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June 9, 2008

**Interstate 5/SR 501 Interchange Replacement  
Summary of Geotechnical Conditions  
Ridgefield, Washington**

**Project 2062005**

Dear Mr. Sakr:

This memorandum provides a summary of geotechnical conditions for inclusion in the contract documents. The summary is based on the geotechnical investigation analysis and design recommendations included in the Foundation Report dated March 10, 2008, for the Interstate 5/SR 501 Interchange Replacement project in Ridgefield, Washington. Our memorandum includes a discussion of the following:

- General Subsurface Conditions
- Ground Water Conditions
- Drilled Shaft Foundations
- Abutment and Retaining Walls
- Embankment Construction
- Cut Slopes
- Use of excavation Material in Construction

The project involves a  $\pm 100$ -foot wide by  $\pm 266$ -foot long, 2-span overcrossing of I-5 supported on drilled shaft foundations. Retaining walls are planned for the approach east of I-5 and for the north end of Timm Road. Approach embankment construction and excavations are also included in the construction.

The Foundation Report is available to prospective contractors and the exploration boring and test pit logs are included in the contract documents.

Sincerely,

FOUNDATION ENGINEERING, INC.



Timothy J. Pfeiffer, P.E.  
Senior Geotechnical Engineer



TJP/plt  
Enclosure

**SUMMARY OF GEOTECHNICAL CONDITIONS  
INTERSTATE 5/SR 501 INTERCHANGE REPLACEMENT  
RIDGEFIELD, WASHINGTON**

**General Subsurface Conditions**

Eleven exploratory boreholes were drilled between May 1 and 16, 2006, using a CME 850B track-mounted drill rig with mud-rotary and hollow-stem auger drilling techniques. Table 1 is a listing of the borehole investigations including purpose, location and final depth.

**Table 1. Borehole Investigations**

<b>Boring No.</b>	<b>Date Completed</b>	<b>Interchange Quadrant</b>	<b>Investigation Purpose</b>	<b>Final Depth (ft)</b>	<b>Water Level Depth (ft)</b>
BH-1	5/3/2006	W	Abutment	110.1	No well
BH-2	5/2/2006	W	Abutment	100.9	No well
BH-3	5/11/2006	Median	Interior Bent	105.2	No well
BH-4	5/12/2006	Median	Interior Bent	81.5	No well
BH-5	5/8/2006	E	Abutment	105.2	40.3 to 742.5
BH-6	5/9/2006	E	Abutment	120.5	No well
BH-8	5/16/2006	NW	On/Off Ramp	31.5	10.8 to 12.0
BH-9	5/5/2006	SW	On/Off Ramp	41.5	No well
BH-11	5/15/2006	NE	On/Off Ramp	21.5	No well
BH-12	5/15/2006	NE	On/Off Ramp	31.5	No well
BH-13	5/10/2006	SE	On/Off Ramp	31.5	8.6 to 7.25
BH-14	11/10/2006	East	Retaining Wall	31.5	No well
BH-15	11/10/2006	East	Retaining Wall	31.5	No well

Eight test pits (TP-1 to TP-8) were excavated on November 6, 2006, using a light-duty rubber-tire Hitachi EX30 backhoe. The test pits extended to a maximum depth of ±5 feet.

Soils observed during our explorations included the following geologic units:

Fill. Existing fill was predominately regraded native soil consisting of soft to stiff silt with sand and gravel

Alluvium. Alluvium included soft to stiff silt with sand and clay near the surface, followed by a zone of medium stiff to hard clay. Below the hard clay the alluvium graded from stiff to very stiff silt to medium dense to dense sand.

Troutdale Formation. Troutdale Formation underlies the site and consisted of very dense, sandy gravel.

The following describes the subsurface conditions observed in the exploration for the bridge foundations:

West Abutment. Fill was encountered in BH-2 to  $\pm 5$  feet. The fill generally consisted of regraded native soil and the contact was interpreted based on the existing topography. Medium stiff silt with sand was encountered at the ground surface in both BH-1 and BH-2 to depths of  $\pm 7.5$  and 5 feet followed by alluvium consisting of soft silt extending to  $\pm 10$  and 7.5 feet in BH-1 and BH-2, respectively. The soft silt is underlain by stiff silt with sand and clay to  $\pm 15$  and  $\pm 14$  feet, respectively. The stiff silt is underlain by  $\pm 12$  to 14.5 feet of very stiff to hard clay with sand. The clay is followed by very stiff to hard silt and dense to very dense sand to a depth of  $\pm 98.5$  and 100.5 feet in BH-1 and BH-2, respectively. Troutdale Formation consisting of cemented sandy gravel was encountered to the final depth of the borings at  $\pm 110.1$  and 100.9 feet in BH-1 and BH-2, respectively.

Interior Bent. In BH-3, fill consisting of soft to medium stiff silt with gravel was encountered to  $\pm 1.5$  feet. The fill is underlain by medium stiff silt with sand to  $\pm 7.5$  feet. The silt is underlain by loose sand from  $\pm 7.5$  to 11 feet. Below the sand, medium stiff to very stiff clay extends to  $\pm 20.3$  feet. The clay is underlain by stiff to very stiff silt and medium dense to dense sand to  $\pm 102$  feet, followed by the Troutdale Formation to 105.2 feet (the limit of our exploration). The Troutdale Formation consists of very dense, sandy gravel.

In BH-4, medium stiff silt with sand was encountered to  $\pm 5$  feet. From  $\pm 5$  to 8.5 feet the silt grades to soft, clayey silt. The clayey silt is underlain by stiff to very stiff silty clay to a depth of  $\pm 29$  feet. The silty clay is underlain by hard to very stiff clay to  $\pm 45$  feet and hard sandy silt to  $\pm 81.5$  feet (the limit of our exploration).

East Abutment. Fill was encountered from the surface to  $\pm 4$  to 5 feet in BH-5 and BH-6, respectively. The fill generally consisted of medium stiff to very stiff silt with sand and gravel. The fill is underlain by alluvium consisting of medium stiff to very stiff silt with sand to  $\pm 20$  and  $\pm 10$  feet in BH-5 and BH-6, respectively. A layer of soft silt was encountered in BH-6 between  $\pm 10$  to 17 feet. The silt is underlain by very stiff clay with sand to  $\pm 30$  feet in BH-5 and  $\pm 25$  feet in BH-6. The clay is underlain by stiff to very stiff silt with sand and clay to a depth of  $\pm 40$  feet. Very stiff to hard silt and dense to very dense sand extends to the Troutdale Formation at  $\pm 105$  and  $\pm 109.9$  feet in BH-5 and BH-6, respectively. The Troutdale Formation consisted of very dense, sandy gravel extending to the final depth of the borings at 105.2 and 120.5 feet.

### Ground Water

Standpipe piezometers were installed in boreholes BH-5, BH-8 and BH-13.

Based on the water level reading and the observed subsurface conditions, there appears to be an upper perched water table above the stiff silty clay and a lower water table in the sandy material below. We recorded water depths in the upper perched zone between  $\pm 8.6$  and  $\pm 24.2$  feet and a ground water depth of  $\pm 40.3$  feet in the lower zone. Based on the observation of standing water in the roadside ditches during the winter, we anticipate that the perched water table approaches the ground surface during the wet winter months.

### **Drilled Shaft Foundations**

The bridge foundation consists of eight, 3-foot diameter drilled shafts for each abutment and five, 6-foot diameter drilled shafts for the interior bent. Embankments will be constructed to full height and to the final slope before excavating for the abutment walls and foundations.

Temporary casing for the drilled shafts will be used for at least the upper 20 feet of the shafts. We anticipate that temporary casing will be partially removed, but we understand that WSDOT practice involves at least 10 feet of permanent casing. The contractor is responsible for installing additional temporary casing as needed and providing confirmation that the sides of the drilled shaft do not cave and that the bottom of the shaft remains free of loose and deleterious soil. Wet shaft conditions are anticipated.

### **Abutment and Retaining Walls**

The new bridge will have up to  $\pm 12$ -foot high abutment walls and variable-height MSE walls with a maximum exposed height of up to 16 feet. Settlement may be on the order of  $\pm 1$  to 2 inches for the retaining walls up to 16 feet high. Most of the settlement is expected to occur during construction.

### **Embankment Construction**

Approach embankments will be up to 26 feet high at the abutments and taper down away from the structure. Embankment construction in the vicinity of the drilled shafts may use only materials that will not interfere with foundation drilling. Approach embankments will be constructed to full height and to the final slope before excavating for the abutment walls and foundations. Anticipated settlement is less than  $\pm 2$  inches and is expected to occur largely during construction.

### **Cuts and Excavations**

Temporary slopes should be cut no steeper than 1(V):1(H). Perched ground water and infiltration of surface water may enter the foundation excavations. Standing water should be removed from excavations and a nominal 4 inches of crushed rock should be placed in the base of the excavation to protect the subgrade.

The silty soil is typically susceptible to erosion and should be seeded and covered with mulch as soon as possible. Surface water runoff should be directed away from newly constructed slopes.

### **Use of Excavation Material in Construction**

Materials from the drilled shaft excavation are not expected to be suitable for use as fill. The existing fill and native alluvium includes fine-grained soils that are expected to be sensitive to disturbance and softening when wet. Therefore, embankment construction and foundation preparation is not recommended during wet weather.

Native alluvium and local fill from excavations on the project are suitable for use as embankment fill if moisture conditioned and compacted. However, the in-place soil is

typically above the optimum moisture content and will require aeration before embankment construction and compaction.

## REFERENCES

Foundation Engineering, Inc., March 10, 2008, Foundation Report, Interstate 5/SR 501 Interchange Replacement, Prepared for HDR Engineering, Inc.

Washington State Department of Transportation, Tony M. Allen, Mark A. Frye, August 27, 2004, Memorandum, SR-5, MP14.21 vic, XL-2013 SR 501 Safety Improvements, Retaining Walls, Geotechnical Recommendations