Paraiso Springs Resort (PLN 040183) – Stream Setback Plan

PREPARED FOR: John Thompson/Thompson Holdings, LLC

COPY TO: file

PREPARED BY: David Von Rueden P.E. (#26428)/CH2MHILL

DATE: April 20, 2012

PROJECT NUMBER: 434834

Introduction

This Technical Memorandum (TM) is in response to a request from the Monterey County Water Resources Agency (MCWRA), as outlined in their November 24, 2010 letter to Jacqueline Onciano/Planning Department, regarding development setback from the Paraiso Springs watercourse. The subject watercourse is an unnamed intermittent drainage swale/stream that traverses the Project site, from west to east. Please refer to the *Paraiso Springs Resort – Response to Hydrology and Hydraulic Analysis and Erosion Control Measures Review Comments Technical Memorandum*, prepared by CH2MHILL and dated October 28, 2008, for additional information about this drainage feature.

Watercourse Setback Delineation

Monterey County Code Chapter 16.16.050K specifies a 50-foot setback from a watercourse for all proposed development. Please see the attached Site Plan (4 pages total) for an annotated map showing approximate watercourse top-of-bank locations, and the 50-foot setback line on either side of the watercourse. Please note that the top-of-bank has been delineated using aerial topography. The watercourse is not clearly defined along its entire length throughout the Project site, because at several locations, it is currently confined to culverts. This analysis only focused on portions of the development where a defined channel exists. All of the existing culverts will be removed from the watercourse as part of the Project.

As shown on the attached Site Plan, the proposed development would encroach into the 50-foot setback zone at several locations. Therefore, we have analyzed the significant encroachments relative to the two provisions outlined in the previously-noted County Code. The locations studied are labeled on the Site Plan as Sections A-A, B-B and C-C. Section A-A is representative of the setback encroachment from time-share-condominiums near the downstream end of the watercourse. Section B-B is located near the center of the development, where Hotel units encroach into the setback zone. Section C-C is located further upstream and indicative of the setback encroachment from the proposed spa and fitness facilities.

Watercourse Capacity

Provision 1 of County Code Chapter 16.16.050K requires that development within a setback zone not significantly reduce capacity of an existing watercourse, nor otherwise adversely affect other properties.

The capacity of the existing watercourse was initially evaluated by CH2MHILL and summarized in the TM entitled *Paraiso Springs Resort: Existing Hydrologic and Hydraulic Site Conditions*, dated July 15, 2005. This document described the flow capacity of the existing watercourse as approximately 4,000 cfs. This capacity exceeded the approximately 400 cfs of runoff from a 100-yr storm event. Subsequently, CH2MHILL re-evaluated the watershed using a more accurate HEC-HMS model and documented the post-Project 100-yr runoff rate as 316 cfs, in their 2008 TM. Based on the previous analysis and the information presented in the following section, the existing watercourse should have adequate capacity to covey the anticipated 100-yr post-project flow rate. The proposed development will not constrict or significantly reduce the existing watercourse capacity. No adverse impacts on other properties are anticipated by the proposed development.

Erosion Protection

Provision 2 of County Code Chapter 16.16.050K requires that the new development be safe from flow related erosion and not cause erosion hazards.

To address this issue, we propose to use Rock Slope Protection (RSP) in the watercourse, at all locations where building or critical roadway construction would encroach into the 50-foot setback zone. Please refer to the attached typical watercourse sections A-A, B-B and C-C for conceptual RSP installation details at critical Project locations. The conceptual RSP design is based upon the California Bank and Shore Rock Slope Protection Design Manual, published by Caltrans. Pertinent pages from this Manual are attached. The approximate stream depths and velocities were calculated manually, using King's Handbook of Hydraulics. These preliminary calculations are also attached. Table 1 summarizes the key design parameters of the RSP design.

Table 1

	Flow 1 Data (Q cfs)	Channel Roughness (*n*)	Average Channel Slope (s)	Channel Bottom Width (b-ft)	Channel Sideslope (z)	100-Yr Water Depth (D-ft)	Stream Velocity[1] (fps)	RSP Class[2]	RSP Thickness[3] (ft)
Section A-A	316	0.03	0.100	10	4:1	1.4	9.7	Light	3
Section B-B	316	0.03	0.053	7	2:1	2.0	9.7	Light	3
Section C-C	316	0.03	0.071	20	4:1	1:2	7.3	Light	3

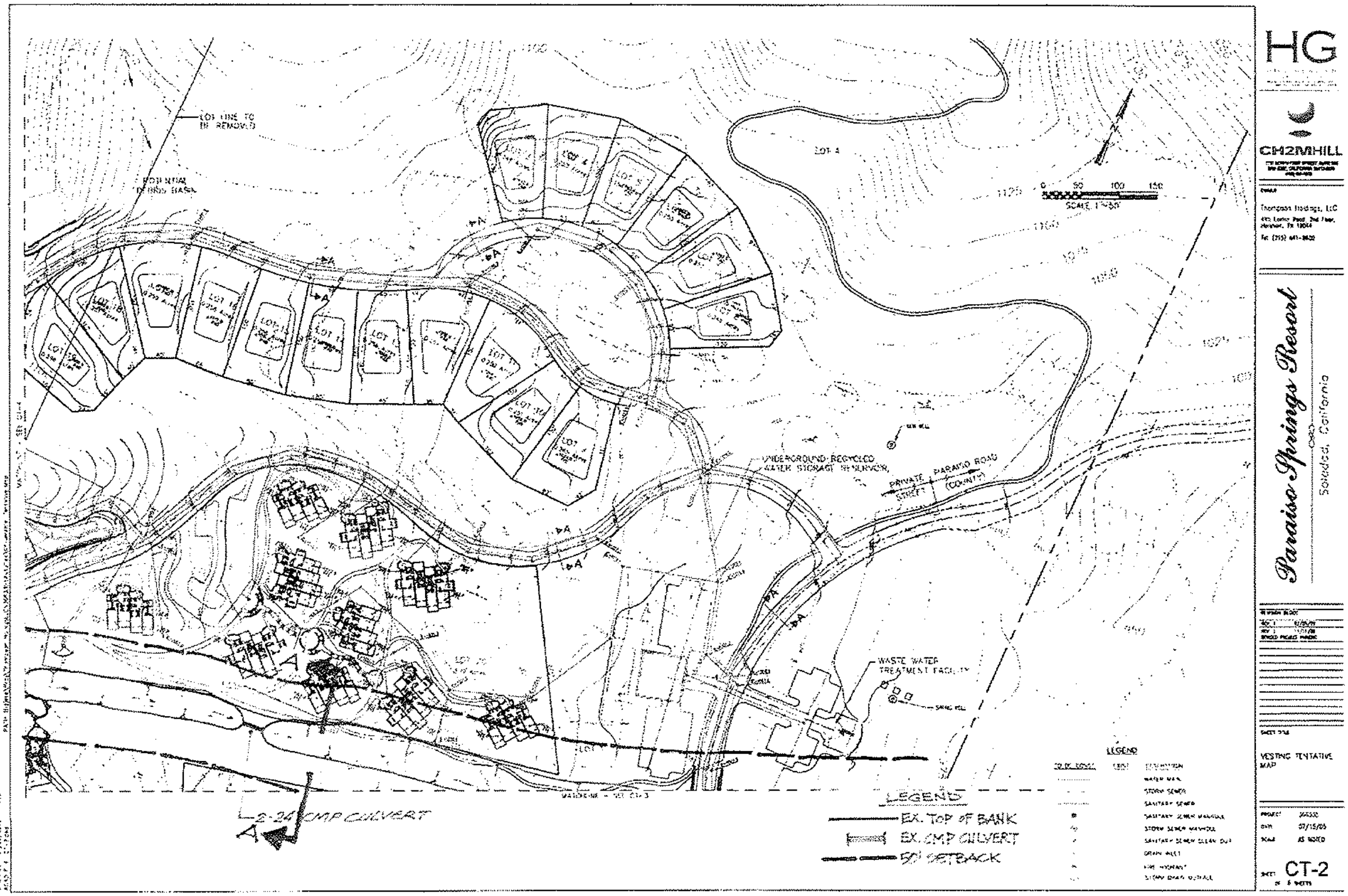
[1]Velocity shown is 67% of calculated average channel velocity, applicable for parallel flow per CALTRANS Manual.

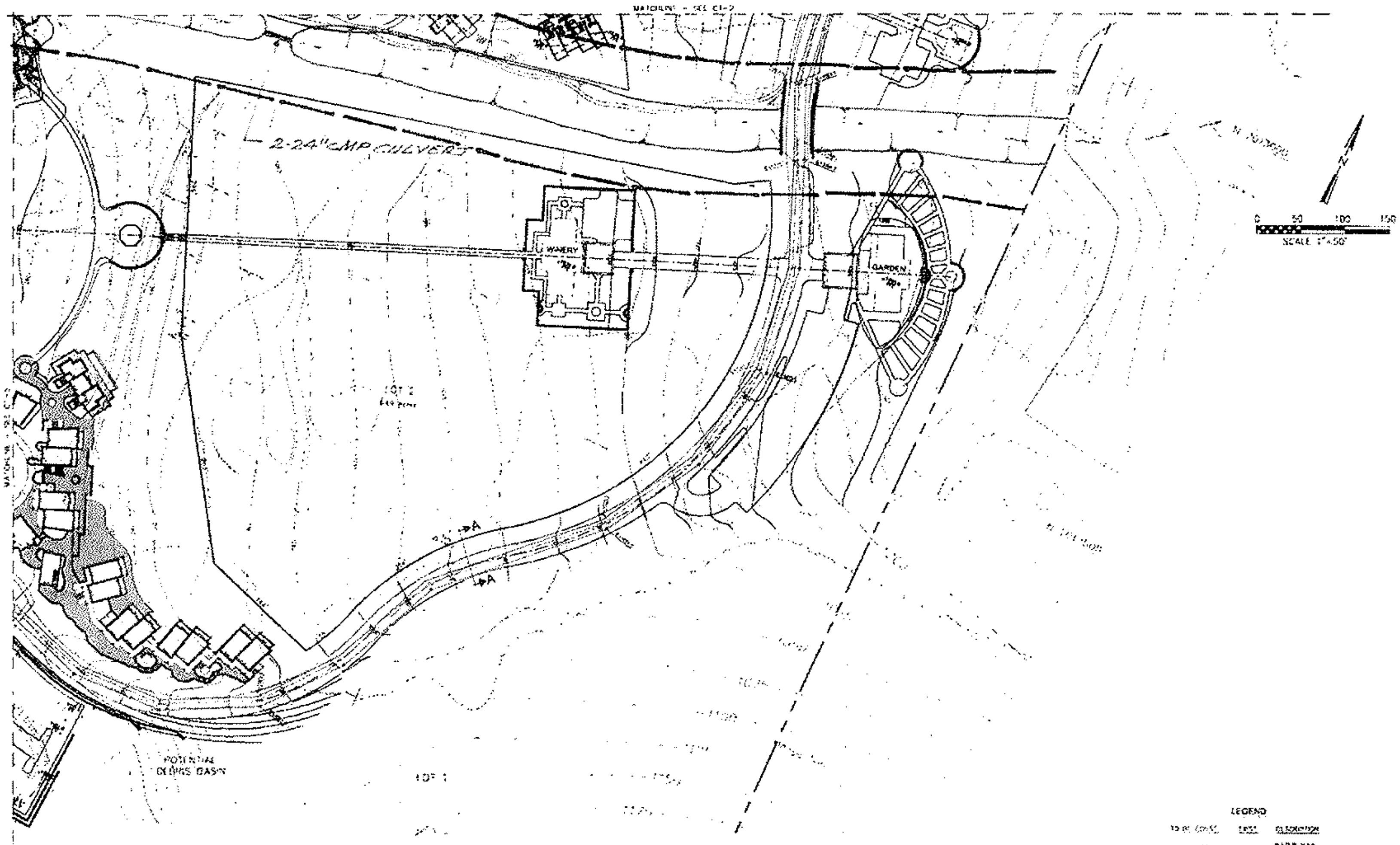
[2] RSP class is based on CALTRANS standard specifications, Section 72.

[3] RSP section includes placement of a geotextile fabric, between soil surface and rock.

Summary

It is anticipated that during Project design, the Site Plan will be refined to reduce setback zone encroachments. At locations where setback encroachments cannot be avoided, erosion control measures as described herein will be constructed within the existing watercourse for erosion protection and to preserve 100-yr flow capacity.


HG
CH2MHILL
Thompson Holdings, LLC
Paraiso Springs Resort
Soledad, California
VESTING TENTATIVE MAP
07/15/05
AS NOTED
CT-2
LOT LINE TO BE REMOVED
POTENTIAL DEBRIS BASIN
LOT 4
SCALE 1"=50'
UNDERGROUND RECYCLED WATER STORAGE RESERVOIR
PRIVATE STREET
PARAISO ROAD (COUNTY)
WASTE WATER TREATMENT FACILITY
2-24" CMP CULVERT
LEGEND
EX. TOP OF BANK
EX. CMP CULVERT
50' SETBACK
LEGEND
WATER MAIN
STORM SEWER
SANITARY SEWER
SANITARY SEWER MANHOLE
STORM SEWER MANHOLE
SANITARY SEWER CLEAN OUT
DRAIN INLET
FIRE HYDRANT
STORM DRAIN OUTFALL



HG

CH2MHILL

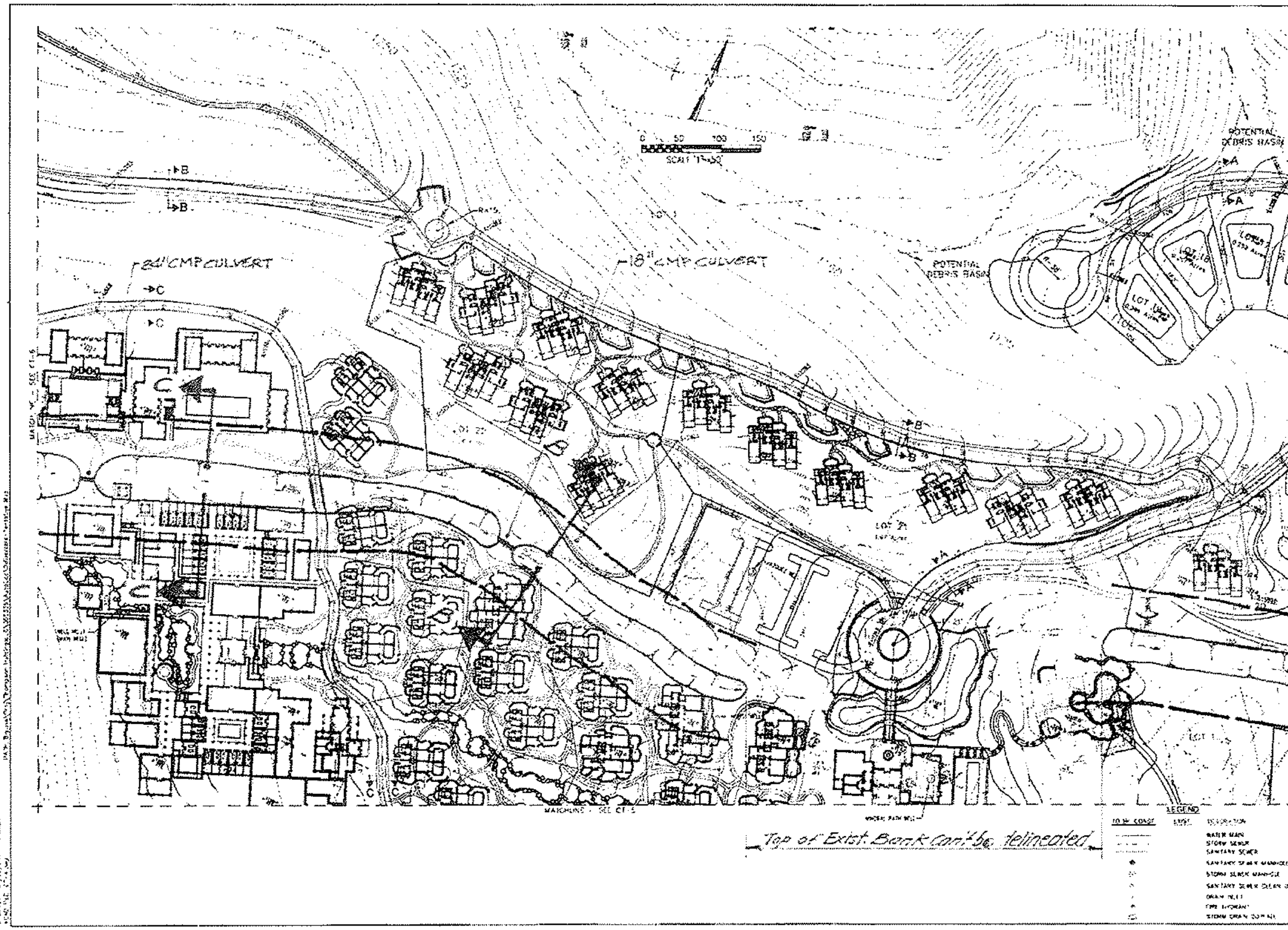
OWNER
Thompson Holdings, LLC
Tel. (215) 441-8600

Paraiso Springs Resort
Soledad, California

VESTING TENTATIVE MAP

PROJECT 356315
DATE 07/15/05
SCALE AS NOTED

SHEET CT-3



HG

CH2MHILL

Thompson Holdings, LLC

Paraiso Springs Resort

Soledad, California

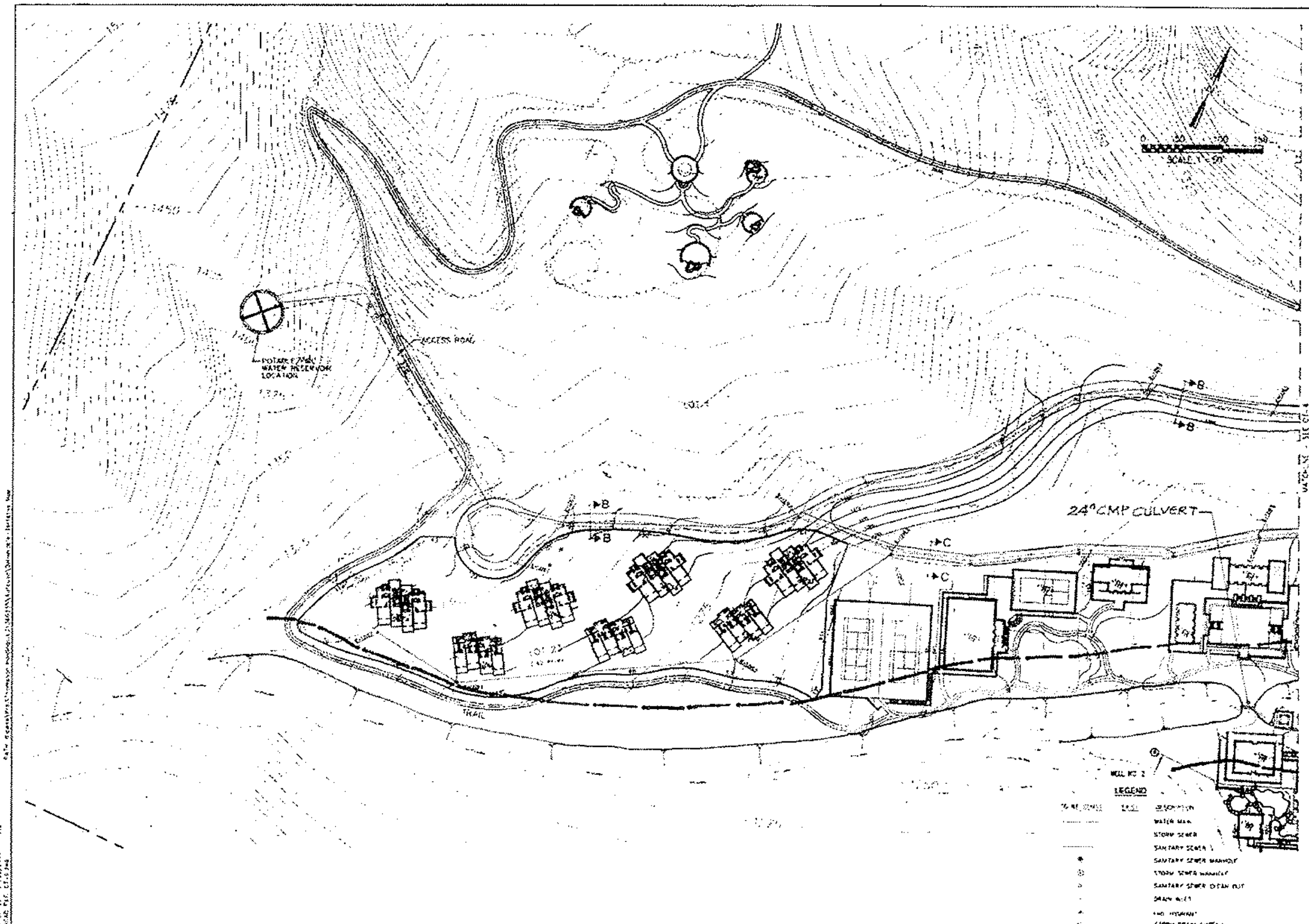
VESTING TENTATIVE MAP

PROJECT 346330

DATE 07/15/05

SCALE AS NOTED

SHEET CT-4



HG

CH2MHILL

Thompson Holdings, LLC
495 Easton Road, 2nd Floor,
Horsham, PA 19044

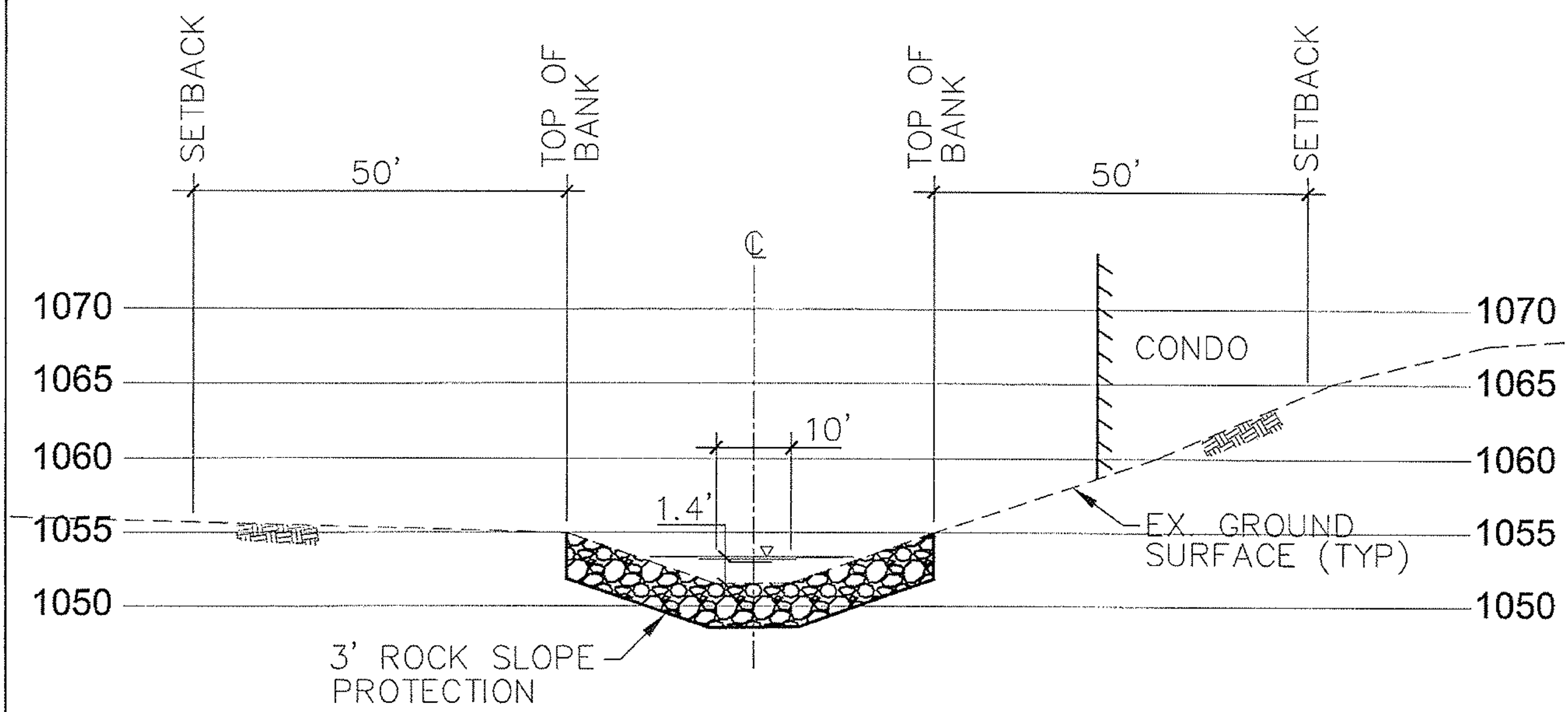
Paraiso Springs Resort

Soledad, California

VESTING TENTATIVE MAP

PROJECT 346335
DATE 07/15/05
SCALE AS NOTED

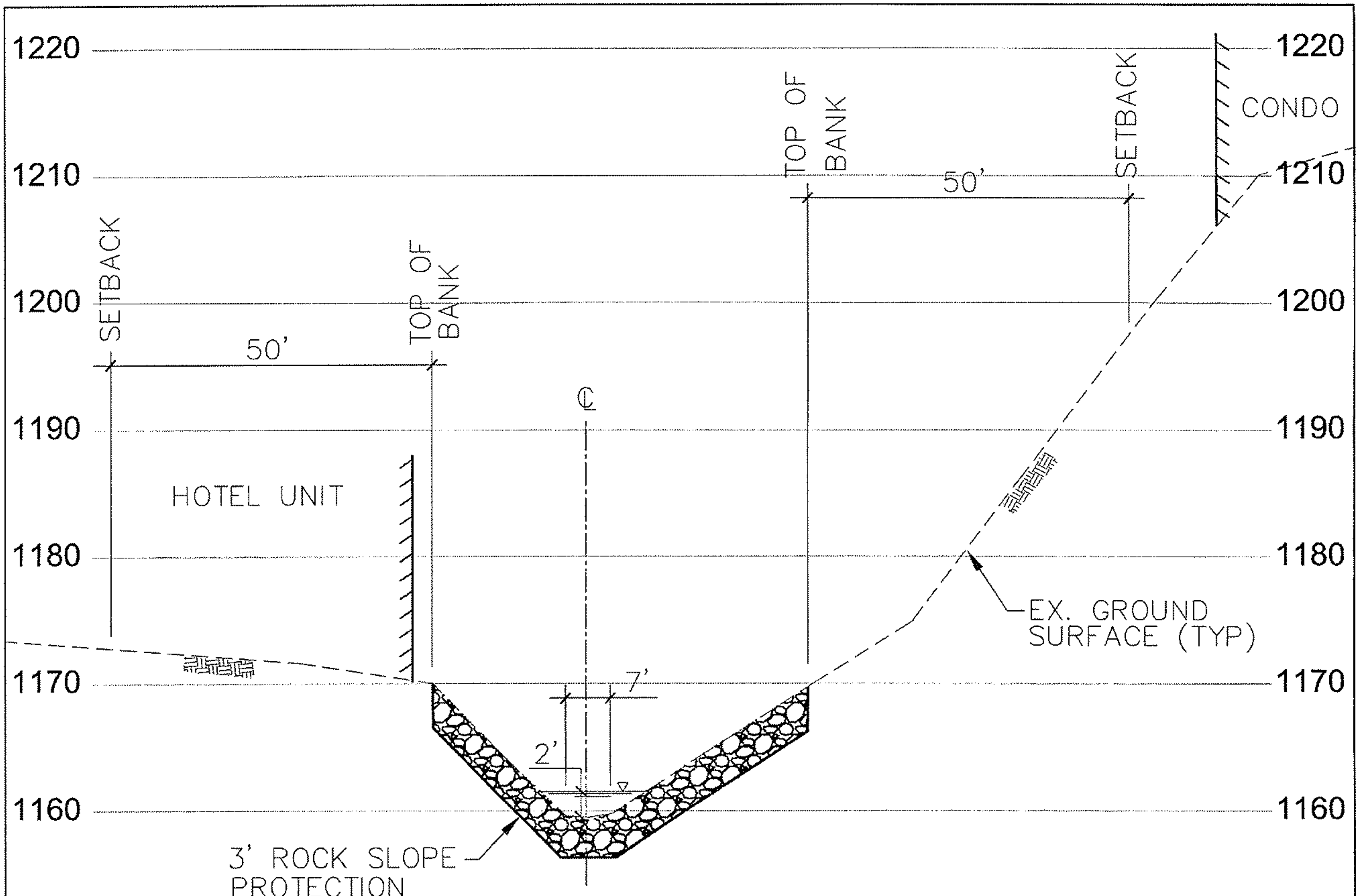
SHEET CT-6



SECTION A-A

SCALE HORZ. = 1"=20'
VERT. = 1"=10'

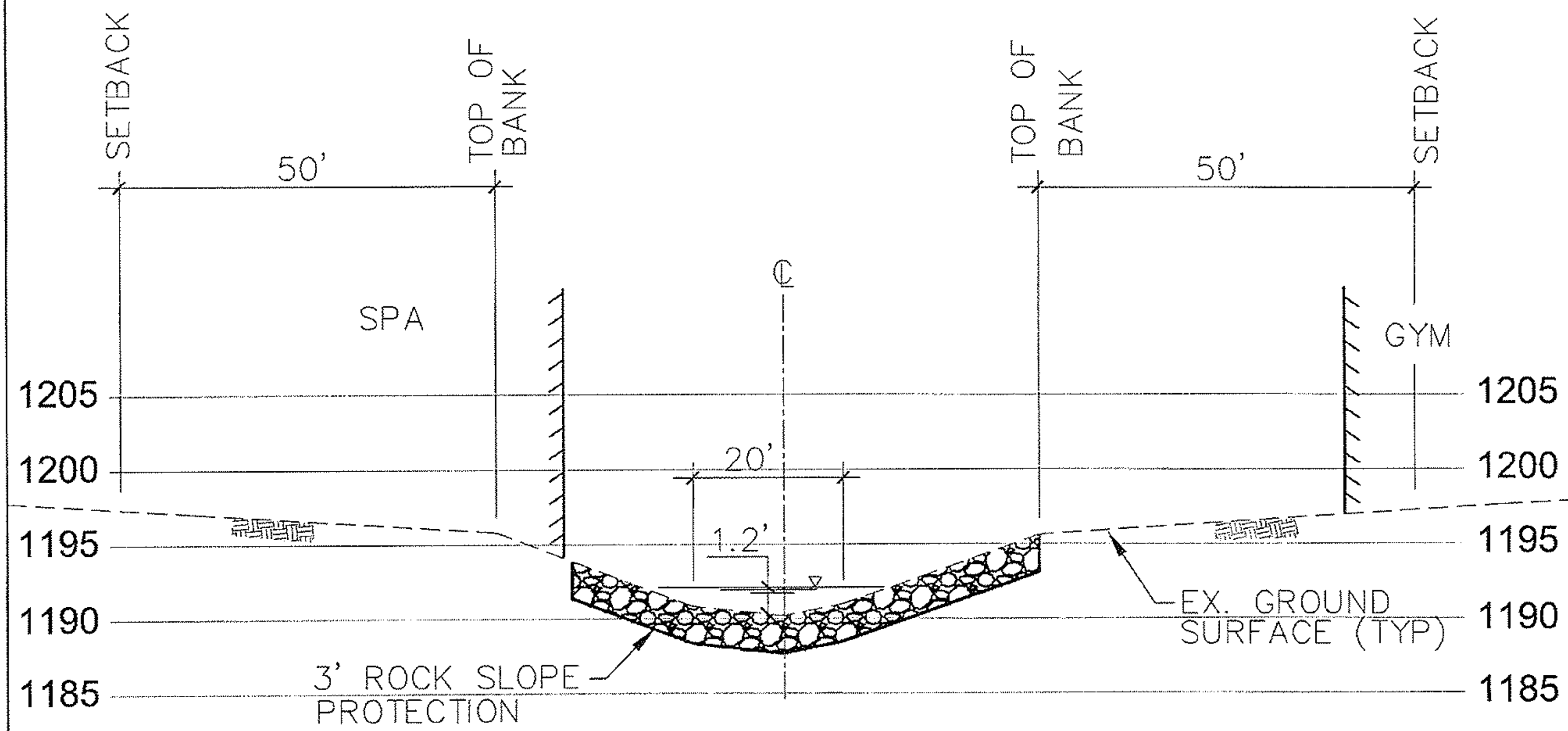
CH2MHILL
1737 NORTH FIRST STREET, SUITE 300
SAN JOSE, CALIFORNIA 95112-4524
(408) 436-4909



SECTION B-B

SCALE HORZ. = 1"=20'
VERT. = 1"=10'

CH2MHILL
1737 NORTH FIRST STREET, SUITE 300
SAN JOSE, CALIFORNIA 95112-4524
(408) 436-4909



SECTION C-C

SCALE HORZ. = 1"=20'
VERT. = 1"=10'

CH2MHILL

1737 NORTH FIRST STREET, SUITE 300
SAN JOSE, CALIFORNIA 95112-4524
(408) 436-4909

- Determine RSP Size & Thickness
  - Use King's Handbook to determine approx. stream depth.
  - Use Caltrans's Bank & Shore Protection Manual to size RSP.
  - $Q_{100} = 316$ cfs

① Section A-A

$n = 0.03$, $s = 0.100$ (from topo)
$b = 10'$; $z = 4.1$

$$Q = \frac{K'}{n} b^{8/3} s^{1/2}$$

$$K' = \frac{Q(n)}{(b^{8/3})(s^{1/2})} = \frac{316(0.03)}{(10)^{8/3}(0.100)^{1/2}} = 0.06459$$

$D/b = 0.14$ (from Handbook Table 7-11)

$D = 0.14(10) = 1.4'$

$A = 22$ ft²

$V = Q/A = 316/22 = 14.4$ fps

Size RSP: $SG = 2.65$, $a = 14°$

$$W = \frac{0.00002\, V^6\, SG}{(SG-1)^3 \sin^3(\beta - a)}$$ (from Caltrans' Manual)

$$W = \frac{0.00002\,(14.4 \times 0.67)^6 (2.65)}{(2.65-1)^3 (\sin^3 70° - 14°)} = 16.7\#$$

Use Class Light, $T = 2.5'$ (say 3' w/ geotextile

CH2MHILL SUBJECT BY DVR
SHEET NO 2 OF DATE 3-26-12
PROJECT NO.

② Section C-C $n = 0.03$, $s = 0.071$, $b = 20'$, $z = 4:1$

$$K' = \frac{(316)(0.03)}{(20)^{8/3}(0.071)^{1/2}} = 0.01207$$

$D/b = 0.06$ (from Handbook Table 7-11)

$D = 1.2'$, $A = 29^{\#}$

$V = 316/29 = 10.9$ fps

Size RSP: $SG = 2.65$, $a = 14°$

$$W = \frac{0.00002\,(10.9 \times 0.67)^6\,(2.65)}{(2.65-1)^3 \sin^3(70-14)}$$

$W = 3.2^{\#}$

Use same RSP as for Section A-A

③ Section B-B $n = 0.03$, $s = 0.053$, $b = 7'$, $z = 2:1$

$$K' = \frac{(316)(.03)}{(7)^{8/3}(0.053)^{1/2}} = 0.2297$$

$D/b = .29$ (from Handbook) Table 7-11

$D = 2.0$, $A = 22^{\#}$

$V = 316/22 = 14.4$ fps

Size RSP: $SG = 2.65$, $a = 26.6°$

$$W = \frac{(0.00002)(14.4 \times .67)^6(2.65)}{(2.65-1)^3 \sin^3(90-26.6)} = 29.3^{\#}$$

Use same RSP as for Section A-A

Table 7-11. Values of K' in Formula $Q = \frac{K'}{n} b^{8/3} s^{1/2}$ for Trapezoidal Channels

D = depth of water b = bottom width of channel

	$\frac{D}{b}$	Side slopes of channel, ratio of horizontal to vertical									
		Vertical	¼-1	½-1	¾-1	1-1	1½-1	2-1	2½-1	3-1	4-1
	.01	.00068	.00068	.00069	.00069	.00069	.00069	.00069	.00069	.00070	.00070
	.02	.00213	.00215	.00216	.00217	.00218	.00220	.00221	.00222	.00223	.00225
	.03	.00414	.00419	.00423	.00426	.00428	.00433	.00436	.00439	.00443	.00449
	.04	.00660	.00670	.00679	.00685	.00691	.00700	.00708	.00716	.00723	.00736
	.05	.00946	.00904	.00979	.00991	.01002	.01019	.01033	.01047	.01060	.01086
C-C	.06	.0127	.0130	.0132	.0134	.0136	.0138	.0141	.0143	.0145	.0150
	.07	.0162	.0166	.0170	.0173	.0175	.0180	.0183	.0187	.0190	.0197
	.08	.0200	.0206	.0211	.0215	.0219	.0225	.0231	.0236	.0240	.0250
	.09	.0241	.0249	.0256	.0262	.0267	.0275	.0282	.0289	.0296	.0310
	.10	.0284	.0294	.0304	.0311	.0318	.0329	.0339	.0348	.0358	.0376
	.11	.0329	.0343	.0354	.0364	.0373	.0387	.0400	.0413	.0424	.0448
	.12	.0376	.0303	.0408	.0420	.0431	.0450	.0466	.0482	.0497	.0527
A-A	.13	.0425	.0446	.0464	.0480	.0493	.0516	.0537	.0556	.0575	.0613
	.14	.0476	.0502	.0524	.0542	.0569	.0587	.0612	.0636	.0659	.0706
	.15	.0528	.0559	.0586	.0608	.0627	.0662	.0692	.0721	.0749	.0805
	.16	.0582	.0619	.0650	.0676	.0700	.0740	.0777	.0811	.0845	.0912
	.17	.0638	.0680	.0716	.0748	.0775	.0823	.0866	.0907	.0947	.1026
	.18	.0695	.0744	.0786	.0822	.0854	.0910	.0960	.1008	.1055	.1148
	.19	.0753	.0809	.0857	.0899	.0936	.1001	.1059	.1115	.1169	.1277
	.20	.0812	.0876	.0931	.0979	.1021	.1098	.1163	.1227	.1290	.1414
	.21	.0873	.0945	.101	.106	.111	.120	.127	.135	.142	.156
	.22	.0934	.1015	.109	.115	.120	.130	.139	.147	.155	.171
	.23	.0997	.1087	.117	.124	.130	.141	.150	.160	.169	.187
	.24	.1061	.1161	.125	.133	.140	.152	.163	.173	.184	.204
	.25	.1125	.1236	.133	.142	.150	.163	.176	.188	.199	.222
	.26	.119	.131	.142	.152	.160	.175	.189	.202	.215	.241
	.27	.126	.139	.151	.162	.171	.188	.203	.218	.232	.260
	.28	.132	.147	.160	.172	.182	.201	.217	.234	.249	.281
B-B	.29	.139	.155	.170	.182	.194	.214	.232	.250	.268	.302
	.30	.146	.163	.179	.193	.205	.228	.248	.267	.287	.324
	.31	.153	.172	.189	.204	.218	.242	.264	.285	.306	.347
	.32	.160	.180	.199	.215	.230	.256	.281	.304	.327	.371
	.33	.167	.189	.209	.227	.243	.271	.298	.323	.348	.396
	.34	.174	.198	.219	.238	.256	.287	.316	.343	.370	.423
	.35	.181	.207	.230	.251	.269	.303	.334	.363	.392	.450
	.36	.189	.216	.241	.263	.283	.319	.353	.385	.416	.478
	.37	.196	.225	.252	.275	.297	.336	.372	.406	.440	.507
	.38	.203	.234	.263	.288	.312	.353	.392	.429	.465	.537
	.39	.211	.244	.274	.301	.326	.371	.413	.452	.491	.568
	.40	.218	.253	.286	.315	.341	.389	.434	.476	.518	.600
	.41	.226	.263	.297	.328	.357	.408	.456	.501	.546	.633
	.42	.233	.273	.300	.342	.373	.427	.478	.526	.574	.668
	.43	.241	.283	.321	.357	.389	.447	.501	.553	.603	.703
	.44	.248	.293	.334	.371	.405	.467	.525	.580	.633	.740
	.45	.256	.303	.346	.386	.422	.488	.549	.607	.664	.777

Table 7-11. Values of K' in Formula $Q = \frac{K'}{n} b^{8/3} s^{1/2}$ for Trapezoidal Channels (*Continued*)

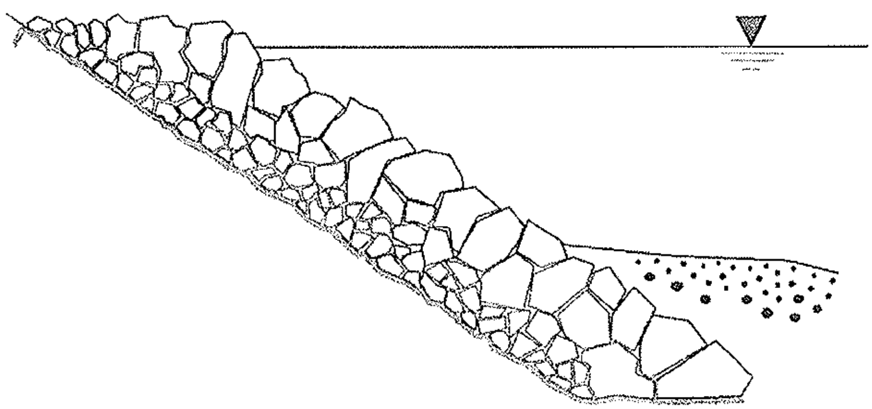
D = depth of water b = bottom width of channel

$\frac{D}{b}$	Side slopes of channel, ratio of horizontal to vertical									
	Vertical	¼-1	½-1	¾-1	1-1	1½-1	2-1	2½-1	3-1	4-1
.46	.264	.313	.359	.401	.439	.509	.574	.636	.696	.816
.47	.271	.323	.372	.416	.457	.531	.599	.665	.729	.856
.48	.279	.334	.385	.432	.474	.553	.625	.695	.763	.897
.49	.287	.344	.398	.447	.493	.575	.652	.725	.797	.939
.50	.295	.355	.412	.463	.511	.598	.679	.757	.833	.983
.51	.303	.366	.425	.480	.530	.622	.707	.789	.869	1.03
.52	.311	.377	.439	.496	.549	.646	.736	.822	.907	1.07
.53	.319	.388	.453	.513	.569	.671	.765	.856	.945	1.12
.54	.327	.399	.467	.531	.589	.696	.795	.891	.984	1.17
.55	.335	.410	.482	.548	.609	.722	.826	.926	1.025	1.22
.56	.343	.422	.497	.566	.630	.748	.857	.963	1.07	1.27
.57	.351	.433	.511	.584	.651	.775	.889	1.000	1.11	1.32
.58	.359	.445	.526	.602	.673	.802	.922	1.038	1.15	1.37
.59	.367	.456	.542	.621	.694	.830	.956	1.077	1.20	1.43
.60	.375	.468	.557	.640	.717	.858	.990	1.117	1.24	1.49
.61	.383	.480	.573	.659	.739	.887	1.02	1.16	1.29	1.54
.62	.391	.492	.588	.678	.762	.916	1.06	1.20	1.33	1.60
.63	.399	.504	.604	.698	.785	.946	1.10	1.24	1.38	1.66
.64	.408	.516	.620	.718	.809	.977	1.13	1.28	1.43	1.72
.65	.416	.529	.637	.738	.833	1.008	1.17	1.33	1.48	1.79
.66	.424	.541	.653	.759	.857	1.04	1.21	1.37	1.53	1.85
.67	.433	.553	.670	.780	.882	1.07	1.25	1.42	1.59	1.91
.68	.441	.566	.687	.801	.907	1.10	1.29	1.47	1.64	1.98
.69	.449	.579	.704	.822	.933	1.14	1.33	1.51	1.69	2.05
.70	.457	.592	.722	.844	.959	1.17	1.37	1.56	1.75	2.12
.71	.466	.604	.739	.866	.985	1.21	1.41	1.61	1.81	2.19
.72	.474	.617	.757	.889	1.012	1.24	1.46	1.66	1.86	2.26
.73	.483	.631	.775	.911	1.039	1.28	1.50	1.71	1.92	2.34
.74	.491	.644	.793	.934	1.067	1.31	1.54	1.77	1.98	2.41
.75	.499	.657	.811	.957	1.095	1.35	1.59	1.82	2.05	2.49
.76	.508	.670	.830	.981	1.12	1.39	1.63	1.87	2.11	2.57
.77	.516	.684	.849	1.005	1.15	1.43	1.68	1.93	2.17	2.65
.78	.525	.698	.868	1.029	1.18	1.46	1.73	1.99	2.24	2.73
.79	.533	.711	.887	1.053	1.21	1.50	1.78	2.04	2.30	2.81
.80	.542	.725	.906	1.078	1.24	1.54	1.83	2.10	2.37	2.90
.81	.550	.739	.925	1.10	1.27	1.58	1.88	2.16	2.44	2.98
.82	.559	.753	.945	1.13	1.30	1.62	1.93	2.22	2.51	3.07
.83	.567	.767	.965	1.15	1.33	1.67	1.98	2.28	2.58	3.16
.84	.576	.781	.985	1.18	1.36	1.71	2.03	2.34	2.65	3.25
.85	.585	.796	1.006	1.21	1.40	1.75	2.08	2.41	2.72	3.35
.86	.593	.810	1.03	1.23	1.43	1.79	2.14	2.47	2.80	3.44
.87	.602	.825	1.05	1.26	1.46	1.84	2.19	2.54	2.87	3.54
.88	.610	.839	1.07	1.29	1.49	1.88	2.25	2.60	2.95	3.63
.89	.619	.854	1.09	1.31	1.53	1.93	2.31	2.67	3.03	3.73
.90	.628	.869	1.11	1.34	1.56	1.98	2.36	2.74	3.11	3.83

State of California
Department of Transportation
Engineering Service Center
Office of Structural Foundations
Transportation Laboratory

CALIFORNIA BANK AND SHORE ROCK SLOPE PROTECTION DESIGN

Practitioner's Guide and Field Evaluations of Riprap Methods



Final Report No. FHWA-CA-TL-95-10
Caltrans Study No. F90TL03

Third Edition - Internet
October 2000

Prepared in Cooperation with the US Department of Transportation
Federal Highway Administration

5-1-C. Determine Minimum Stone Weight. Solve Equation 1 for W in US customary units. To get values in System International (SI), metric units, first divide the weight of minimum stable rock, W in pounds by 2.2 to get W in kilograms, then divide by 1000 to get W in tonnes. Use W later in section 5-1-D.
See Figure 5-1 for key variables in Equation 1.

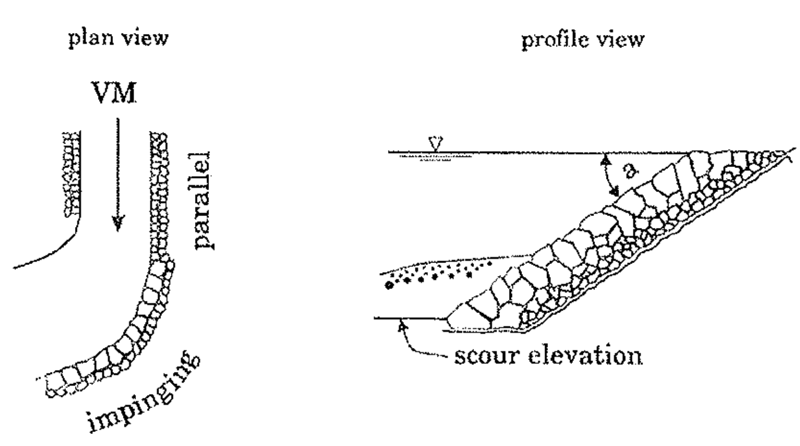
Equation 1.

$$W = \frac{0.00002 \quad V^6 \quad SG}{(SG - 1)^3 \quad SIN^3 (r - a)}$$

W = theoretical **minimum rock mass (size or weight)** which resists forces of flowing water and remains stable on slope of stream or river bank, POUNDS.
V = velocity to which bank is exposed, FEET PER SECOND.
for PARALLEL flow multiply average channel velocity VM by 0.67 (2/3)
for IMPINGING flow multiply average channel velocity VM by 1.33 (4/3)
SG = specific gravity of the rock.
r = 70 DEGREES (for randomly placed rubble, a constant).
a = outside slope face angle with horizontal, DEGREES.

In profile, the lower elevation limit of riverbank RSP is based on expected scour (determined by experience, measurements, or scour equations). The upper elevation limit is based on design high water, although it may be set higher.

Figure 5-1. Key Variables in Equation 1



GRADING OF ROCK SLOPE PROTECTION **PERCENTAGE LARGER THAN**

STANDARD Rock SIZE or Rock MASS or Rock WEIGHT		RSP-Classes [A]											
		Method A Placement					Method B Placement						
		RSP-Classes other than Backing									Backing No.		
US unit		8 ton	4 ton	2 ton	1 ton	1/2 ton	1 ton	1/2 ton	1/4 ton	Light	1 [B]	2	3
	SI unit	8 T	4 T	2 T	1 T	1/2 T	1 T	1/2 T	1/4 T	Light	1 [B]	2	3
16 ton	14.5 tonne	0-5											
8 ton	7.25 tonne	50-100	0-5										
4 ton	3.6 tonne	95-100	50-100	0-5									
2 ton	1.8 tonne		95-100	50-100	0-5		0-5						
1 ton	900 kg			95-100	50-100	0-5	50-100	0-5					
1/2 ton	450 kg				95-100	50-100	-----	50-100	0-5				
1/4 ton	220 kg					95-100	95-100	-----	50-100	0-5			
200 lb	90 kg							95-100	-----	50-100	0-5		
75 lb	34 kg								95-100	-----	50-100	0-5	
25 lb	11 kg									95-100	90-100	25-75	0-5
5 lb	2.2 kg											90-100	25-75
1 lb	0.4 kg												90-100

[A] US customary names (units) of RSP-Classes listed above SI names, example US is "2 ton" metric is "2 T".
[B] "Facing" has same gradation as "Backing No. 1". To conserve space "Facing" is not shown .

Example for determining RSP-Class of outside layer. By using Equation 1, if the calculated W=135 kg (minimum stable rock size):
1. Enter table at left and select closest value of STANDARD Rock SIZE which is greater than calculated W, in this case 220 kg
2. Trace to right and locate "50-100" entry 3. Trace upward and read column heading "1/4 T", then 1/4 T is first trial RSP-Class.

Table 5-1. Guide for Determining RSP-Class of Outside Layer

Table 5-3. Minimum Layer Thickness SI metric (US customary)		
RSP-Class Layer	Method of Placement	Minimum Thickness
8 T (8 ton)	A	2.60 meters (8.5 feet)
4 T (4 ton)	A	2.07 meters (6.8 feet)
2 T (2 ton)	A	1.65 meters (5.4 feet)
1 T (1 ton)	A	1.31 meters (4.3 feet)
1/2 T (1/2 ton)	A	1.04 meters (3.4 feet)
1 T (1 ton)	B	1.65 meters (5.4 feet)
1/2 T (1/2 ton)	B	1.31 meters (4.3 feet)
1/4 T (1/4 ton)	B	1.00 meters (3.3 feet)
Light	B	760 millimeters (2.5 feet)
Facing	B	550 millimeters (1.8 feet)
Backing No. 1	B	550 millimeters (1.8 feet)
Backing No. 2	B	380 millimeters (1.25 feet)
Backing No. 3	B	230 millimeters (0.75 feet)

For total thickness, add each layer thickness. Use zero thickness for the RSP-fabric. Before adopting values in Table 5-3, consult with a materials engineer about rock sources, quality, shapes, and specific gravity. Calculate new thickness values if the shape factor is not spherical and specific gravity is not reasonably close to 2.65. "Minimum Thickness" values were calculated by starting with US customary units, hard-converting to a value in feet, then soft-converting to SI metric values.

5-1-G. Review Hydraulic Calculations at Site With RSP and Possibility of Vegetation. This step of the layered design process is required to help assure future success of the revetment under changed channel dimensions, roughness coefficients, and other permit/agreement requirements. Examples are: filling voids among RSP with soil and/or covering RSP with soil then planting local species, and/or enhancing fish habitat by placing large-sized rock along the toe. Discuss site hydraulics with people of permit agencies and feasible revegetation efforts. Historically, sites with no prior vegetation are usually not revegetated, especially when subjected to scouring velocities or high wave attack.