

APPENDIX C

Hydrology Appendix

**Table 1. Recharge and water-holding properties of surficial soils
Roblar Road Quarry, Sonoma County, California**

Map Symbol	Soil Series ¹	Parent Material	Taxonomy (order, subgroup, family)	Hydrologic Soil Group	Project Area Coverage (% estimated)	Depth Zone (inches)	USCS ²	Attenberg Limits		Permeability (inches/hour)	Available Water Capacity ³		Reaction (pH)	Remarks
								Liquid	Plastic		Per Inch (in./in. of soil)	Profile (total, in)		
SnD2	Steinbeck loam, 9% to 15% slopes, eroded	weakly to moderately consolidated Wilson Grove sandstone	Alfisols	B (moderate infiltration and runoff potential)	40%	0 to 24	CL	25-35	10-20	0.63 to 2.0	0.16 to 0.18	3.8	5.1 to 5.5	Most of the proposed quarry area is covered with this soil.
			Mollic Haploxeraalfs			24 to 45	CL	30-40	20-30		0.18 to 0.21	3.8	5.6 to 6.0	
			Fine-loamy, mixed, mesic			<i>Total</i>		7.6						
SnE, SnE2	Steinbeck loam, 15% to 30% slopes	weakly to moderately consolidated Wilson Grove sandstone	Alfisols	B (moderate infiltration and runoff potential)	15%	0 to 21	CL	25-35	10-20	0.63 to 2.0	0.16 to 0.18	3.4	5.1 to 5.5	Areas north of the proposed quarry, including the existing landfill area.
			Mollic Haploxeraalfs			21 to 40	CL	30-40	20-30		0.18 to 0.21	3.4	5.6 to 6.0	
			Fine-loamy, mixed, mesic			<i>Total</i>		6.8						
SnF	Steinbeck loam, 30% to 50% slopes	weakly to moderately consolidated Wilson Grove sandstone	Alfisols	B (moderate infiltration and runoff potential)	15%	0 to 18	CL	25-35	10-20	0.63 to 2.0	0.16 to 0.18	2.9	5.1 to 5.5	Areas north of the proposed quarry, and east the existing landfill area.
			Mollic Haploxeraalfs			18 to 36	CL	30-40	20-30		0.18 to 0.21	3.1	5.6 to 6.0	
			Fine-loamy, mixed, mesic			<i>Total</i>		5.9						
LoF2	Los Osos clay loam, 30% to 50% slopes, eroded	Weathered, fractured sandstone and shale	Mollisols	C (slow infiltration, high runoff potential)	20%	0 to 12	CL or ML	35-45	10-20	0.2 to 0.63	0.19 to 0.21	2.3	5.6 to 6.0	Areas on the south and west portions of the site.
			Typic Argixerolls			12 to 28	CL or ML	35-50	10-25		0.14 to 0.16	2.2	6.6 to 7.3	
			Fine, montmorillonitic, thermic			<i>Total</i>		4.5						
CeB	Clear Lake clay, 2% to 5% slopes	Alluvium; soils formed under poor drainage conditions	Mollisols	D (very slow infiltration, very high runoff)	> 5%	0 to 60	CH	50-60	20-35	0.06 to 0.2	0.14 to 0.16	8.4	5.1 to 8.4	Found in the southwest portion of the site near Americano Creek and Ranch Tributary.
			Typic Haplaquolls			60 to 72	SC	15-25	5-10		0.14 to 0.16	1.7	7.4 to 8.4	
			Coarse-loamy, noncalcareous, mesic			<i>Total</i>		10.1						
BCA	Blucher fine sandy loam, overwash, 0% to 2% slopes	Alluvium; soils of stream bottoms and alluvial fans, somewhat poorly drained loam	Vertisols	C (slow infiltration, high runoff potential)	< 5%	0 to 34	SM or CL	20-40	0-35	0.63 to 0.2	0.14 to 0.18	4.8	5.6 to 8.4	Found in the southwest portion of the site near Americano Creek.
			Typic Pelloxererts			34 to 72	ML or CL	40-50	10-30		0.19 to 0.21	7.2	7.4 to 8.4	
			Fine, montmorillonitic, thermic			<i>Total</i>		12.0						

Notes

- Information taken from the most-recent USDA soil survey for the area (1972), and/or Soil Survey Laboratory Data for Some Soils of California (Soil Survey Investigations Report No. 24), 1973. This soil survey generally does not distinguish areas smaller
- USCS = Unified Soils Classification System, commonly used in geotechnical or soil-foundation investigations, and in routine engineering geologic logging.
- Available Water Capacity = Held water available for use by most plants, usually defined as the difference between the amount of soil water at field capacity (one day of drainage after a rain or recharge event) and the amount at the wilting point.

Table 2. Summary of field measurements and water quality analyses, Roblar Road Quarry, Sonoma County, California

PARAMETER	UNITS	REPORTING LIMIT	MCL	Sampled Waters			
DESCRIPTORS				F061023001	F061023002	F061023003	F061023004
Lab I.D.				Americano Creek	Americano Creek	Ranch Tributary	Center Swale
Site				at Canfield Rd	at Roblar Rd	Outlet	Spring Box
Latitude, NAD27	degrees			N38.32398	N38.31723	N38.31429	N38.31579
Longitude, NAD27	degrees			W122.79627	W122.80852	W122.80812	W122.80017
Elevation, NGVD29	feet			260	115	118	455
Lab used				Caltest	Caltest	Caltest	Caltest
Sample collected by				gp, mw	gp, mw	gp, mw	gp, mw
Sample filtering				yes	yes	yes	yes
FIELD MEASUREMENTS							
Date	MM/DD/YY			6/28/2005	6/28/2005	6/28/2005	6/28/2005
Time	HH:MM			10:30	11:30	11:50	15:00
Specific conductance (@ 25 C°)	umhos/cm			475	511	574	216
Conductance (@ field temp)	umhos/cm			386	431	504	179
Temperature	deg C			15.2	16.8	18.3	16.0
WATER QUALITY INDICATORS							
Alkalinity (total)	mg/L CaCO3	10		130	140	130	46
Hardness (total)	mg/L CaCO3	5		170	180	260	56
Hydroxide (OH)	mg/L	1.7		0	0	0	0
pH	pH Units	0.1	10.6	7.3	7.5	7.7	6.8
Specific conductance (@ 25 C°)	umhos/cm	10	1600	460	500	600	210
Total dissolved solids (TDS)	mg/L	10	1000	351	375	449	156
GENERAL MINERALS							
Bicarbonate (as CaCO3)	mg/L	12		160	170	150	56
Calcium (Ca)	mg/L	0.5		37	37	57	12
Carbodate (as CaCO3)	mg/L	6	120	0	0	0	0
Chloride (Cl)	mg/L	1	250	32	41	33	15
Iron (Fe)	mg/L	0.05	0.3	0.5	0.15	0.21	0
Magnesium (Mg)	mg/L	0.5		18	20	28	6.3
Manganese (Mn)	mg/L	0.005	0.05	0.048	0	0.012	0
Potassium (K)	mg/L	1		3.7	5	2.2	1.8
Sodium (Na)	mg/L	1		31	37	26	18
Sulfate (SO4)	mg/L	5	250	23	20	110	21
TITLE 22 PRIMARY STANDARDS, INORGANIC							
Aluminum (Al)	mg/L	0.05	1				
Antimony (Sb)	mg/L	0.006	0.006				
Arsenic (As)	mg/L	0.002	0.010				
Barium (Ba)	mg/L	0.1	1				
Beryllium (Be)	mg/L	0.001	0.004				
Cadmium (Cd)	mg/L	0.001	0.005				
Chromium (Cr)	mg/L	0.001	0.05				
Fluoride (F)	mg/L	0.1	1	0.24	0	0.27	0.29
Mercury (Hg)	mg/L	0.0002	0.002				
Nickel (Ni)	mg/L	0.01	0.1				
Nitrate as (NO3)	mg/L	1	45	10.6	7.5	9.3	13.7
Selenium (Se)	mg/L	0.005	0.05				
Thallium (Tl)	mg/L	0.001	0.002				
OTHER CONSTITUENTS							
Boron (B)	mg/L	0.1		0	0.38	0	0
Copper (Cu)	mg/L	0.01	1	0	0	0	0
Silica (as SiO2)	mg/L	1		53	42	41	55
Zinc (Zn)	mg/L	0.02	5	0	0	0	0
LAB CHECK							
Major Cations (Ca+Mg+K+Na+Fe+Mn)	meq/L	--	--	4.79	5.23	6.34	1.95
Major Anions (HCO3+CO3+Cl+SO4+F+NO3)	meq/L	--	--	4.76	5.09	6.38	2.22
Ion Balance (Cations/Anions)	--	--	--	1.01	1.03	0.99	0.88

NOTES

Observer key: mw = Mark Woysner; gp = Gustavo Porras

Lab results: 0 = not detected; blank value = not tested

MCL = Title 22 Maximum Contaminant Level as of June 12, 2003; the MCL of Lead is the Regulatory Action Level

Table 3. Water levels measured on site, Roller Road Quarry, Sonoma County.

Description of monitoring station	Ground Water											Surface Water (for comparative purposes)				
	County Landfill Well R-1 (downgradient) ¹	County Landfill Well R-2 (upgradient) ¹	County Landfill Well R-3 (downgradient) ¹	Dailey Borehole #3 ²	Dailey Borehole #4 ²	Dailey Borehole #5 ²	On Site Well #1	On Site Well #2	Center Swale Spring Box at Top of Wetland	Center Swale Shallow Piezometer at Bottom of Wetland	Center Swale Shallow Dugout Well	Center Swale Spring and Stock Pond	East Swale Upper Channel	Ranch Tributary Upper Limit of Riparian Corridor	Ranch Tributary Outlet	Americano Cr. at Canfield Rd.
GPS waypoint number	-- (feet)	-- (feet)	-- (feet)	-- (feet)	-- (feet)	-- (feet)	429 (feet)	417 (feet)	003 (feet)	412 (feet)	007 (feet)	418 (feet)	420 (feet)	-- (feet)	431 (feet)	407 (feet)
Well descriptors:																
Surface elevation	160	350	180	479	523	448	310	510	455	410	412	500	450	490	118	160
Stickup	0	0	0	0	0	0	0.77	0.78	0.5	0.44	1.25	--	--	--	--	--
Total depth	28	46	45	37	51	24	340	540	3	3	5.5	--	--	--	--	--
Depth to water:																
11/19/04	12.19	21.02	24.78	--	--	--	--	--	--	--	--	--	--	--	--	--
1/6/05	10.45	20.25	22.84	--	--	--	--	--	--	--	--	--	--	--	--	--
5/24/05	--	--	--	--	--	--	83.14	53.00	--	1.88	--	--	--	--	--	--
6/28/05	--	--	--	--	--	--	83.19	53.21	0.50	2.53	3.30	--	--	--	--	--
8/18/05	--	--	--	17	17	20.5	--	--	--	--	--	--	--	--	--	--
10/10/05	--	--	--	--	--	--	83.70	55.10	0.50	dry	3.10	--	--	--	--	--
Water-level elevation:																
11/19/04	147.81	328.98	155.22	--	--	--	--	--	--	--	--	500	450	490	118	160
1/6/05	149.55	329.75	157.16	--	--	--	--	--	--	--	--	500	450	490	118	160
5/24/05	--	--	--	--	--	--	227.63	457.78	--	408.56	--	500	450	490	118	160
6/28/05	--	--	--	--	--	--	227.58	457.57	455.00	407.91	409.95	500	450	490	118	160
8/18/05	--	--	--	462.00	506.00	427.50	--	--	--	--	--	500	450	490	118	160
10/10/05	--	--	--	--	--	--	227.07	455.68	455.00	--	410.15	500	450	490	118	160

Notes:

1. Reported in Pacific Geosciences, March 2005, Ground-water monitoring report for the Roller Landfill, Sonoma County, California
2. Reported in Dailey, 2005, Geotechnical/geological evaluation for EAR, proposed Roller Road quarry, Sonoma County, California.

Table 4. Estimated static seepage rate, Roblar Road Quarry, Sonoma County, California.

	Franciscan Greywacke/melange (KJfs) ²		Los Osos clay loam (weathered Franciscan Greywacke/melange)		Steinbeck loam (weathered Wilson Grove Formation)
	Mean	Maximum	Low at depth	High at depth	
Water level elevation in well #1 on site (feet) ¹	227	227	227	227	227
Water level elevation in well #2 on site (feet) ¹	456	456	456	456	456
Horizontal distance between wells #1 and #2 (feet)	1500	1500	1500	1500	1500
Ground-water gradient	0.12	0.12	0.12	0.12	0.12
Soil permeability (inches/hour) (Table 1) ³	--	--	0.06	0.2	0.63
Hydraulic conductivity (feet/second)	3.15E-07	8.38E-06	1.39E-06	4.63E-06	1.46E-05
Width of quarry seepage (feet) ⁴	1000	1000	1000	1000	1000
Depth of seepage (feet) ⁴	50	50	50	50	50
Seepage area (square feet) ⁴	50000	50000	50000	50000	50000
Seepage rate (cfs) ⁵	0.0019	0.05	0.01	0.03	0.09
Seepage rate (gpm) ⁵	1	23	4	12	39

Notes:

1. Measured by Balance Hydrologics staff on September 30, 2005.
2. Reported hydraulic conductivity in Landfill 1 delineation assessment report central disposal site, Sonoma County, California (Pacific GeoScience, 2005).
3. Miller, V.C., 1972, Soil Survey, Sonoma County: USDA and UC publication.
4. Estimated cross-sectional area below 400-foot elevation.
5. Rate estimated with Darcy's Law.