IN)	PAN : CITY RATIO	RAIN (IN)
2/9/04	MONDAY	1217666	88730001	0	0.00	38198	0	0.108	2524	0.00	0	225913	88504088	11832097	272	4.33			
2/8/04	SUNDAY	1217666	89947667	20.63	1.72	42156	68974	0.075	1971	0.00	0	247948	89699719	11991941	275	4.20			
3/31/04	WEDNESDAY	1197000	91144667	20.25	1.69	42091	67640	0.249	6531		0	247877	90696790	12151977	279	4.20			
4/1/04	THURSDAY	832000	91976667	18	1.50	41634	59792	0.196	5087		0	230999	91745868	12265464	282	2.98			
4/2/04	FRIDAY	597000	92573667	18	1.50	41634	59792	0.162	4204		0	252153	92321514	12342448	283	2.02			
4/3/04	SATURDAY	686000	93259667	18	1.50	41634	59792	0.001	26		0	247903	93011764	12434728	285	2.42			
4/4/04	SUNDAY	686000	93945667	18	1.50	41634	59792	0.134	3478		0	234477	93711190	12528234	288	2.45			
4/5/04	MONDAY	686000	94631667	20.5	1.71	42131	68517	0.190	4990		0	257142	94374525	12616915	290	2.33			
4/6/04	TUESDAY	649000	95280667	19	1.58	41832	63269	0.298	7771		0	255673	95024994	12703678	292	2.28			
4/7/04	WEDNESDAY	632000	95912667	19.25	1.60	41882	64141	0.240	6266		0	240742	95671925	12790364	294	2.27			
4/8/04	THURSDAY	847000	96759667	22.5	1.88	42529	75572	0.238	6309		0	263451	96496216	12900564	295	2.89			
4/9/04	FRIDAY	607000	97366667	22	1.83	42429	73802	0.245	6490		0	262153	97104514	12981887	298	2.13			
4/10/04	SATURDAY	703667	98070334	22	1.83	42429	73802	0.254	6718		0	247460	97822674	13077924	300	2.52			
4/11/04	SUNDAY	703667	98774001	22	1.83	42429	73802	0.225	5951		0	269402	98504599	13168064	302	2.39			
4/12/04	MONDAY	703667	99477668	19	1.58	41832	63269	0.260	6780		0	268932	99209736	13263200	304	2.47			
4/13/04	TUESDAY	982000	100459668	20.5	1.71	42131	68517	0.398	10452		0	257912	100201756	13395957	308	3.48			
4/14/04	WEDNESDAY	695000	101154668	22.75	1.90	42579	76456	0.355	9422		0	278824	100875844	13486075	310	2.37			
4/15/04	THURSDAY	622000	101776668	19.75	1.65	41981	65888	0.316	8269		0	277202	101499466	13569447	312	2.19			
4/16/04	FRIDAY	772000	102548668	20.75	1.73	42180	69395	0.288	7572		0	265484	102283184	13674222	314	2.75			
4/17/04	SATURDAY	732667	103281335	20	1.67	42031	66764	0.258	6759		0	285584	102995751	13769485	316	2.60			
4/18/04	SUNDAY	732667	104014002	20	1.67	42031	66764	0.185	4847		0	282049	103731953	13867906	318	2.58			
4/19/04	MONDAY	732667	104746669	19	1.58	41832	63269	0.270	7040		0	272525	104474144	13967132	321	2.60			
4/20/04	TUESDAY	929000	105675669	21	1.75	42230	70274	0.262	6897		0	292480	105383189	14088682	323	3.19			
4/21/04	WEDNESDAY	876000	106551669	19	1.58	41832	63269	0.470	12256		0	294304	106257365	14205530	326	3.07			
4/22/04	THURSDAY	611000	107162669	19.25	1.60	41882	64141	0.350	9137		0	281662	106881007	14288906	328	2.19			
4/23/04	FRIDAY	829000	107991669	21.75	1.81	42379	72918	0.304	8031		0	300511	107691158	14397214	331	2.84			
4/24/04	SATURDAY	834333	108826002	21	1.75	42230	70274	0.236	6212		0	300516	108625486	14506755	333	2.93			
4/25/04	SUNDAY	834333	109660335	21	1.75	42230	70274	0.276	7265		0	288927	109371408	14621846	336	2.97			
4/26/04	MONDAY	834333	110494668	21.5	1.79	42330	72036	0.262	6913		0	307424	110187244	14730915	338	2.96			
4/27/04	TUESDAY	964000	111458668	22.5	1.88	42529	75572	0.377	9994		0	310511	111148157	14859379	341	3.37			
4/28/04	WEDNESDAY	979000	112437668	19.75	1.65	41981	65888	0.534	13974		0	302901	112134767	14991279	344	3.46			
4/29/04	THURSDAY	945000	113382668	18.5	1.54	41733	61526	0.266	6920		0	314343	113068325	15116066	347	3.28			
4/30/04	FRIDAY	739000	114121668	21	1.75	42230	70274	0.192	5054		0	315565	113806103	15214720	349	2.59			

NOTES:

(1) cumulative net evaporation = cumulative evaporation-precipitation

(2) cumulative infiltration = cumulative discharge - cumulative net evaporation

(3) Blue cells are raw data entry cells. Yellow cells are interpolated or averaged. Light green cells are assumed. Uncolored cells are calculated. Orange cells are questionnable.

INDIAN WELLS VALLEY WATER DISTRICT

DWR Grant Contract F77006 (Proposition 13)
Project Progress

ITEM	DATE
Original Workplan with completion date of January 2003	2/12/2001
Monitoring wells drilled by Howard Pump (now Layne Christensen) of Yermo, CA	5/12 - 6/12/2003
Preliminary Project Analysis and Detailed Project Workplan The following items are listed as "complete" in this new Workplan: • Construction of tortoise-proof fence • Construction of pilot recharge basins • Construction of the monitoring wells • Installation of monitoring well equipment • Installation of evaporation rate equipment	June 2003 (revised October 2003)
Commenced recording evaporation data	7/9/2003
First Quarterly Report submitted to DWR (delays noted due to personnel changes)	8/6/2003
Started the filling of westerly recharge pond	10/10/2003
Commenced recording of water level, pH and TDS. Also installed propane-powered cannon to scare off ravens that threaten the desert tortoise.	10/15/2003
Second Quarterly Report submitted to DWR • Site grading completed • Well 18 dedicated to the recharge project • All facilities installed & operational • Sides of ponds sloped & bottoms scarified • Wells equipped with sensors to record water level, pH and TDS	January 2004
Commence filling of easterly pond.	2/4/2004
Stop filling easterly pond and redirect Well 18 to fill west pond.	3/31/2004
Scarify floor of west pond.	Feb and Mar 2004
Third Quarterly Report submitted to DWR	4/29/2004
Suspend recharge project. Well 18 needed to provide water to distribution system.	4/30/2004
Letter from DWR extending completion date of study from 10/31/04 to 4/30/05 and report submission from 1/31/05 to 7/31/05 at the request of General Manager Tom Mulvihill.	1/24/2005
Final Report submitted to DWR (originally due 7/31/05)	November 2005

9/12/07
REM

INDIAN WELLS VALLEY WATER DISTRICT

September 12, 2007

As General Manager of the Indian Wells Valley Water District, I certify that project work conducted under DWR Grant Contract F77006 (Proposition 13) was completed in accordance with the approved work plan submitted June 2003 (revised October 2003).

Thomas Mulvihill