

July 29, 2008

Standard Pacific of Tucson  
4578 North First Avenue  
Tucson, Arizona 85718-5748

Attn: Ms. Geri Grey



Consulting Engineers & Scientists

Terracon Consultants, Inc.  
355 S. Euclid, Suite 107  
Tucson, Arizona 85719  
Phone 520.770.1789  
Fax 520.792.2539  
www.terracon.com

**RE: Supplemental Recommendations to Geotechnical Engineering Report  
Phase I Residential Development at the Pines  
At the Pines Golf Course  
North of Cortaro Road and West of Interstate 10  
Marana, Arizona  
Terracon Project No. 63045225, Addendum 9**

Terracon has completed the geotechnical engineering report for the Residential Development at the Pines (Terracon Project 63045525, dated December 8, 2004). Between June 2005 and January 2007, eight addendums to the geotechnical report were provided. Two of these addendums addressed pavement recommendations for Continental Links Drive. The remainder primarily addressed a portion of the property where fills between 7 and 27 feet deep exist. Alternative recommendations to mitigate problems arising from potential settlement of this fill were provided.

These recommendations applied to the lots in the area of deep existing fills. These lots included:

Lot 1	Lot 16	Lot 73
Lot 2	Lot 17	Lot 74
Lot 3	Lot 18	Lot 75
Lot 4	Lot 19	Lot 76
Lot 5	Lot 70	Lot 77
Lot 6	Lot 71	Lot 78
Lot 15	Lot 72	Lot 115

We have been requested by Mr. Ken Kimball of Borm Structural Engineers to provide additional alternative recommendations for these lots including drilled pier/grade beam foundations.

The deepest fills estimated to be between 17 and 27 feet are expected at Lots 71 to 77. We recommend drilled piers extend to depths of at least 30 feet in these areas. In the areas of Lots 1 to 4, 17 to 19, 70, 78, and 115, we anticipate the depth of fill to be between 10 and 17 feet. We recommend drilled piers extend to depths of at least 20 feet in these areas. In the areas of Lots 5 and 6, 15 and 16 we expect depth of fill between 5 and 10 feet. We recommend drilled piers extend to depths of at least 12 feet in these areas. The pier depths should be verified in the field to determine if the tip elevations are below the existing fill. The following criteria may be used for design of the drilled shafts.

Also included in the tabulation are estimated passive pressures and COM624 or Lpile parameters for lateral load analysis of drilled shafts. Straight sided shafts are recommended for construction in the predominantly granular soils. The design parameters are as follows:

Depth Below Existing Grade (ft.)	Internal Angle of Friction (degrees)	Total Unit Weight (pcf)	Allowable End Bearing Pressure (psf)	Allowable Skin Friction (psf)*	Ultimate Passive Pressure (pcf)**	p-y Modulus (pci)***
0 - <10	--	--	--	--	--	--
10 - <15	30	105	6000	--	315	25
15 - <20	30	105	8000	--	315	25
20 - <25	32	110	10,000	--	360	90
25 - <30	32	110	12,000	--	360	90
30 - <35	35	115	14,000	250	420	125
35 - <40	35	115	20,000	500	420	225
*Compression or Tension						
**Equivalent Fluid Pressure						
***This is the k coefficient used in the equation $E_s=kx$ where x is the depth below the surface						

The passive pressures are ultimate values; therefore, appropriate factors of safety or shaft deflection limits should be applied in the shaft design. The above parameters assume the groundwater level is below the maximum depth of the drilled shaft.

In designing to resist uplift forces, the effective weight of the shaft and structure (divided by an appropriate factor of safety) and the allowable skin friction values provided above should be used.

Drilled shafts should be designed with a minimum shaft diameter of 24 inches. If downhole inspection or manual clean out is required, a minimum shaft diameter of 30 inches is recommended.

It should be noted that the loaded capacities provided herein are based on the stresses induced in the supporting soils. The structural capacity of the shafts should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. Furthermore, the response of the drilled shaft foundations to lateral loads is dependent upon the soil/structure interaction as well as the shaft's actual diameter, length, stiffness and "fixity" (fixed or freehead condition).

Temporary casing might be required to prevent caving in the granular soils. Temporary casing should also be used whenever shafts are installed adjacent to any existing structures or improvements, to reduce potential ground loss and movement, due to drilled shaft excavation. Water, if encountered, should be removed from each shaft hole prior to concrete placement. Casing should be installed for the full shaft depth if downhole inspection and clean out is required. Shaft concrete should be placed immediately after completion of drilling and cleaning. If shaft concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

Temporary casing used (if required) for shaft construction should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete inside the casing to counteract earth and any hydrostatic pressures outside the casing. An insufficient head of concrete inside the case can cause "necking" of the shaft, resulting in a reduced shaft capacity. Shaft concrete should have a relatively high fluidity when placed in cased holes or through a tremie. Shaft concrete with slump in the range of 6 to 8 inches is recommended.

Phase I Residential Development at the Pines  
Pines Golf Course  
Terracon Project No. 63045225, Addendum 9

4

The contractor should check for gas and/or oxygen deficiency prior to any workers entering the excavation for observation and manual cleanup. All necessary monitoring and safety precautions as required by OSHA, State or local codes should be strictly enforced.

We recommend that all drilled shaft installations be observed on a full-time basis by an experienced geotechnical engineer in order to evaluate that the soils encountered are consistent with the recommended design parameters.

Settlement of drilled shafts designed and constructed in accordance with the recommendations in this report should be less than 1-inch.

If you have any questions regarding this letter please contact us.

Sincerely,

**TERRACON**



Expires 03/31/2009

Oleg B. Lysyj, P.E.  
Principal

Copies: Addressee (1)  
Borm, Attn: Ken Kimball (1) [kenk@borm.com](mailto:kenk@borm.com)