

# GEOSCIENCE

# Monterey Peninsula Water Supply Project

## **Test Slant Well**

**GEOSCIENCE Project No. 13027-14**

# **LOG OF BORING Test Slant Well**

SHEET 1 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	12-30-14 / Tue	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	N. Reynolds & M. Salmon	Drill Rig Type	DUAL ROTARY (Foremost DR-40)	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by		Borehole Diameter (in)	30 "	Total Depth (ft)

Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	SOIL COLOR
0	0					
3	1					
6	2					
9	3					
12	4					
15	5					
18	6					
21	7					
24	8					
27	9					
30	10					
33	11					
36	12					
39	13					
42	14					
45	15					

GEOSCIENCE					Monterey Peninsula Water Supply Project Test Slant Well GEOSCIENCE Project No. 13027-14	LOG OF BORING Test Slant Well		
					SHEET 2 OF			
Location		CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)	
Ground Surface Elevation (ft)		Logged by		Drill Rig Type	DUAL ROTARY	Plunge (Degrees)	19	
Horizontal/Vertical Datum		Reviewed by		Borehole Diameter (in)	Total Depth (ft)			
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION		SOIL COLOR	
15								
48								
51								
17								
54								
18								
57								
19								
60								
20								
63								
21								
66								
69								
23								
72								
24								
75								
25								
78								
81	Finer than above							
84								
87								
26								
27								
28								
89								
90								
30								

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SHEET 3 OF

Location		CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)				Logged by	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum				Reviewed by	Borehole Diameter (in)	Total Depth (ft)	
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION		SOIL COLOR
30							
93							2.5Y 7/4
31							Pale
96							Brown
32							
99					SAND: 100% FMC Sub A-Sub R, well-med sorted sand; w/ Trace F gravel to 5mm. Overall, finer sample than 28-30 ft bgs		
33							
102							
34							2.5Y
105							
35					SAND: 100% FMC, Pred FM, Sub- subR sand; w/ trace Ang-SubR F gravel to 13mm.		5/4
108							
36							light
111							olive
114							Brown
37							
117							
38							
118							
39							
120					SAND: 100% FMC, Pred MC, sub A-sub R sand; w/ trace sub A-sub R F gravel to 7mm. (Q,F,M,O)		2.5Y
40							5/4
123							
41							Light
126							olive
42							brown
129							
43							
132							
43							
135							
44							
138							
45							

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SHEET 4 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by	Borehole Diameter (in)		Total Depth (ft)
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION
					SOIL COLOR
45					
141	46	coarse sand fine gravel			@46 ft TUD = gravel @ 12mm
144	47				(SP) From previous page 43-48 ft TUD
147	48				48'
150					
149					
153	50				SAND: 100% EMC Sand; Predominantly M; Ang-SubR; trace FC, gravel;
156	51	coarse gravel 35mm			Sub A-SubR; +o 36mm.
159	52				
162	53				53'
165	54				(SP) SAND: 100% EMC Sand; predominantly, M; Ang-SubR. Trace F gravel; Sub A-SubR; +o 19mm.
168	55				55'
171	56				
174	57				(SP) SAND: 100% EMC sand; Pred FM; Ang-SubR & trace FC gravel; Sub A-Sub R; +o 28mm,
177	58				
180	59				
183	60				60'

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SHEET 5 OF

Location	CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)			Logged by	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum			Reviewed by	Borehole Diameter (in)	Total Depth (ft)	
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	
11/20/15	~205	18.5" on casing Joint #12	~9.92 ft/hr	SP	SAND: 100% Fm sand, sub A sub B, Trace FC to 40mm gravel - Gold flecks (mica)	10 YR 5/4 Yellowish brown
~218	~234	18.5" on casing Joint #13	~7 ft/hr	SP	SAND: 100% Fm sand, sub A sub B, Trace FC to 30mm gravel - Gold flecks (mica)	2.5 Y 5/3 light olive brown
75	75	18.5" on casing Joint #13	~7 ft/hr	SP	SAND: 100% F sand with trace silt. Sub A: sub B. Trace siltstone Gold flecks of mica	2.5 Y 5/3 light olive brown

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SHEET 6 OF

Location	CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)			Logged by	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum			Reviewed by	Borehole Diameter (in)	Total Depth (ft)	
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	SOIL COLOR
231	75	~18.5 plunge			CONTINUED FROM PREVIOUS PAGE	
234	76		~7 ft/hr		(SP)	
237	77				78.0'	
240	78				SAND: 100% F sand with trace Coarse and silt, Sub A; sub R; Trace P to 8mm gravel; Trace siltstone; Gold Flecks of Mica	
243	79				2.5Y 5/3	
246	80				light olive brown	
249	81				83.0'	
252	82				SAND: 90% FM sand, Pred F with trace C; 10% silt; trace F incl. to 8mm gravel; trace clay balls; trace siltstone; Gold Flecks of mica	
255	83				2.5Y 5/3	
258	84				light olive brown	
261	85				(SP-SM)	
264	86				88.0'	
267	87				SEE NEXT PAGE	
270	88				11/21/15	
273	89	20"	~8.1 ft/hr			
276	90					

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SHEET 7 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	12/1/15	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	CLS & EOW	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by		Borehole Diameter (in)		Total Depth (ft)
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	SOIL COLOR
112/1/15	~279	26" Joint 16	~8.1 ft/hr	SP-SM	SAND: 90% FM sand, Pred F, sub A, sub B; 10% silt; Trace F to 4mm gravel; trace siltstone; Gold flecks (mica) (QFMAO)	2.5Y 5/3 light olive brown
~282	279					
112/1/15	~285	26" Joint 17	~8.7 ft/hr	SP-SM	SAND: 90% FM sand, Pred F, sub A, sub B; 10% silt; Trace F to 20mm gravel; trace siltstone; Gold flecks (mica) (QFMAO)	2.5Y 5/3 light olive brown
~288	285					
112/1/15	~291	26" Joint 17	~8.7 ft/hr	SP-SM	SAND: 90% FM sand, Pred F, sub A, sub B; 10% silt; Trace F to 20mm gravel; trace siltstone; Gold flecks (mica) (QFMAO)	2.5Y 5/3 light olive brown
~294	288					
112/1/15	~297	26" Joint 17	~8.7 ft/hr	(SP)	SAND: 100% FMC sand, Pred F, A-Sub A; Trace F gravel to 8mm. (QFMAO)	2.5Y 5/2 grayish brown
~300	297					
112/1/15	~303	26" Joint 18	~6.6 ft/hr	(SP)	SAND: 90% FMC sand (QFMAO) sub Angular.	2.5Y 6/4 light yellowish brown
~306	303					
112/1/15	~309	26" Joint 18	~6.6 ft/hr		10% FC gravel to 30mm. trace chert.	
~312	309					
112/1/15	~315	26" Joint 18	~6.6 ft/hr			
~318	315					
341	318					
	321					
	105.0'					

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SHEET 8 OF

Location	CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)			Logged by	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum			Reviewed by	Borehole Diameter (in)	Total Depth (ft)	
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	SOIL COLOR
112/15						
117 S						
112/15						
~363 ft MD						
117 S						
112/15						
~380 ft MD						

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SHEET 9 OF

Location	CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)			Logged by ECW & NRR	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum			Reviewed by	Borehole Diameter (in)	Total Depth (ft)	
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	
~380	A-MO					
11/22/15						
369	120				SAND: 100% FM sand, sub A; sub R (Q, F, M, A, O)	
372	121	26 " Tdmt 20	~16.31 ft/hr			
375	122					
378	123					
381	124					
384	125					
~394	A-MO					
11/22/15						
387	126	24 ft OD casing stirring @				
390	127	128 ft bgs (TVD) 1-25-15 6+13			(SP) SAND: 100% F sand, w/tr M&C sand, subA-subR (QFM A0); tr F subR to R gravel to 13 mm; tr silt; some well rounded siltstone gravel.	
393	128					
396	129					
399	130					
402	131					
405	132				SAND: 100% SAND; F-M GRAINS; POORLY GRADED; SUBANGULAR- SUBROUNDED; UNCONSOLIDATED; (QMF A); WET.	
408	133			SP		
411	134					
414	135					

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SHEET 10 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	1-25-2015	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	AZAD VHALIGHI (130~140.5)	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by		Borehole Diameter (in)		Total Depth (ft)
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/min)	Geologic Unit	MATERIAL DESCRIPTION	SOIL COLOR
135						
417						
136				SP	CONT. Pg 9-10	
420					SAND; 100% SAND; F-M GRAINS; POORLY GRADED; SUBANGULAR-SUBROUND; UNCONSOLIDATED; (Qmfa); WET.	2.5YR 5/4 LIGHT YELLOWISH BROWN
137						137
423						
138				SP	SAND; 100% SAND; F-M GRAINS; POORLY GRADED; SUBANG-SUBROUND; UNCONSOLIDATED; (Qmfa); WET	7.5YR 5/6 REDDISH BROWN
426						
139						
429						
140						140
432		STOPPER TO ADD SCINT 24 ~140.5		SP	SAND; 100% SAND; F-M GRAINS; POORLY GRADED; SUBANG-SUBROUND; UNCONSOLIDATED; (Qmfa); WET	2.5Y 6/3 LIGHT YELLOWISH BROWN
141						
435						
142						
438						
143						
441						
144						
444						
145					145.0	
447				(SR)	SAND: 100% FMC sand, pred FM (QFMAO) subA-subR. tr FC gravel to 28mm. tr clay; clayballs	2.5Y 5/4 LIGHT OLIVE BROWN
146						
450						
147						
453					147.5	
148				(SR)	SAND: 95% FMC sand A-subR. (QFMAO) 5% FC gravel to 33mm. tr silt. tr clayballs	2.5Y 6/3 LIGHT YELLOWISH BROWN
456						
149					149.0	
459				(SC)	CLAYEY SAND: 60% FMC sand, pred F, (QFMAO) A-subR. 30% Clay. High plasticity. 10% FC gravel to 40mm.	2.5Y 5/3 Light olive brown
150					150.0	

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SHEET 11 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by <i>ECW, NRP</i>	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by	Borehole Diameter (in)	24" oD	Total Depth (ft)
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION
					SOIL COLOR
150					
462					
151					
465					
152					
468					
153					
471					
154					
474					
155					
477					
156					
480					
157					
483					
158					
486					
159					
489					
160					
492					
161					
495					
162					
498					
163					
501					
164					
165					

Y26/15

155.0

(SP) 100% F sand. subA-SubR.  
Tr F gravel to 17m

2.5y 4/4  
olive brown

(SP) SAND: 100% F subA SubR sand (QFMA0),  
w/tr small weakly cemented sand pieces; well sorted; similar to above.

2.5y 4/4  
Olive Brown

(SP) SAND: 100% F subA - subR sand, w/tr mod. cemented silty/clayey sand balls to 20mm;  
well sorted; tr med plasticity sandy clay balls.

2.5y 4/3  
Olive Brown

(ML) SILT w/SAND: 70% silt; 25% F subA - subR well sorted sand (QFMA0); 5% clay; transitions from a moderately cemented sandy silt to a low plasticity silt w/sand; tr med plasticity sandy clay balls; tr rusty alteration.

2.5y 5/3  
light olive brown

to 165.5

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SHEET 12 OF

Location	CEMEX - Marina, CA		Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)			Logged by NRR, ECW	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum			Reviewed by	Borehole Diameter (in)	24" OD	Total Depth (ft)
Linear Depth (ft)	MATERIAL DESCRIPTION					SOIL COLOR
Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit			
507				ML SILT w/SAND cont...		
510				CL CLAY: Silty clay w/med plast and some rust-colored alteration some moderately cemented silt balls; tr fine sand. (QFMAO)	2.5Y 5/3 (light olive brown)	
513				ML SILT w/SAND: 60% Silt, low plast, 35% VF Sand subA, 5% clay (QFMAO)	"	
516				SM SILTY SAND: Silty Sand w/clay. 60% F sand subA - subR. 30% silt no plast. 10% clay (clay balls) medium plast. Tr F gravel to 8mm. (QFMAO)	"	
519				ML SILT: clayey silt 75% silt (QFMA) 20% clay, med plast, weakly cemented.	"	
522				SP SAND: 95% EMC sand. pred. FM. A-subR (QFMAO) 5% silt. Tr F gravel to 6mm.	5% v.f. sand	
525				SC CLAYEY SAND: 80% PMC sand A-subR. 15% Clay, medium plast. 5% silt. (QFMAO)	"	
528				SP SAND: 100% F sand subA - subR. Tr silt - (QFMAO)	"	
531				CLAYEY SAND: 80% PMC sand A-subR. 15% Clay, medium plast. 5% silt. (QFMAO)	"	
534				SP SAND: 100% F sand subA - subR. (QFMAO)	"	
537				SC CLAYEY SAND: 80% PMC sand A-subR. 15% Clay, medium plast. 5% silt. (QFMAO)	"	
540				SP SAND: 100% F sand subA - subR. (QFMAO)	"	
543				SP SAND: 100% F sand subA - subR. (QFMAO)	"	
546				SP SAND: 100% F sand subA - subR. (QFMAO)	2.5Y 4/3 olive brown.	
549				SP SAND w/GRANVEL: 85% FMC sand subA - subR QFMAO 15% FC gravel to 25mm. Tr silt/balls Tr clay/balls	2.5Y 4/4 olive brown	
552						179.0
567.3						179.5
180						

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SHEET 13 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	Drill Rig Type	Plunge (Degrees)
Horizontal/Vertical Datum		Reviewed by	Borehole Diameter (in)	Total Depth (ft)

Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION	SOIL COLOR
573.58	180				199.5	
	555			(SP)	SAND: 100% F sand; Sub A-Sub R; trace silt; trace clay balls; well sorted.	2.5Y 4/4 olive brown
	558			(SP)	SAND: 100% F/M sand; subA; moderately cemented balls; trace gravel to 16mm; tr. clay; tr. silt.	R15 2.0Y 4/4 olive brown
	561					10 YR
	564			(SP)	SAND: 100% F/M sand; trace C; sub A-Sub R; tr. silt & clay. Behaves like non-newtonian fluid.	4/3 Brown
589.33	576					
	579			(SP)	Same	10 YR 4/4
	582					dark yellowish brown
	585					
	588					
	591			(SP)	Same: more shell fragments than previous samples	same
	594					
	597					
	195					

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**LOG OF BORING Test Slant Well**

SHEET 14 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	Drilling Contractor BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	Drill Rig Type DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by	Borehole Diameter (in)	Total Depth (ft)
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit
				MATERIAL DESCRIPTION
				SOIL COLOR
195				
600				
196				
608				
620.85				
197				
606				
198				
609				
197.0				
612				
199				
613				
200.0				
615				
201				
618				
202				
621				
203				
624				
204				
627				
205				
630				
206				
633				
207				
636				
208				
639				
209				
642				
210				

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SHEET 15 OF

Location	CEMEX - Marina, CA	Date(s) Drilled	Drilling Contractor	BOART LONGYEAR	Bearing (Azimuth)
Ground Surface Elevation (ft)		Logged by	Drill Rig Type	DUAL ROTARY	Plunge (Degrees) 19
Horizontal/Vertical Datum		Reviewed by	Borehole Diameter (in)		Total Depth (ft)
Linear Depth (ft)	Vertical Depth (ft)	Notes	Penetration Rate (ft/hr)	Geologic Unit	MATERIAL DESCRIPTION
					SOIL COLOR
210					SAND : 100% F sand subA - subB
648	211				2.5Y 4/3
651	212				olive brown
654	213				(AFMAO)
657	214				
660	215				
677.58					
668	216	(SP)			SAND: 100% F sand subA - subB (AFMAO)
666	217				2.5Y 4/3 olive brown
669	218				
672	219				
675	220				
678	221				
681	222				
684	223				Same material to 724 feet MD 230 ft TVD
687	224				
690	225				
709.09					