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Washington State Department of Transportation

Memorandum

Date: May 4, 2000

TO: J.Weigel/K.Kirker
Bridge & Structures, 47340

FROM: T. M. Allen/M. Bahiradhan
FOSSC Geotechnical Branch, 47365

SUBJECT: SR-14, OL-2530
SE 192nd Avenue Interchange
MP 9.01 to MP 10.56
Geotechnical Report

Attached with this memorandum is the geotechnical report for the subject project. This report presents the geotechnical recommendations for the SE 192nd I/C bridge and Quarry Road bridge foundations, retaining walls and drainage facilities. This report supersedes our previous recommendations and addresses the following:

- Site geology
- Seismicity
- Subsurface conditions
- Foundation recommendations for SE 192nd Avenue I/C and Quarry Road bridges
- Retaining walls
- Detention ponds and Bioswale
- Construction considerations

If you have questions regarding geotechnical information or require further information, please contact M. Bahiradhan at 360-709-5459.

TMA:mbr
Attachment

cc: Jack Folk, Southwest Region, S-15
Rich Lang, Southwest Region, S-15
Doug Ficco, Southwest Region, S-15
Karl Kirker, EESC Bridge & Structures, 47340

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Ray Shaefer, EESC Bridge & Structures, 47340
Alex Young, EESC Bridge & Structures, 47340
Ron Lewis, FOSSC Construction, 47354
Barry Brechto, FHWA 0943
McClellan, Jim, Southwest Region, S-15

GEOTECHNICAL REPORT

SR-14

MP 9.01 to 10.56

SE 192nd Avenue Interchange

Geotechnical Recommendations for SE 192nd Undercrossing, Quarry Rd. Overcrossing, Retaining walls, and Drainage Fac.
0L-2530

Tony M. Allen, P.E.
State Geotechnical Engineer

Prepared by:
M. Bahiradhan, P.E.
Geotechnical Engineer

Reviewed by:
James G. Cuthbertson, P.E.
Chief Foundations Engineer

TONY M. ALLEN
STATE OF WASHINGTON
25339
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES JULY 1, 2001

JAMES G. CUTHBERTSON
STATE OF WASHINGTON
31992
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 03-13-02

May, 03, 2000

Washington State Department of Transportation
Sid Morrison
Secretary of Transportation

Field Operations Support Service Center
Materials Laboratory
Geotechnical Branch
P.O. Box 47365
Olympia, WA 98504-7365

Contents

1. INTRODUCTION **3**

2. PROJECT DESCRIPTION **3**

2.1. SE 192ND AVENUE UNDER-CROSSING BRIDGE 3
2.2. QUARRY ROAD OVER-CROSSING BRIDGE 3
2.3. RETAINING WALLS 3
2.4. DETENTION POND AND BIOSWALE 4

3. FIELD EXPLORATION AND TESTING **4**

3.1. FIELD EXPLORATION 4
3.2. LABORATORY TESTING 4

4. SITE GEOLOGY **5**

5. SITE CONDITIONS FOR BRIDGES **6**

5.1. SE 192ND AVENUE UNDER-CROSSING BRIDGE 6
5.1.1. Surface Conditions *6*
5.1.2. Subsurface conditions *6*
5.2. QUARRY ROAD OVER-CROSSING BRIDGE 7
5.2.1. Surface condition *7*
5.2.2. Subsurface condition *7*

6. SEISMOLOGICAL CONSIDERATIONS **7**

6.1. SITE SEISMICITY 7
6.2. DESIGN EARTHQUAKE PARAMETERS 7
6.3. LIQUEFACTION POTENTIAL 8

7. GEOTECHNICAL RECOMMENDATIONS **8**

7.1. 192ND AVENUE UNDER-CROSSING BRIDGE 8
7.1.1. Approach Embankments *8*
7.1.2. Approach Slabs *8*
7.1.3. Foundation Recommendations *8*
7.1.4. Resistance Factors for spread footing design *9*
7.1.5. Vertical soil spring constants for spread footing design *9*
7.2. QUARRY ROAD OVER-CROSSING BRIDGE 10
7.2.1. Approach Embankments *10*
7.2.2. Approach Slabs *10*
7.2.3. Foundation Recommendations *10*
7.2.4. Vertical Spring Constants and Resistance Factors for the Spread Footing Design *10*

8. RETAINING WALL SITE CONDITIONS/RECOMMENDATIONS **11**

8.1. WALL 2 11
8.1.1 Shotcrete faced geosynthetic wall *11*
8.1.2 Hilfiker welded wire wall *12*
8.2. WALLS 5 , 6 , 7, 8, 9 & 10 12
8.3. WALL 11 13
8.3.1 Shotcrete faced geosynthetic wall *14*
8.3.2 Hilfiker welded wire wall *14*
8.4. WALL 12 15

9. DETENTION POND AND BIOSWALE **16**

10. CONSTRUCTION CONSIDERATIONS **17**

1. INTRODUCTION

We are presenting the geotechnical recommendations for bridge foundations, retaining walls and a detention pond/bioswale.

The analysis, conclusions and recommendations presented in this letter are based on the project description and site conditions that existed at the time of the field exploration. We assume the exploratory borings represent the subsurface conditions throughout the project area. If different subsurface conditions are encountered or appear to be present, we should be contacted so that we can re-evaluate our recommendations and assist you.

2. PROJECT DESCRIPTION

The proposed project consists of two bridges, nine retaining walls, a detention pond and a bioswale. A plan view of the project is presented in Figure 1, in Appendix B.

2.1. SE 192ND AVENUE UNDER-CROSSING BRIDGE

The proposed bridge is a 35.6 m single span structure with curtain walls on both ends to retain the abutment fill. The proposed bridge approaches involve cuts and fills. The cut and fill slopes recommendations for this project were presented in a report by D. Jenkins sent to J. Allinger on April 29, 1999 titled; "192nd Interchange, Soils Report". Figures 2 and 3 in Appendix B present the plan and elevation of this proposed bridge.

2.2. QUARRY ROAD OVER-CROSSING BRIDGE

The proposed new alignment of SR-14 requires the extension of the north side of the existing Quarry Road bridge. Figures 4 and 5 in Appendix B present the plan and elevation view of the proposed bridge widening. The retaining walls, as shown in Figure 4 of Appendix B, retain the fill along the proposed alignment of SR-14.

2.3. RETAINING WALLS

Table 1 below presents the dimensions and locations of the walls on this project.

Wall No.	Type	Maximum height (m)	Length (m)	Begining		Ending	
				Station	Offset (m)	Station	Offset (m)
2	Fill	5.3	30.0	L 14 + 681.000	17.8 LT	L 14 + 711.071	17.8 LT
5	Fill	7.3	12.6	L 15 + 202.420	16.2 LT	L 15 + 215.000	16.2 LT
6	Fill	7.3	46.7	L 15 + 223.800	16.2 LT	L 15 + 270.540	16.2 LT
7	Fill	9.4	11.0	192nd 1+ 011.405	9.6 LT	192nd 1 + 022.435	9.6 LT
8	Fill	10.4	15.4	192nd 1+ 061.645	9.6 LT	192nd 1 + 077.060	9.6 LT
9	Fill	10.4	14.7	192nd 1+ 061.645	9.6 RT	192nd 1 + 076.365	9.6 RT
10	Fill	9.4	12.4	192nd 1+ 010.000	9.6 RT	192nd 1 + 022.435	9.6 RT
11	Fill	4.6	72.0	B 1 + 530.000	7.6 RT	B 1+ 600.142	7.6 RT
12	Cut	4.0	28.8	B 1 + 610.000	7.2 LT	B 1+ 640.000	7.2 LT

Table 1 : Dimensions and locations of the walls

2.4. *DETENTION POND AND BIOSWALE*

Figures 27 and 28 in Appendix B present the proposed locations of the detention pond, bioswale and the locations of test borings H-2-99, H-3-99 and H-6-99. The surface area of the proposed detention pond is approximately 4500 sq.m. We understand from the region that the fore and back slopes of the detention pond will be at 3H:1V and 2H:1V respectively. The side slope of the Bioswale is 3H:1V.

3. FIELD EXPLORATION AND TESTING

3.1. *FIELD EXPLORATION*

The field exploration program for the project consisted of Standard Penetration Test (SPT) borings. The information obtained during the field exploration was used in conjunction with existing information obtained from the previous studies to characterize the subsurface conditions throughout the project area. The logs of the test borings provided in this report should be included in the contract documents.

Standard Penetration Tests (SPT), in general, were performed at 1.5 m intervals in the test borings. Disturbed soil samples from the SPT were visually classified in the field then submitted to the OSC Materials Laboratory for more detailed classification and testing. The undisturbed samples were submitted to the OSC Materials Laboratory for testing. The borings completed for this study utilized augers and wet rotary methods with auto safety hammers for the SPT tests. SPT values reported on the logs and profiles are the actual field measured SPT values. They have not been corrected for energy, silt content, rod weight and flexure, or overburden pressures. Edited boring logs are presented in Appendix D.

3.2. *LABORATORY TESTING*

Laboratory testing was performed on selected samples from the field exploration program.

All disturbed soil samples were visually examined and then grouped together based on particle size distribution, consistency, and color. Once groups of samples were established that had

similar characteristics, a minimum of one sample per group was tested. The testing consisted of performing particle size analyses, determining the liquid limit, plastic limit and plasticity index if applicable. The tests were done in accordance with AASHTO T-88, T-89 and T-90 guide specifications respectively. After the testing was complete, the samples were classified using the Unified Soil Classification System (USCS). The laboratory test results are presented in Appendix E.

4. SITE GEOLOGY

The project site is located in the Portland-Vancouver basin. The oldest exposed rocks in the project area are Oligocene age volcanic rocks (approximately 28 million years in age). These rocks are comprised of basaltic-andesite and basalt flows with local interbeds of mafic tuff, basaltic sandstone, and conglomerate. These rocks were subjected to considerable folding, faulting, and erosion. During Miocene time (12-15 million years in age) extensive basalt flows were extruded over much of eastern Washington. Several flows were channeled down the Columbia River occasionally reaching the pacific ocean. All of these Miocene age flows comprise the Columbia River Basalt Group. This unit was also subjected to extensive folding, faulting and erosion. Downwarping of the region began in the late Miocene and early Pliocene (8-12 million years in age). As the basin developed, sand, silt, and clay were deposited forming the lower member of the Troutdale Formation. This lower member of the Troutdale formation is composed of interlayer sand and silt. In the late Pliocene (2-5 million years in age), the depositional environment changed. Coarse sand and gravel deposits formed as a great fan along the western edge of the Cascades. This unit comprises the upper member of the Troutdale formation. During the late Pliocene and early Pleistocene (1-2 million years in age), numerous small volcanic vents developed in the region extruding basalt flows, breccias and scoria. These include the Boring lava flows. Again the depositional environment changed in the region. Deltaic deposits of sand and gravel formed on the lowlands from the ancient Columbia River to a present day elevation. Several volcanic vents were identified in the project area during past field exploration. The volcanic vent material at this site is characterized as an orange-brown, hydrothermally altered and weathered, weak basalt with clay seams. Additional information can be obtained from the reports presented below:

- Badger, T & Lowel, S.M., **SR-14, Quarry Site G-78 Evaluation**, 1988
- Sylwester, R.E, D.P. Findley, J.Liu, **SR14/192nd Interchange Site Geophysical Investigation**, April 21, 2000
- T. M. Allen, N. F. Boyd, **QS-G-78, SF3142, Murhard Quarry**; November, 22, 1995
- T. M. Allen, L. J. Moses, **SR-14, C.S.0604, JD-0848, QS G-78 Geotechnical Evaluation**; February 5, 1999
- D. P. Findley, R. E. Sylwester, **SE 192nd Avenue Interchange Site Geophysical Investigation**; December 1999

5. SITE CONDITIONS FOR BRIDGES

5.1. SE 192ND AVENUE UNDER-CROSSING BRIDGE

5.1.1. Surface Conditions

The ground surface at the proposed structure location consisted of highly fractured basalt rock. The existing basalt rock cut slope was nearly vertical. The main orientation of the fractures are horizontal and vertical. The existing cut slope at the proposed south abutment wall location was approximately 0.5H:1V. An exposed cut at the proposed location of the south pier consisted of a mixture of silt, sand, gravel, cobbles and boulders.

5.1.2. Subsurface conditions

A geophysical survey was conducted to investigate the presence of vent material at this proposed bridge site. The geophysical survey suggests the possible presence of vent material at both pier locations of this bridge. Therefore, we have accounted for the presence of this vent material in the ultimate capacities recommended in section 7.1 of this report. Based on discussions with bridge and structures, we believe that the foundation bearing pressures of this bridge piers are below the revised allowable bearing capacity of this vent material. Therefore, we anticipate the existing footing design is appropriate.

Borings H-1a-98, H-2a-98 and H-1-99 were drilled to explore the subsurface conditions at the proposed SE 192nd avenue under crossing bridge location. Figure 2 in Appendix B presents the locations of these test borings. The following soil/rock units were found common in all three borings.

Unit 1 is a basalt rock with wide range of weathering and fracture frequency, and with clay seams. This unit is present in the top 10 m depth of the subsurface.

Unit 2 is a very dense conglomerate consisting of a mixture of silt, clay, sand, gravel and cobbles (Troutdale formation) found below the capping basalt. The thickness of this layer is approximately 4 m. This very dense conglomerate is also found below the depth of 23.6 m.

Unit 3 is a very dense silty sand. This unit is generally found below the depths of 14.4 m and 23.6 m.

A water table was found at a depth of approximately 8 m in boring H-1-99, elevation 34.4 m.

5.2. *QUARRY ROAD OVER-CROSSING BRIDGE*

5.2.1. Surface condition

The existing embankment fill slopes in this area ranges between 1H:1V and 1.5H:1V. The east embankment slope of the bridge was covered in tall trees with fractured rock near the toe. An area of standing water was found at the toe of the slope.

5.2.2. Subsurface condition

Borings H-4-99 and H-5-99 were drilled to explore the subsurface condition of the Quarry road over crossing bridge extension along the proposed SR-14 alignment. Figure 4 in Appendix B presents the locations of these test borings. The following soil/rock units were found in borings at this structure location:

Unit 1a is a loose to dense silty sand with organics in the top 2 m. This unit was present between elevations 56.4 m and 53.6 m from west to east.

Unit 2a is a loose to dense well graded gravel. This unit was approximately 2 m thick and found below the top silty sand unit.

Unit 3a is a very dense mixture of silt, clay, sand, gravel and cobbles found below the gravel unit.

6. SEISMOLOGICAL CONSIDERATIONS

6.1. *SITE SEISMICITY*

The project is located in the Portland-Vancouver Basin. A convergence of the North American crustal plate and Juan de Fuca Plate is situated west of the project. The Juan de Fuca plate is subducting beneath the North American plate resulting in tectonic strain accumulation along the interface. The plate convergence can result in shallow earthquakes along the plate interface (thrust events), deep earthquakes within the subducted Juan de Fuca plate (intraplate normal-faulting events), and shallow earthquakes within the North American crust. Historic shallow earthquakes in the region include the 1981 Elk Lake earthquake (magnitude 5.5), the 1961 quakes that occurred on the southern end of Mt. St. Helens (magnitude 4.8 and 5.1), the 1962 Portland earthquake (magnitude 5.2), and the 1996 Scott Mills earthquake (magnitude 5.6) that occurred 54 km SW of Portland.

The nearest potentially active fault zone is the northwest striking Portland Hills fault zone about 30 km to the southwest.

6.2. *DESIGN EARTHQUAKE PARAMETERS*

An acceleration coefficient of 0.20g is recommended based on the current policy of WSDOT for the region west of the cascade crest. The recommended acceleration coefficient is based on expected ground motion at the project site that has a 90 percent probability of not being exceeded in a 50 year period.

Design response spectra presented in the AASHTO guide specification are considered appropriate for seismic design of the structures on this project. A Type I soil profile response spectrum is recommended for seismic design of the project. A site coefficient of 1.0 should be used to estimate the peak ground acceleration at the foundation level.

6.3. *LIQUEFACTION POTENTIAL*

We have evaluated the potential for liquefaction of the project soils based on the SPT data obtained from the field explorations and the percentages of silt. Our analysis indicates that the potential for liquefaction of the bearing soils at both bridge foundations is low.

7. GEOTECHNICAL RECOMMENDATIONS

7.1. *192ND AVENUE UNDER-CROSSING BRIDGE*

7.1.1. Approach Embankments

The south approach embankment will be located on a very dense conglomerate of silt, sand, gravel and cobbles. The north approach embankment will be located on rock. The maximum heights of the North and South approaches are 9 m and 7.5 m respectively. We recommend that gravel borrow meeting standard specifications be used for the bridge approach embankments. Method C compaction meeting standard specification requirements should be used. Select borrow or common borrow with Method B compaction should be used for embankment construction outside of the Bridge Approach Embankments limits.

7.1.2. Approach Slabs

Based on the height of the fill and the variation of the supporting soils/rock at the abutments, we recommend that approach slabs be used.

7.1.3. Foundation Recommendations

We recommend that spread footings be used to support the end piers. The spread footings for The north and south piers should be founded at or below elevation 41 m. Boring H-2A-98 at the site indicates the presence of a clay seam approximately 0.6 m in thickness at elevation 41m. Since we were unable to obtain a boring at the exact footing location, and the clay seem was only encountered in one boring, we are uncertain as to its continuity through the Pier 1 footing location. To ensure that the clay seam is either not present or removed, we recommend that the rock below the footing be over excavated 1 m to elevation 40 m. See Figure 3a for over excavation details.

Table 2 presents ultimate capacities for strength, service and extreme event limit states for all piers of this bridge. The capacities shown in Table 2 are based on the effective foundation width range of 1.5 m to 6 m. The service limit capacity is based on 25 mm total settlement for each foundation.

Limit State	Strength	Extreme	Service
Bearing capacity (kPa)	1700	1700	670

Table 2: Design bearing capacities

At both piers, the settlement should occur as the loads are applied. The estimated differential settlement between the abutment piers on spread footings could be as much as 25 mm (1 inch). Post construction settlement is expected to be negligible.

We recommend that the passive resistance of the front fill be considered when the stability of the structure is being evaluated against sliding. The following soil properties should be used to estimate the active and passive pressures of the foundations.

Parameters	Abutment	
	North	South
Unit weight of retained soil (kN/m^3)	20.4	20.4
Friction angle of retained soil (deg.)	36	36
Active earth pressure coeficient	0.26	0.26
Passive earth pressure coeficient for sliding	3.9	3.9
Coefficient of sliding	0.45	0.45

Table 3: Soil parameters for lateral load and resistance

7.1.4. Resistance Factors for spread footing design

The recommended resistance factors for applicable limit states are presented in Table 4 below.

Limit state	Bearing	Sliding resistance	
		Shear	Passive
Strength	0.45	0.8	0.5
Service	1	N/A	N/A
Extreme Event	1	1	1

Table 4: Resistance factors for spread footing design

7.1.5. Vertical soil spring constants for spread footing design

We recommend that equivalent spring constants for the spread footing foundation be determined by the method outlined in section 7.2.4 of FHWA Report No. FHWA-IP-87-6 entitled: Seismic Design and Retrofit for Highway Bridges.

Based on the results of our analysis, we have developed a range of shear modulus values for the bearing soil unit under service load. The most critical spring constant for the pier support depends on the rigidity of the superstructure. This is determined by the structural engineer. We are providing a range of shear modulus values so that you may decide which is more critical, a weak or stiff spring. Table 5 presents the soil parameters to determine the vertical spring constant for the foundations.

Shear modulus (Mpa)		Poission's ratio
0.2% strain	0.02% strain	
57	170	0.3

Table 5: Soil parameters for vertical spring constants

7.2. *QUARRY ROAD OVER-CROSSING BRIDGE*

7.2.1. Approach Embankments

The maximum height of the East and West approaches is approximately 6 m. We recommend that a gravel borrow with Method C compaction be used for Bridge Approach Embankments. Select borrow or common borrow with Method B compaction should be used for embankment construction outside of the Bridge Approach Embankments limits.

7.2.2. Approach Slabs

We recommend that approach slabs only be used if the existing bridge has approach slabs.

7.2.3. Foundation Recommendations

Based on discussions with Bridge and Structures, we recommend that the spread footings be used to support the proposed bridge. We recommend that the footings be located at a matching elevation of the existing footings or according to minimum requirements stated in Bridge Design Manual.

The ultimate capacities of the spread footings for strength, extreme event and service limit states for east and west foundations of this bridge are presented in Table 6. The capacities shown in Table 6 are based on the effective foundation widths range of 1 m to 5 m. The service limit capacity is based on 25 mm total settlement.

Limit State	Strength	Extreme	Service
Bearing Capacity (kPa)	1500	1500	550

Table 6: Design bearing capacities

At both foundations, the settlement should occur as the loads are applied. The estimated differential settlement between the spread footings could be as much as 25 mm (1 inch). Post construction settlement is expected to be negligible.

We recommend that the passive resistance of the front fill be considered when the stability of the structure is being evaluated against sliding. Table 3 presents the soil properties to estimate the active and passive pressures of the foundations.

7.2.4. Vertical Spring Constants and Resistance Factors for the Spread Footing Design

We recommend using the values presented in Table 7 for the design of spread footing at this proposed bridge. The resistance factors in Table 3 should be used for foundation design.

Shear modulus (Mpa)		Poission's ratio
0.2% strain	0.02% strain	
35	105	0.3

Table 7: Soil parameters for vertical spring constants

8. RETAINING WALL SITE CONDITIONS/RECOMMENDATIONS

8.1. WALL 2

This fill wall supports the widening of SR-14. The dimensions and location of this wall are presented in Table 1.

Existing surface slope is approximately 1.5H:1V in the proposed wall location. The slope is densely vegetated with small trees. A concrete box culvert carrying fisher creek across the existing SR-14 was present at the bottom of the slope.

Test borings H-9-99 and H-9a-00 were drilled near the wall location. Test boring H-9-99 generally consisted of alternating layers of loose to medium dense silty sand and loose to medium dense silt layers in the top 4.2 m. A gravel unit was found at a depth of 4.2 m with varying contents of silt, sand and clay and continued until the bottom of the boring which was reached at approximately 18.2 m. This gravel unit was medium dense in the top 1 m and became dense to very dense with depth. The water table was found at a depth of 7.2 m. Test boring H-9A-00 consisted of loose to medium dense silty sand in the top 6 m and a very dense conglomerate of silt, sand, gravel and cobbles below it. Bore hole was terminated at 9.5 m. No water table was found in boring H-9A-00.

We recommend using a geosynthetic wall with shotcrete facing or a welded wire MSE wall such as Hilfiker wall at this proposed location due to their lower cost. The recommendations for all two ~~three~~ wall types are presented so that the region can choose the most desirable wall type. We understand from the region that the aesthetic appearance of this proposed wall was not a concern. Concrete cantilever walls were not considered due to cost considerations.

8.1.1. Shotcrete faced Geosynthetic wall

Table 8 below presents the long term strength requirements for use in the geosynthetic retaining wall general special provisions.

Vertical Height Range (m)	Vertical spacing of reinforcement layers (m)	Minimum Long Term Tensile Strength , Tal (kN/m)
0-3	0.23	5.7
3-6		9.0
0-3	0.30	7.0
3-6		11.5
0-3	0.38	8.5
3-6		14.7

Table 8: Long term tensile strength requirements for different vertical reinforcement spacing

We expect that the total settlement under service load would be less than 25 mm.

Please refer to Appendix B for General Special Provisions for the permanent geosynthetic wall and shotcrete facing. A typical geosynthetic wall profile and other relevant details are presented in Figures 9, 10 and 11.

8.1.2. Hilfiker Welded Wire Wall

Implementation of these walls alternative should be completed in accordance with Section 1130 of the Design Manual.

Soil parameters and design load groups presented in Table 9 and Table 10 should be included in the general special provisions for the welded wire wall/ wire faced geosynthetic wall. We expect that the total settlement would be less than 25 mm under service loads.

Soil Parameters	Reinforced soil	Retained soil	Foundation soil
Friction Angle	38	33	36
Cohesion (kPa)	0	0	0
Unit weight (kN/m3)	20.4	18	19.6

Table 9: Soil Parameters

Allowable Bearing Capacity (kPa) AASHTO Load Group	
StaticLoad (I)	Seismic Load (VII)
115	340

Table 10: Allowable pressures

The following criteria should be met to ensure the overall stability of the wall.

1. The batter of the wall face should be no steeper than 40V:1H.
2. The minimum reinforcement length should not be less than 85 percent of the wall height.
3. The wall should have a minimum of 1.5 m wide horizontal bench in front of the wall.
4. Minimum embedment should be 10 percent of the wall height or 0.5 m below the finished grade, whichever is greater.
5. The minimum depth of the top reinforcement layer should be 0.3 m from the finished ground.
6. The walls should be designed for traffic loads.

8.2. WALLS 5 , 6 , 7, 8, 9 & 10

Walls 5 and 6 support the fill along the realignment of SR-14 on both sides of the proposed extension of Quarry Road Bridge. Walls 7, 8, 9 and 10 support the abutment fills on both sides of the proposed SE 192nd Avenue interchange bridge. The dimensions and locations of these

proposed walls are presented in Table 1. Plan, profile and section views of these walls are presented in Figures 12, 13, 14, 15, 16, 17, 18 and 19.

The existing embankment slopes in the vicinity of the Quarry Road Bridge vary from 1H:1V to 2H:1V. Test borings H-5-99 and H-4-99 were drilled to explore the subsurface conditions for the proposed retaining walls 5 and 6 of the Quarry road extension respectively.

The ground surface at the proposed wall locations of the SE 192nd Ave. I/C bridge consisted of highly fractured basalt rock. The existing cut slopes near the proposed locations of walls # 7 and #10 were steeper than 0.5H:1V. The surface materials of these cuts was a conglomerate of silt, sand, gravel, cobbles and boulders. The proposed location of wall # 8 was in the existing rock cut area. The face of the existing basalt rock cut in the site was nearly vertical. The fracture orientation in the Basalt was generally horizontal and vertical. No additional borings were drilled for these walls which are associated with 192nd Avenue Interchange Bridge. The subsurface conditions encountered in borings H-1a-98, H-2a-98 and H-1-99 are applicable for these walls.

Boring H-5-99 consisted of very loose silty sand in the top 1.6 m. Well graded gravel with cobbles and boulders was found between the elevations of 56.4 m and 53.9 m in boring H-5-99. A very dense mixture of silt, sand, gravel and cobbles was found below the elevation of 53.9 m in boring H-5-99. The boring was terminated at an elevation of 38.7 m. No water table was observed in boring H-5-99.

Boring H-4-99 consisted of loose to medium dense silty sand in the top 4.4 m. Well graded gravel with cobbles and boulders was found between the elevations of 53.6 m and 51.5 m in boring H-4-99. A very dense mixture of silt, sand, gravel and cobbles was found below an elevation of 51.5 m. Boring H-4-99 was terminated at an elevation of 38.7 m. No water table was observed in boring H-4-99.

Concrete cantilever walls were preferred by the region for aesthetic reasons at all proposed wall locations at both bridges (walls #5, #6, #7, #8, #9 and #10). Therefore, other wall options were not explored. We recommend using Type 1 standard concrete cantilever walls at the proposed wall locations. Table 11 presents the allowable bearing capacities of all proposed walls at both bridge locations. We expect the total settlement will be less than 25 mm for foundation pressures less than respective allowable values.

Walls	Allowable bearing capacity (kPa)	
	AASHTO Group I	AASHTO Group VII
	Static Load	Seismic Load
7, 8, 9 &10	300	600
5 & 6	300	600

Table 11: Allowable bearing capacities of retaining walls

8.3. WALL 11

This wall supports fill along the new alignment of the Brady road. The dimensions and locations of this proposed wall are presented in Table 1. Plan, profile and section view of this wall are presented in Figures 20, 21 and 22.

Test boring H-14-00 was drilled at the proposed location of the wall as shown in Figure 20. Boring H-14-00 consisted of alternating layers of very loose to medium dense sand and very

loose to loose silt in the top 7.5 m. A very dense gravel with varying amount of silt and sand was found below 7.5 m and continued until the bottom of the boring which was reached at 15.5 m. No water table was found in this boring.

We recommend using a geosynthetic wall with shotcrete facing or a MSE wall with concrete panel facing ~~such as Hilfiker wall~~ at this proposed location due to cost considerations. Concrete cantilever walls were not considered due to cost considerations.

8.3.1. Shotcrete faced Geosynthetic wall

The typical section and other relevant details of the geosynthetic wall is presented in Figures 23, 10 and 11. Table 8 presents the long term strength requirements for shotcrete faced geosynthetic wall at this location. Please refer to Appendix B for General Special Provisions for the permanent geosynthetic wall and shotcrete facing.

We expect that the total settlement under service load would be less than 25 mm.

8.3.2. ~~Hilfiker~~ MSE ~~Welded Wire~~ Wall w/ precast panels

Implementation of these wall alternatives should be completed in accordance with Section 1130 of the Design Manual.

Soil parameters and design load groups presented in Table 12 and Table 13 should be included in the general special provisions for the ~~welded wire~~ MSE wall/ ~~wire faced geosynthetic~~ wall. We expect that the total settlement would be less than 25 mm under service loads.

Soil Parameters	Reinforced soil	Retained soil	Foundation soil
Friction Angle	38	33	36
Cohesion (kPa)	0	0	0
Unit weight (kN/m3)	20.4	18	19.6

Table 12: Soil Parameters

Allowable Bearing Capacity (kPa) AASHTO Load Group	
StaticLoad (I)	Seismic Load (VII)
220	440

Table 13: Allowable pressures

The following criteria should be met to ensure the overall stability of the wall.

1. The batter of the wall face should be no steeper than 40V:1H.
2. The minimum reinforcement length should not be less than 70 percent of the wall height.
3. The wall should have a minimum1.5 m wide horizontal bench in front of the wall.
4. Minimum embedment should be 10 percent of the wall height or 0.5 m below the finished grade whichever is greater.

5. The minimum depth of the top reinforcement layer should be 0.3 m from the finished ground.

6. The walls should be designed for traffic loads.

8.4. WALL 12

This wall supports a cut along the new alignment of Brady road. The dimensions and location of this proposed wall are presented in Table 1. Plan and profile views of the wall are presented in Figures 20, 24 and 25.

The proposed wall location cuts through an existing 1:1 slope which functions well. Further, an approximately 1.2 m high vertical cut was present at the bottom of the slope near the proposed location of the wall.

Test borings H-12-00 and H-13-00 were drilled to explore the soil condition at this proposed wall location. Test boring H-12-00 consisted of medium dense to very dense sand with varying silt and gravel contents in the top 11 m. Loose silt with sand was found below the top sand and continued until the bottom of the boring which was reached at 12.2 m. Test boring H-13-00 consisted of loose to medium dense sand with varying silt and gravel contents in the top 11 m. Approximately 1.5 m thick of very dense clayey sand was found below the top sand unit. Stiff clay was found at a depth of 12.3 m and continued until the bottom of the boring which was reached at 13 m. No water table was found in these borings.

We understand from the region that the recommended wall type should be cost effective and minimize the excavation of soil mass. Therefore, we recommend using a soil-nailed wall at this proposed wall location.

We recommend that a cement gutter be constructed in the top of the wall to collect the surface water. This collected water should be discharged at or below the toe of the wall.

The nail schedule of the wall is presented in Table 14. A wall profile which shows the location of the nails is presented in Figure 26. An ultimate value of 133.5 kN was used for the punching shear of the shotcrete facing.

Minimum Nail Length (m)	Nail Inclination (degrees)	Horizontal spacing (m)	Bar size	Ultimate Design Load transfer (kN/m)
3.7	15	1.2	6	33.6

Table 14: Nail schedule

We recommend that a prefabricated drainage material be placed between the nails at the excavation face. The prefabricated drainage material should be connected to a drainage pipe below the finished grade. The finished grade in front of the wall should direct the water away from the wall face.

Preproduction verification tests should be performed on nails and these nails should be considered sacrificial. Two verification tests should be performed for each drilling/grouting method proposed to be used to confirm the design assumptions. Bare bars may be used for

sacrificial verification test nails. These verification test locations may be selected between STA 1 + 6.000 and STA 1 + 22.600. However, these locations are typically selected for the top row of the nails and usually performed at the slot made for the top row of the nails. In addition, these locations should be reasonably far apart to include the effect of soil/structural variability. These locations can be verified by the engineer in the field. The nail diameter should be designed by the contractor. We require minimum hole diameter of 127 mm to meet the required minimum grout cover around the reinforcing bar.

9. DETENTION POND AND BIOSWALE

The proposed locations of the detention pond and bioswale are shown in Figures 26 and 27. Storm water will enter the west end of the bioswale and travel east through it and be discharged into the detention pond. No physical separation exists between the detention pond and bioswale. The water level in the detention pond will be controlled by a flow control structure located at the center of the pond. The proposed elevations of the bottom of the detention pond and the high water level are 36 and 38 meters respectively.

Borings H-2-99, H-3-99 and H-6-99 were drilled to explore the subsurface condition of the proposed locations of the bioswale and detention pond. Figures 26 and 27 present the locations of these test borings.

Test boring H-2-99 was drilled near the proposed location of the bioswale. Boring H-2-99 consisted of loose to medium dense gravel in the top 3.8 m followed by slightly weathered basalt rock. The boring was terminated at an elevation of 32.5 m. No water table was found in Boring H-2-99.

Borings H-3-99 and H-6-99 were drilled at the proposed location of the detention pond. In general, the top 2 m in boring H-3-99 consisted of silty sand. A conglomerate of silt, clay, sand, gravel, cobbles and boulders (Troutdale formation) was found below the depth of 2 m and continued until the bottom of the boring which was reached at an elevation of 29.5 m. The top 4.5 m in boring H-6-99 consisted of loose to dense sand. A conglomerate of silt, sand, gravel, cobble and boulders was found below the upper sand layer and continued until the bottom of the boring which was reached at an elevation of 31.5 m. No water table was found in borings H-3-99 and H-6-99.

It is our understanding that the bioswale will be top soiled and seeded. The top soiled side slopes at 3H:1V are expected to be stable. We believe that detention pond geometry has an adequate global safety factor during its critical service period. Based on the soils encountered in the borings, we estimate that the long term infiltration rate is 9 cm/hr for bioswale. This long term infiltration rate accounts the effects of siltation and bio-builup. The infiltration rate in bioswale may be less depending on the top soil used to establish vegetation. Due to the proximity of pond to the face of the slope, piping could occur at its maximum service head. We recommend that clay liners be used as a lining material provided side slopes of 3H:1V or flatter are used.

The boring at the initial portion of the pond indicates the presence of relatively impermeable soils. Therefore, we believe that the portion of the detention pond from STA 1+170 to 1+290 need not be lined. However, we recommend that this unlined portion of the pond be verified in

the field during pond construction for the presence of impermeable soils. Figures 28 and 29 in Appendix A shows the lining details of the pond with stations. Special provision for the geosynthetic clay liner is presented in Appendix B.

10. CONSTRUCTION CONSIDERATIONS

The contractor should be prepared to excavate through rock and soil for foundations and retaining walls. We believe that temporary slopes at 1H:1V or steeper may be feasible for the construction of walls and footings. Shoring or temporary slopes may be necessary during foundations and retaining walls construction. Sheet pile shoring systems may not be feasible due to the presence of cobbles and boulders.

Even though, cobbles and boulders were not present in the test borings at the proposed soil-nailed wall location, we anticipate the presence of cobbles and boulders at the proposed soil-nailed wall excavations.

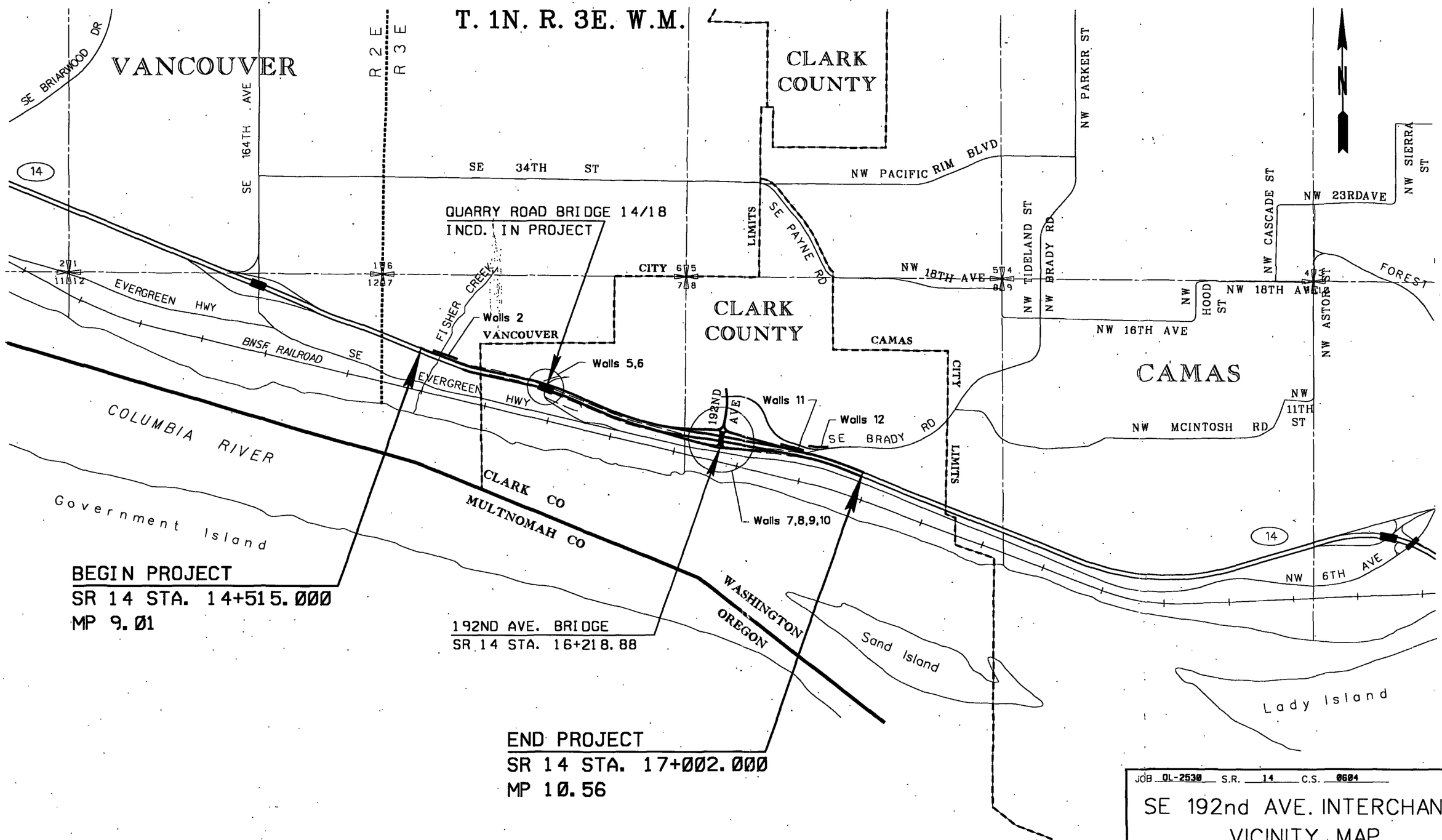

FIGURE 1

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
VICINITY MAP

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 10/99
SCALE 1:200 VERT.
1:200 HORIZ.
SHEET ___ OF ___
DRAWN BY W. M.

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SEC. 8, T. 1N., R. 3E., W.M.
CLARK COUNTY

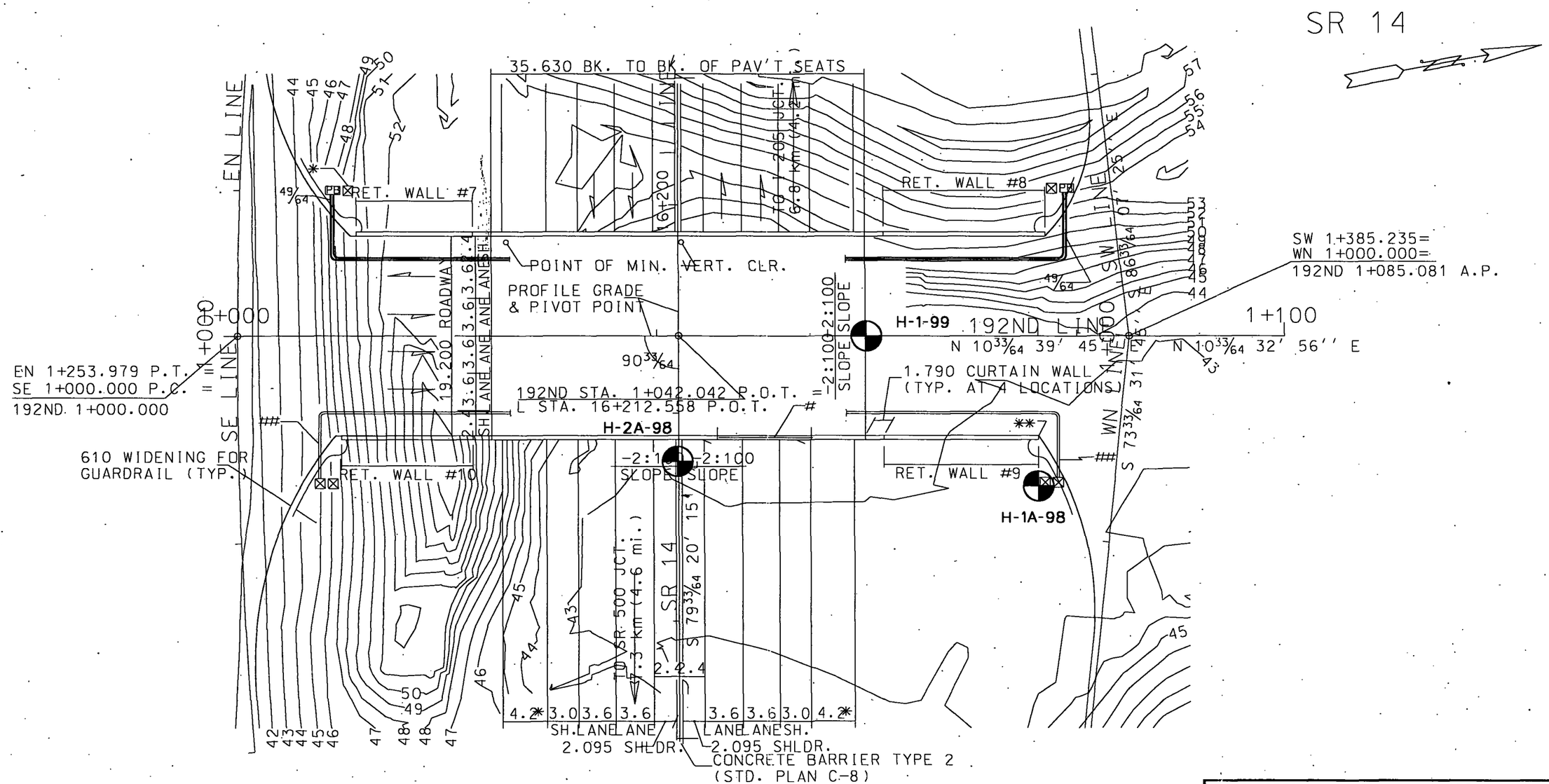

FIGURE 2

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
192nd AVE. UNDERCROSSING

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 11/99
SCALE 1:400 VERT.
1:400 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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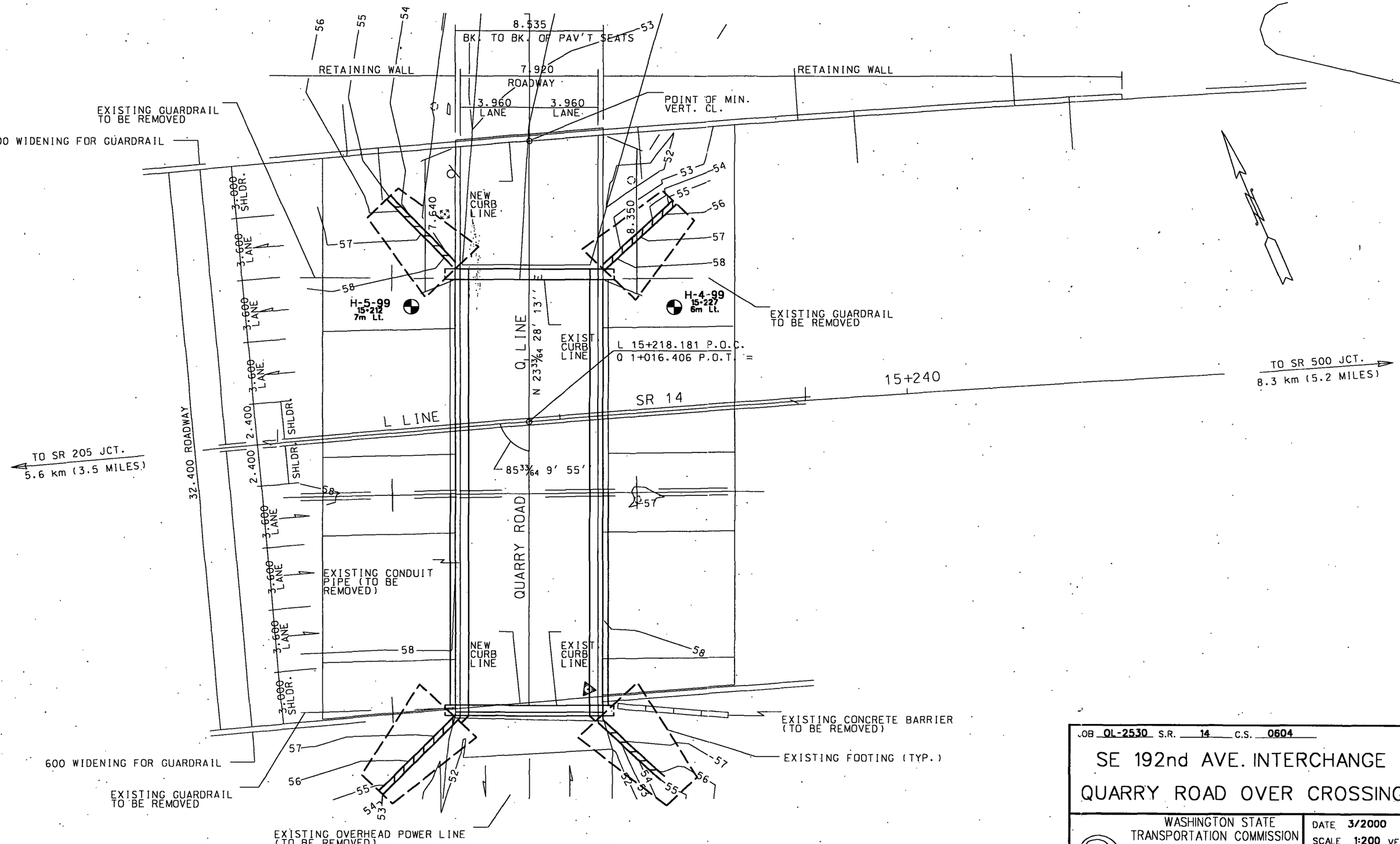

FIGURE 4

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE

QUARRY ROAD OVER CROSSING

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH

T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:200 VERT.
1:200 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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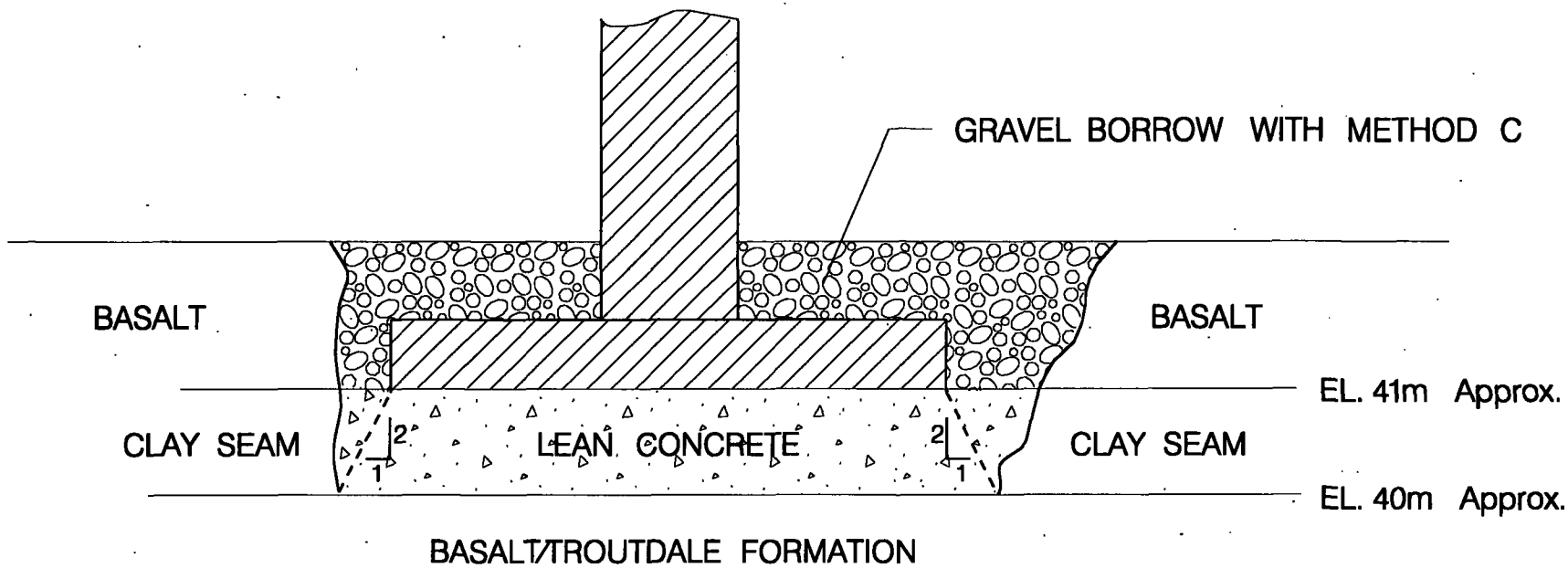

OVER EXCAVATION DETAIL

FIGURE 3a

JOB OL-2530 S.R. 14 C.S. 0604 LAYOUT

SE 192nd AVE. INTERCHANGE
BRIDGE FOUNDATION

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
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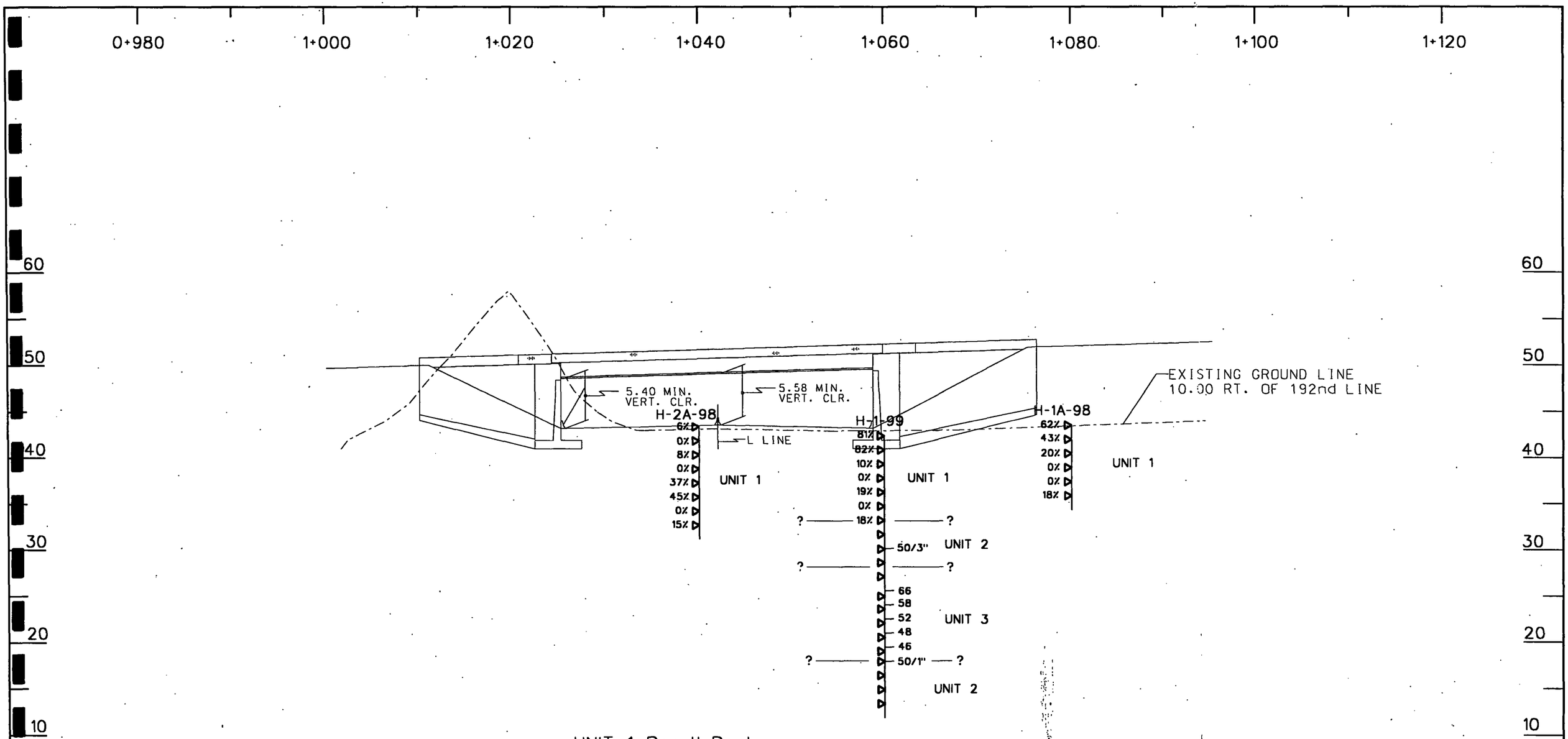


UNIT 1: Basalt Rock

UNIT 2: Well/poorly graded gravel with silt sand and cobbles, very dense, moist, brown

UNIT 3: Silty sand, very dense, moist, brown

TEST HOLE LEGEND

H-1-98	TEST HOLE NUMBER
0+265	TEST HOLE STATION
3.5 m Rt.	TEST HOLE OFFSET
23	STANDARD PENETROMETER TEST (BLOWS PER FOOT)
	UNDISTURBED SAMPLE
W.L. 8-6-86	WATER LEVEL & DATE
?	INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
	INDICATES INTACT ROCK
86%	INDICATES CORE SAMPLE TAKEN
	ROCK QUALITY DESIGNATION

DATUM
N.A.V.D. OF 1988

FIGURE 3

ELEVATION

GRADE ELEVATIONS SHOWN ARE FINISH GRADES AT TOP OF ROADWAY SLAB ON 192nd LINE AND ARE EQUAL TO PROFILE GRADE.

JOB OL-2530 S.R. 14 C.S. 0604

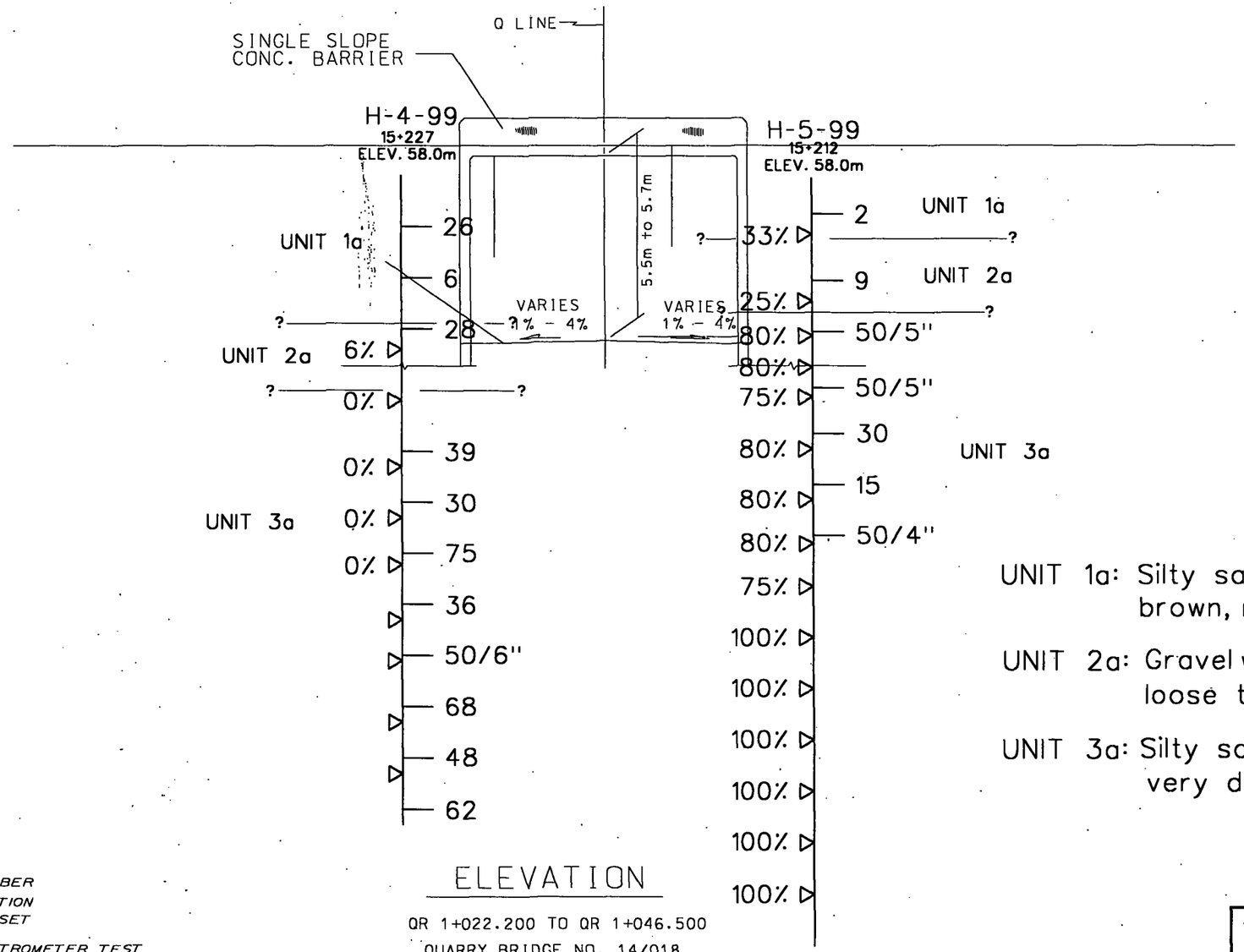
SE 192nd AVE. INTERCHANGE

192nd AVE. BRIDGE

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 11/99
SCALE 1:400 VERT.
1:400 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\11-23-99\layout.dgn Apr. 24, 2000 09:43:25



UNIT 1a: Silty sand, very loose to dense, brown, moist.

UNIT 2a: Gravel with silt, sand and cobbles loose to very dense, moist, gray.

UNIT 3a: Silty sand with gravel and cobbles, very dense, brown, moist.

ELEVATION

QR 1+022.200 TO QR 1+046.500
QUARRY BRIDGE NO. 14/018

FIGURE 5

TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
QUARRY ROAD OVER CROSSING

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:150 VERT.
1:150 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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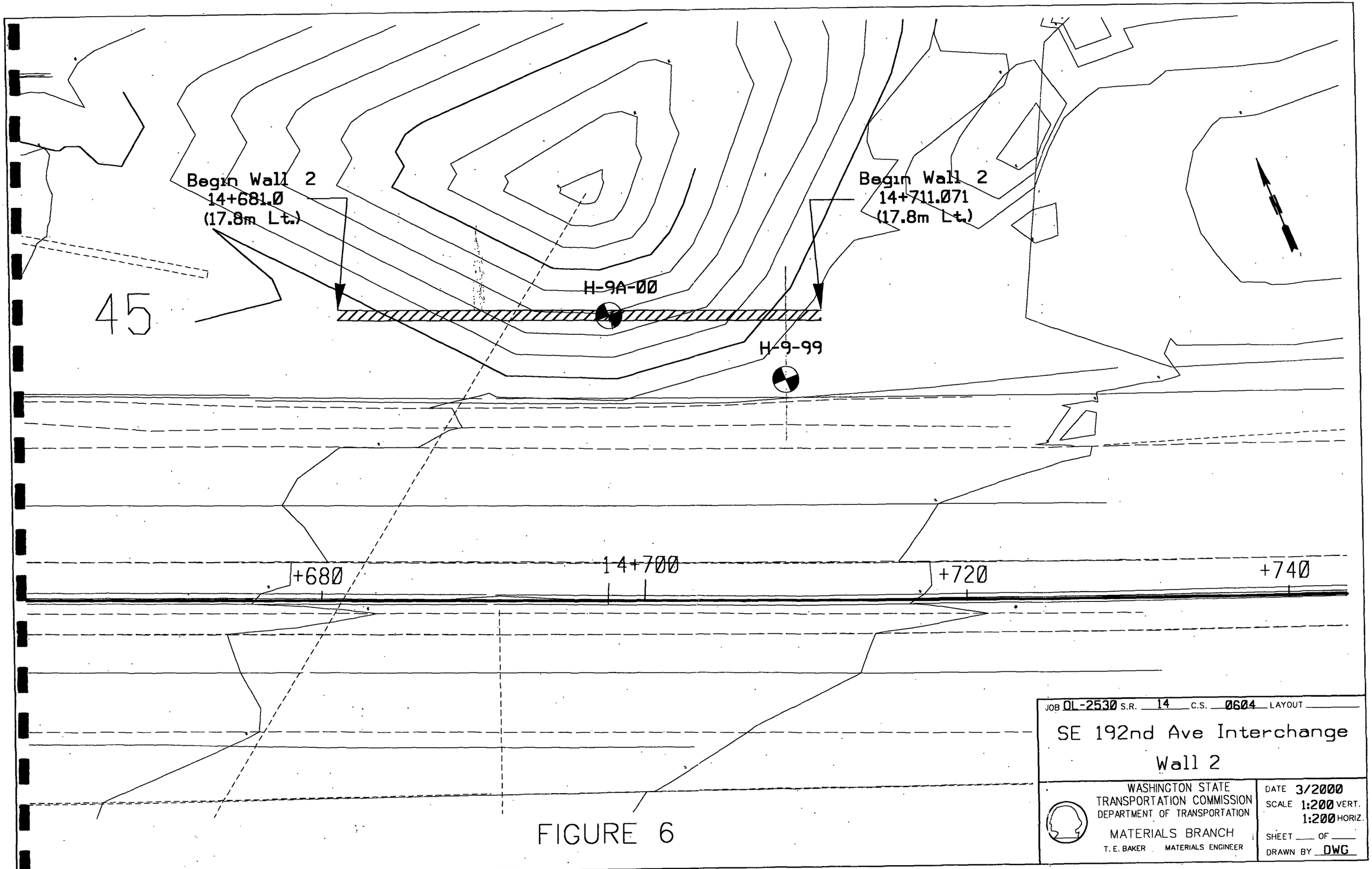
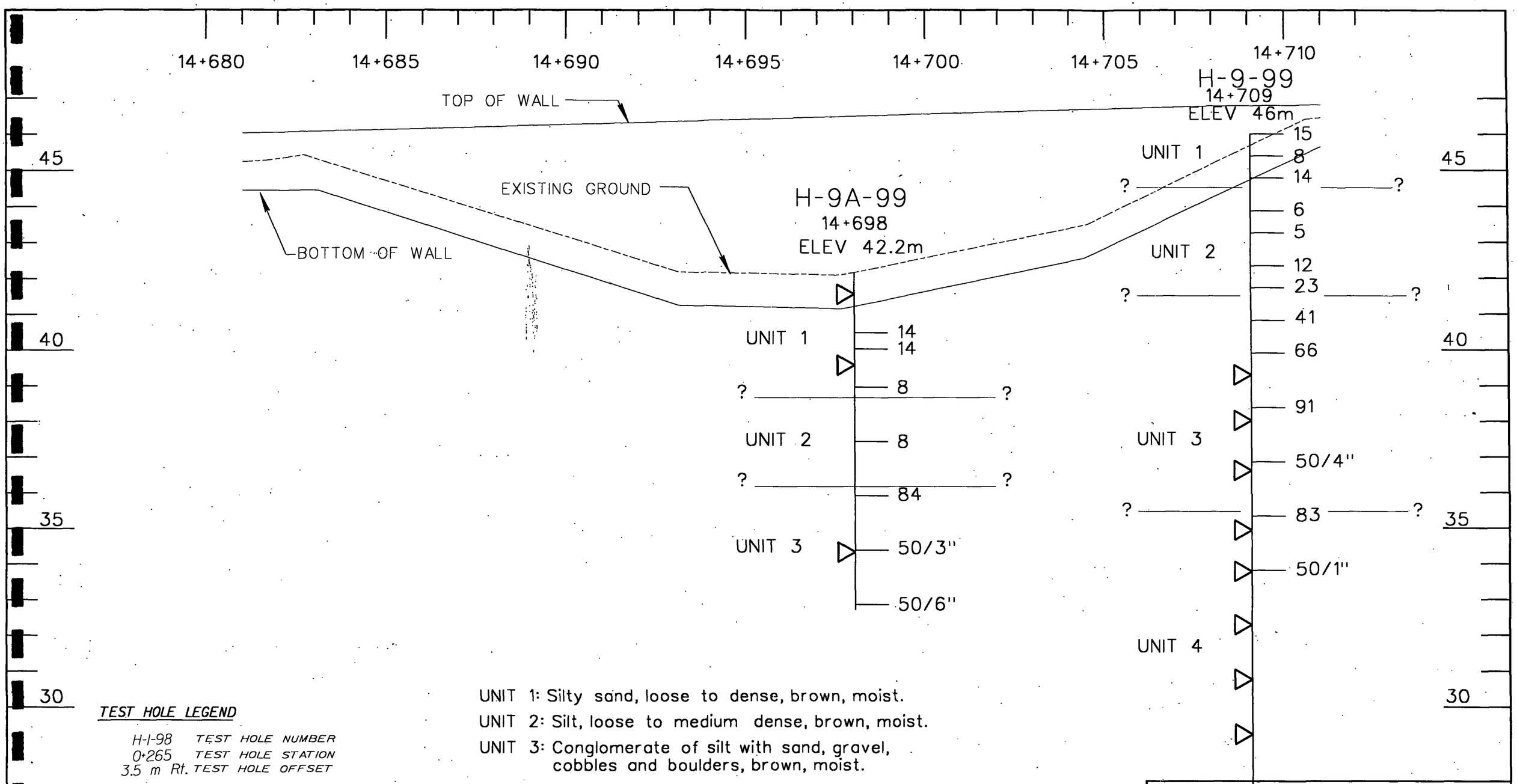


FIGURE 6

...\kc-dot\12530\se 192nd map.dgn Apr. 04, 2000 07:33:36



UNIT 1: Silty sand, loose to dense, brown, moist.

UNIT 2: Silt, loose to medium dense, brown, moist.

UNIT 3: Conglomerate of silt with sand, gravel, cobbles and boulders, brown, moist.

TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

FIGURE 7

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE

PROFILE WALL 2

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY: W.M.

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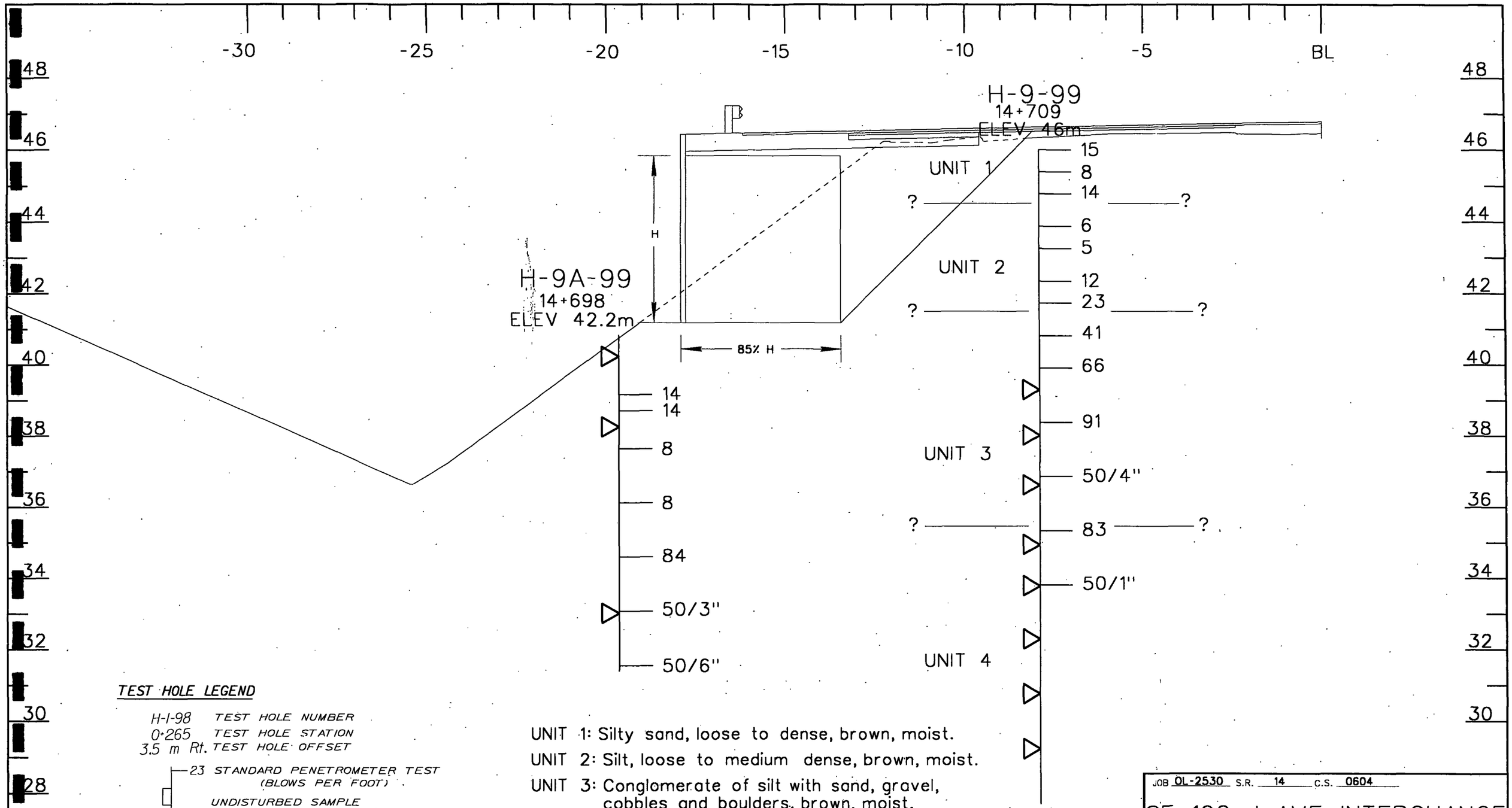

TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

UNIT 1: Silty sand, loose to dense, brown, moist.
UNIT 2: Silt, loose to medium dense, brown, moist.
UNIT 3: Conglomerate of silt with sand, gravel, cobbles and boulders, brown, moist.

STA14+696

FIGURE 8

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
TYPICAL SECTION-WALL 2

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS' ENGINEER

DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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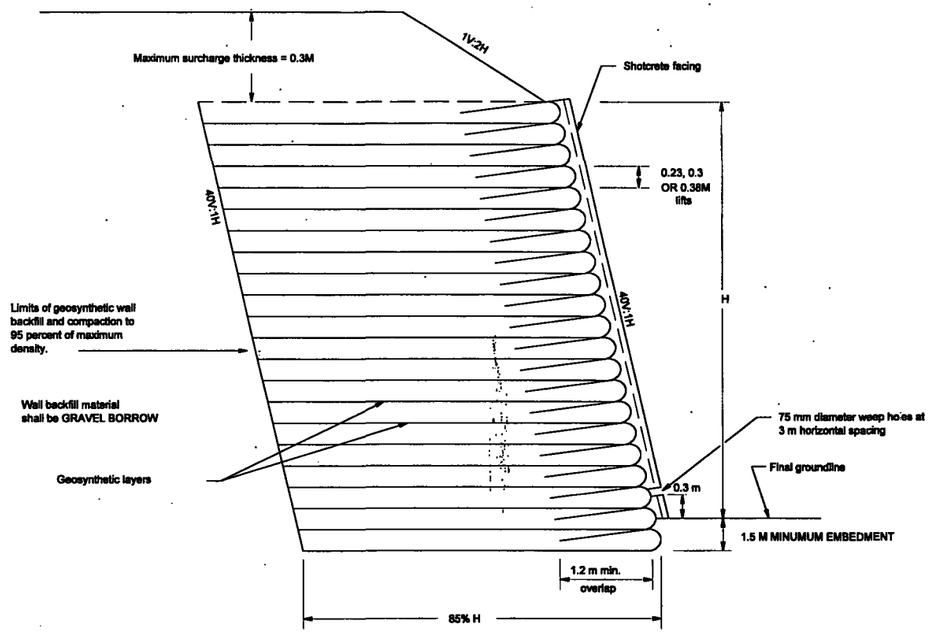
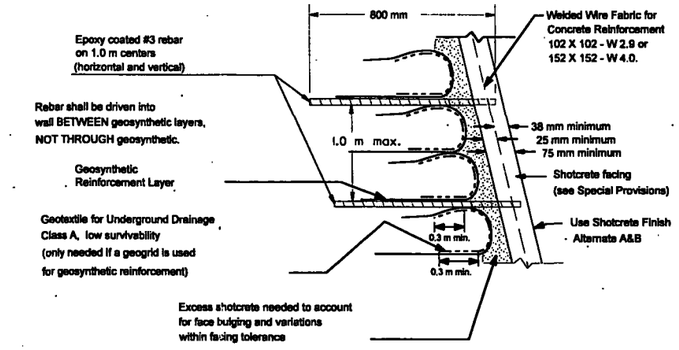
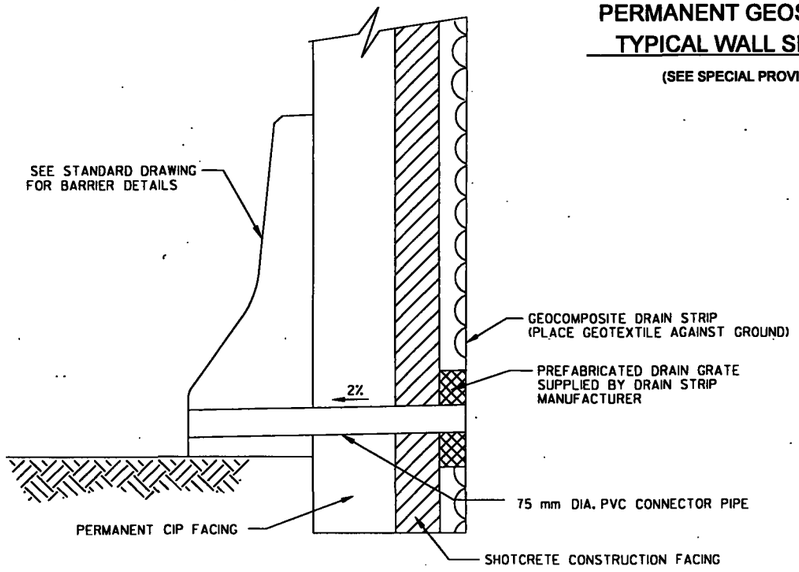


PERMANENT GEOSYNTHETIC TYPICAL WALL SECTION

(SEE SPECIAL PROVISIONS)



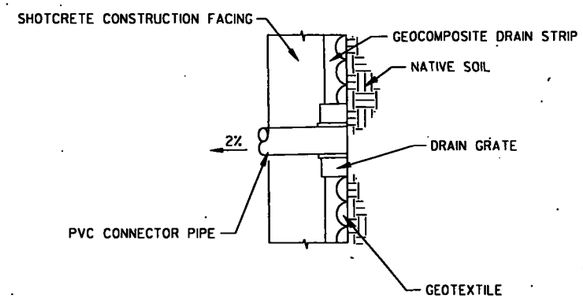
DETAIL: Mesh reinforced shotcrete facing for permanent wall.



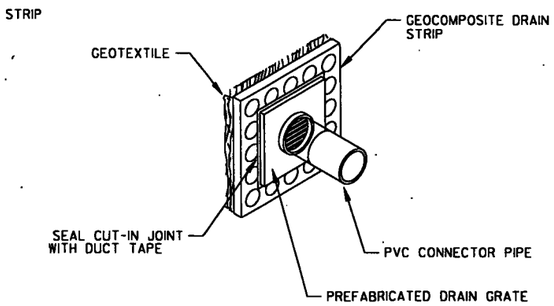
SEGMENTS C, D & E
TYPICAL WALL BASE DRAIN, TRAFFIC BARRIER AND PVC CONNECTOR PIPE DETAIL

4 / 49728

NOT TO SCALE



SECTIONAL VIEW



ISOMETRIC VIEW

NOTE: DRAIN GRATE INSTALLATION SHALL NOT DISRUPT GEOTEXTILE

6 / 49728 DRAIN GRATE DETAILS

NOT TO SCALE

FIGURE 9

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
WALL 2

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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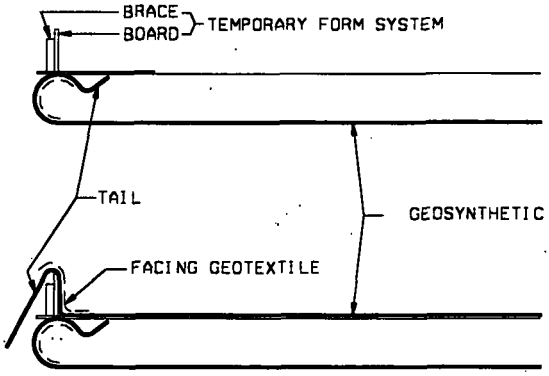
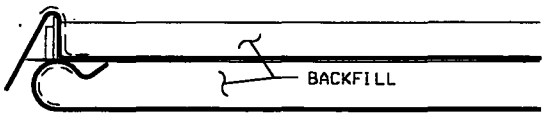
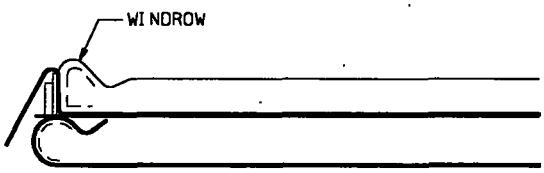


1. SET FORM ON COMPLETED LIFT.

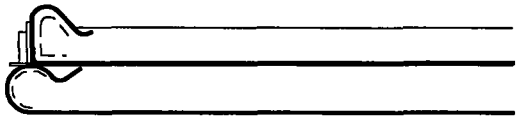
2. UNROLL GEOSYNTHETIC AND POSITION SO THAT A 1.2 M WIDE 'TAIL' DRAPES OVER THE FORM. IF A GEOGRID IS USED FOR THE GEOSYNTHETIC REINFORCEMENT, POSITION FACING GEOTEXTILE TO PREVENT BACKFILL FROM GOING THROUGH GEOGRID OPENINGS.



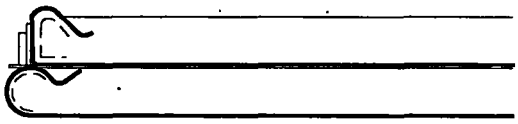
3. PLACE THE BACKFILL, UNTIL THE BACKFILL IS UP TO HALF OF THE REQUIRED VERTICAL GEOSYNTHETIC LAYER SPACING.



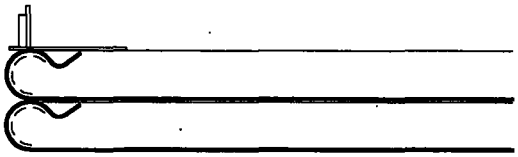
4. PLACE A WINDROW TO SLIGHTLY GREATER THAN FULL LIFT HEIGHT AGAINST THE FORM.



5. PLACE THE GEOSYNTHETIC 'TAIL' OVER THE WINDROW AND LOCK INTO PLACE WITH BACKFILL.



6. COMPLETE BACKFILLING UNTIL THE COMPACTED BACKFILL LAYER THICKNESS IS EQUAL TO THE REQUIRED VERTICAL GEOSYNTHETIC LAYER SPACING.



7. RESET THE FORM AND REPEAT THE SEQUENCE.

GEOSYNTHETIC WALL CONSTRUCTION PROCEDURE

(SEE SPECIAL PROVISIONS)

NOTE: METHOD OF TEMPORARY FORMING IS OPTIONAL. ALSO, FORMING TWO LAYERS AT A TIME WILL HELP MAINTAIN THE WALL FACE BATTER.

JOB OL-2530 S.R. 14 C.S. 0604 LAYOUT

SE 192nd AVE. INTERCHANGE

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
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FIGURE 10

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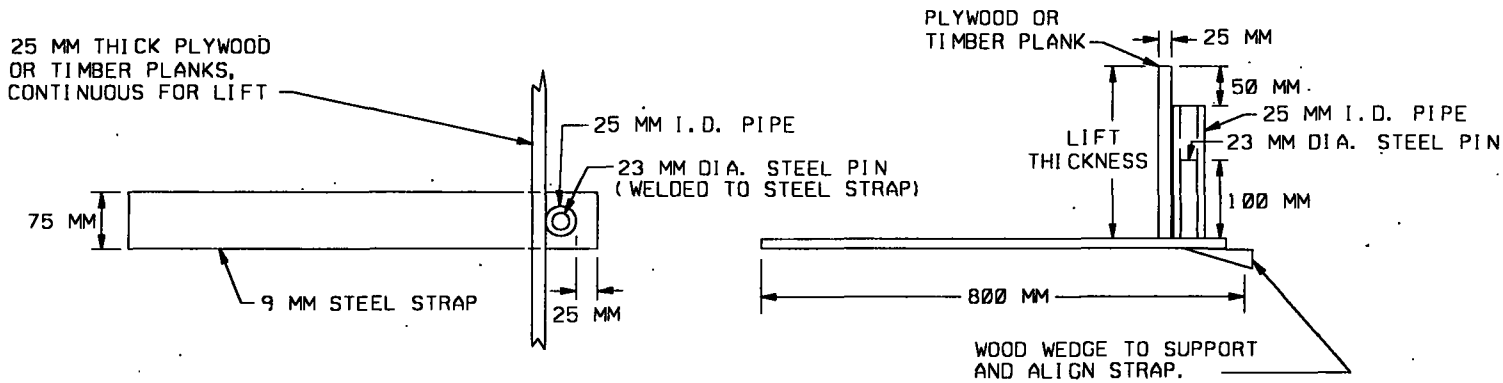

PLAN

ELEVATION

NOTE: PLACE STRAPS AT 1.2 M TO 1.8 M CENTERS
ALONG WALL FACE.

(OPTIONAL) GEOSYNTHETIC TEMPORARY FORM SYSTEM DETAIL

(SEE SPECIAL PROVISIONS)

FIGURE 11

JOB OL-2530 S.R. 14 C.S. 0804 LAYOUT

SE 192nd AVE. INTERCHANGE

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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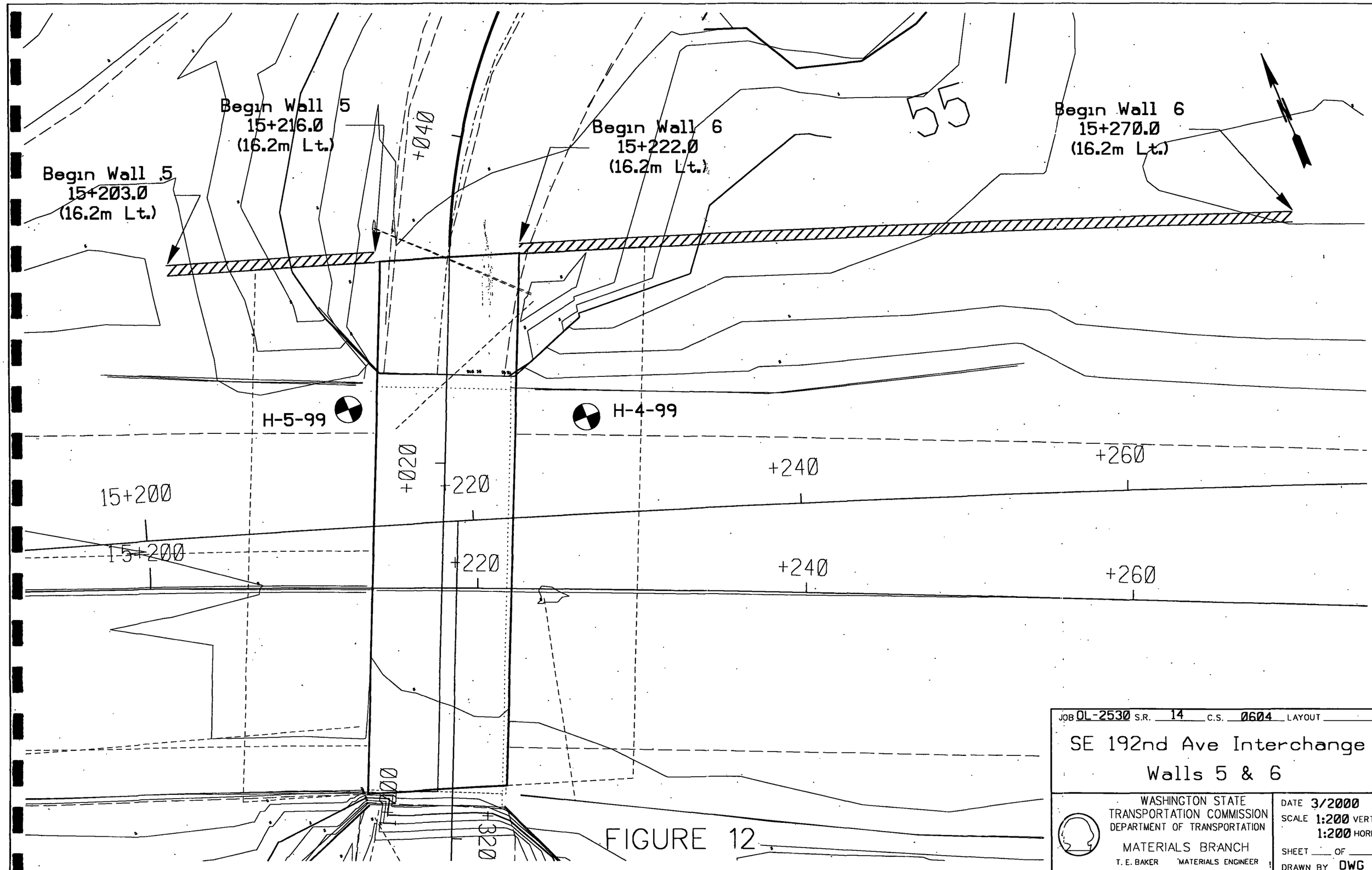


FIGURE 12

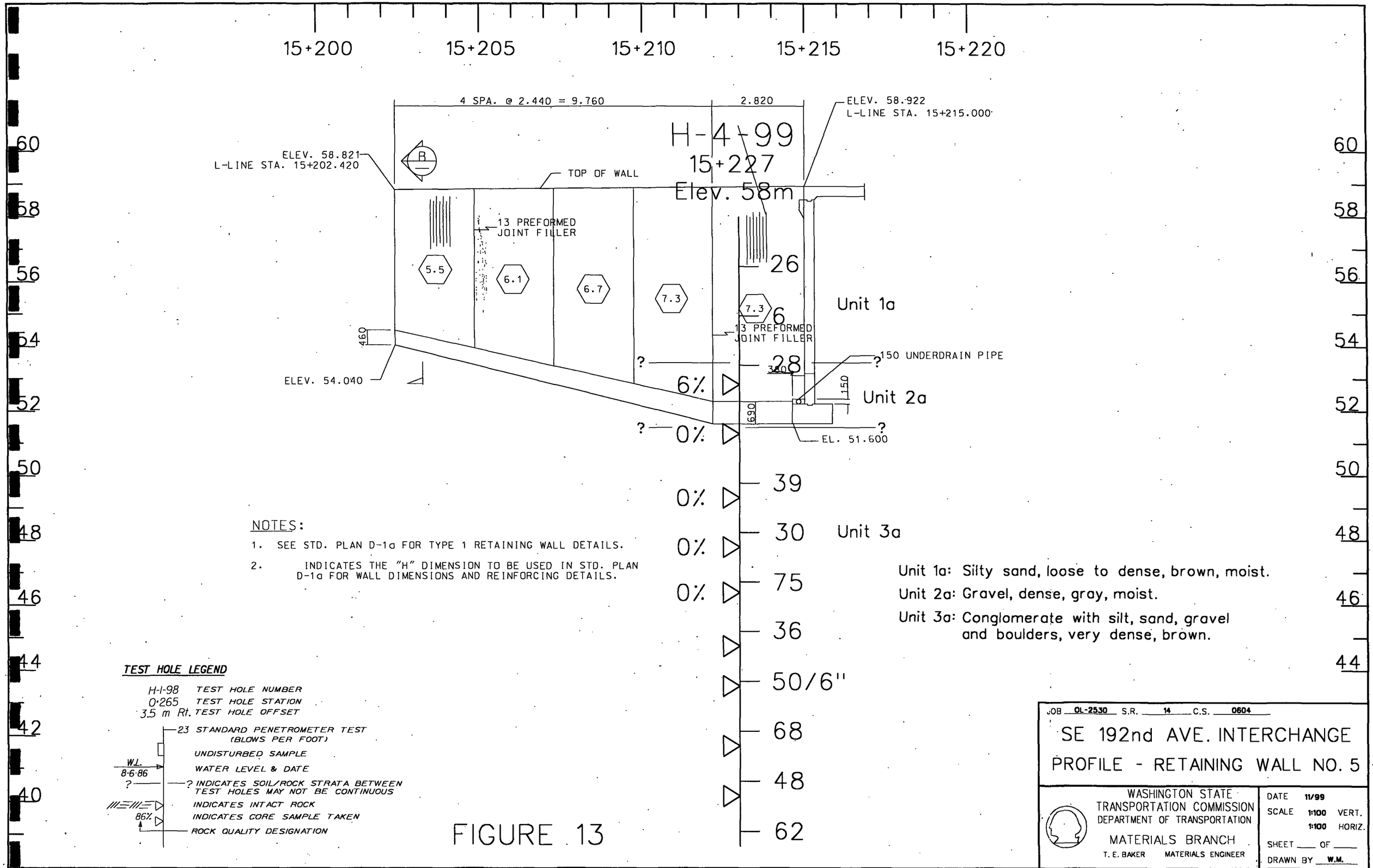
JOB OL-2530 S.R. 14 C.S. 0604 LAYOUT

SE 192nd Ave Interchange
Walls 5 & 6

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:200 VERT.
1:200 HORIZ.
SHEET ___ OF ___
DRAWN BY DWG

...\all of kc-dot\se 192nd map.dgn Apr. 20, 2000 09:12:11



NOTES:

1. SEE STD. PLAN D-1a FOR TYPE 1 RETAINING WALL DETAILS.
2. INDICATES THE "H" DIMENSION TO BE USED IN STD. PLAN D-1a FOR WALL DIMENSIONS AND REINFORCING DETAILS.

Unit 1a: Silty sand, loose to dense, brown, moist.
Unit 2a: Gravel, dense, gray, moist.
Unit 3a: Conglomerate with silt, sand, gravel and boulders, very dense, brown.

TEST HOLE LEGEND

H-I-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET
23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

FIGURE 13

JOB OL-2530 S.R. 14 C.S. 0604

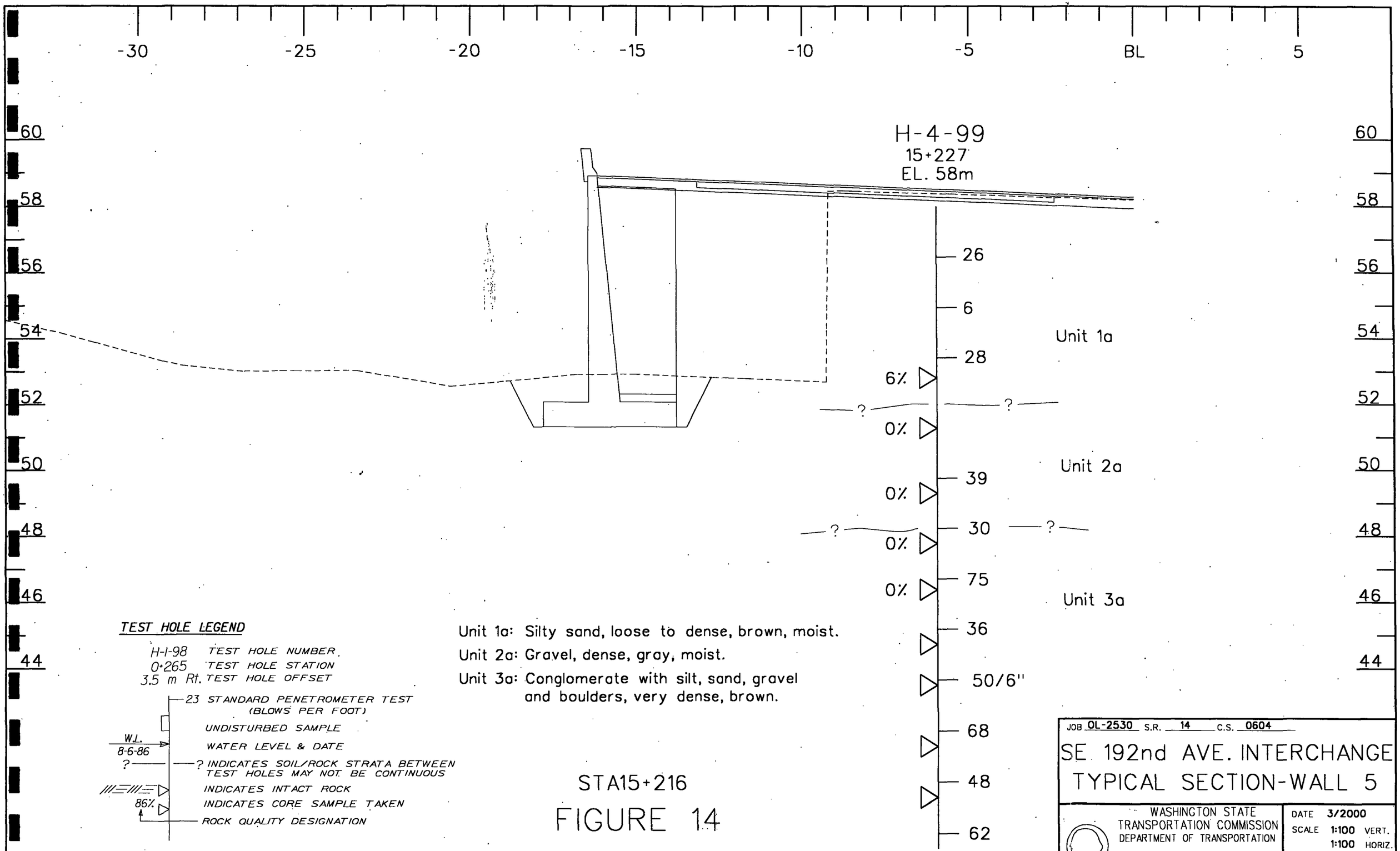
SE 192nd AVE. INTERCHANGE

PROFILE - RETAINING WALL NO. 5

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 11/99
SCALE 1:100 VERT. 1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\11-23-99\wall5.dgn Apr. 24, 2000 09:59:17



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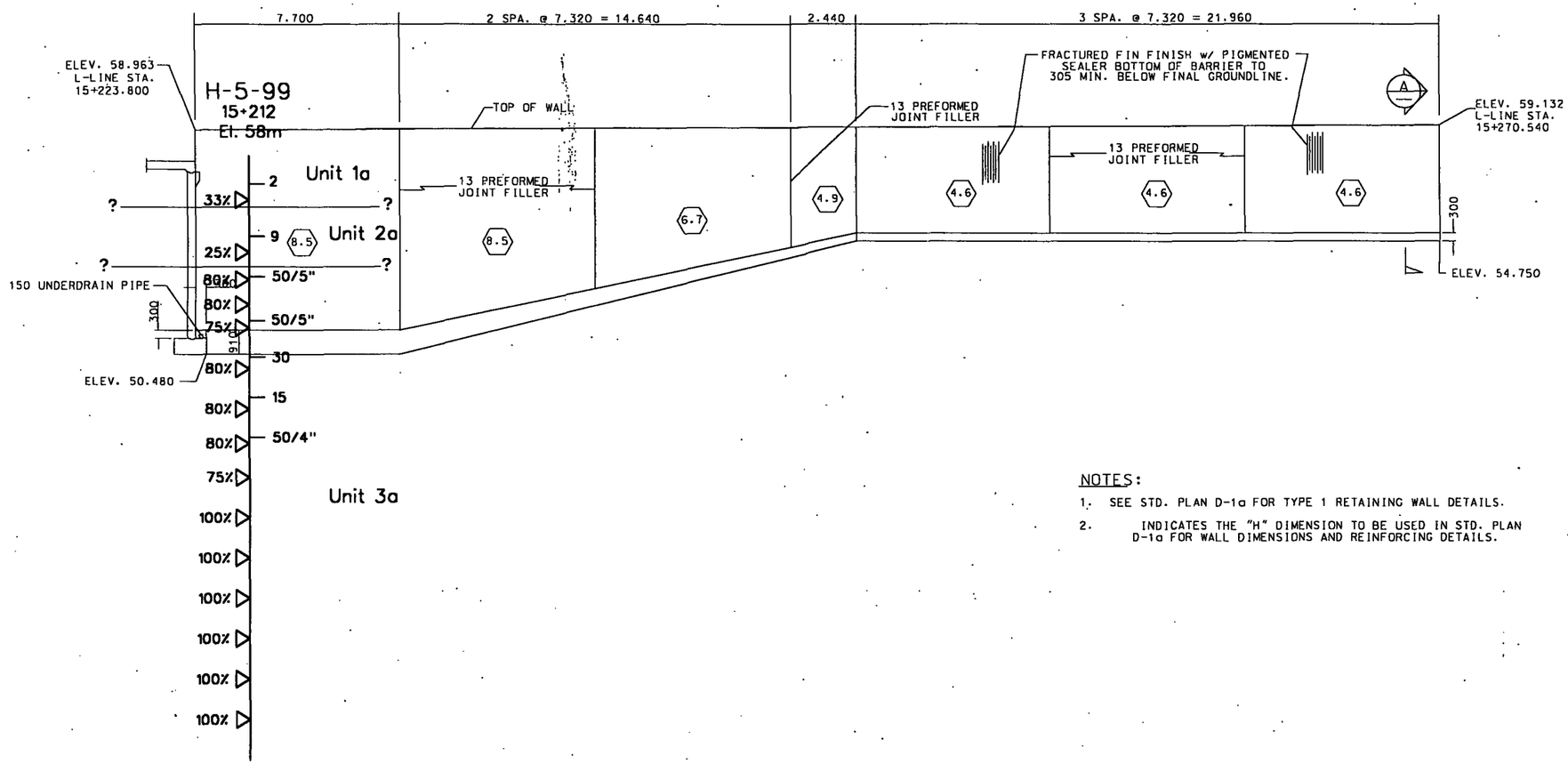


NOTES:

1. SEE STD. PLAN D-1a FOR TYPE 1 RETAINING WALL DETAILS.
2. INDICATES THE "H" DIMENSION TO BE USED IN STD. PLAN D-1a FOR WALL DIMENSIONS AND REINFORCING DETAILS.

TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET
23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

Unit 1a: Silty sand, very loose, brown, moist.
Unit 2a: Sand with gravel, loose, brown, moist.
Unit 3a: Conglomerate with silt and sand and gravel and cobbles, very dense, brown, moist.

FIGURE 15

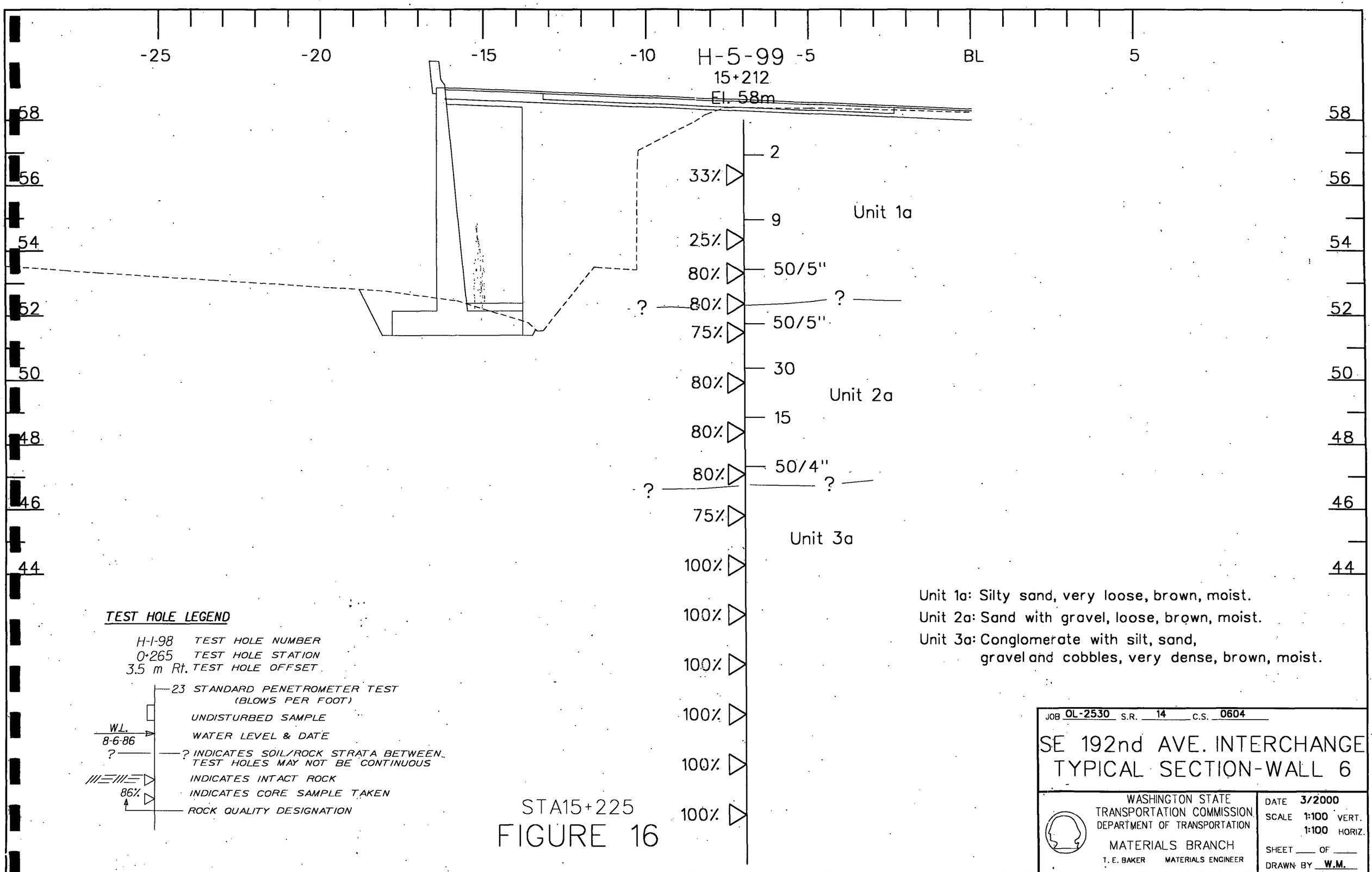
JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
PROFILE - RETAINING WALL NO. 6

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 11/99
SCALE 1:200 VERT.
1:200 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\11-23-99\wall6.dgn Apr. 24, 2000 10:04:42



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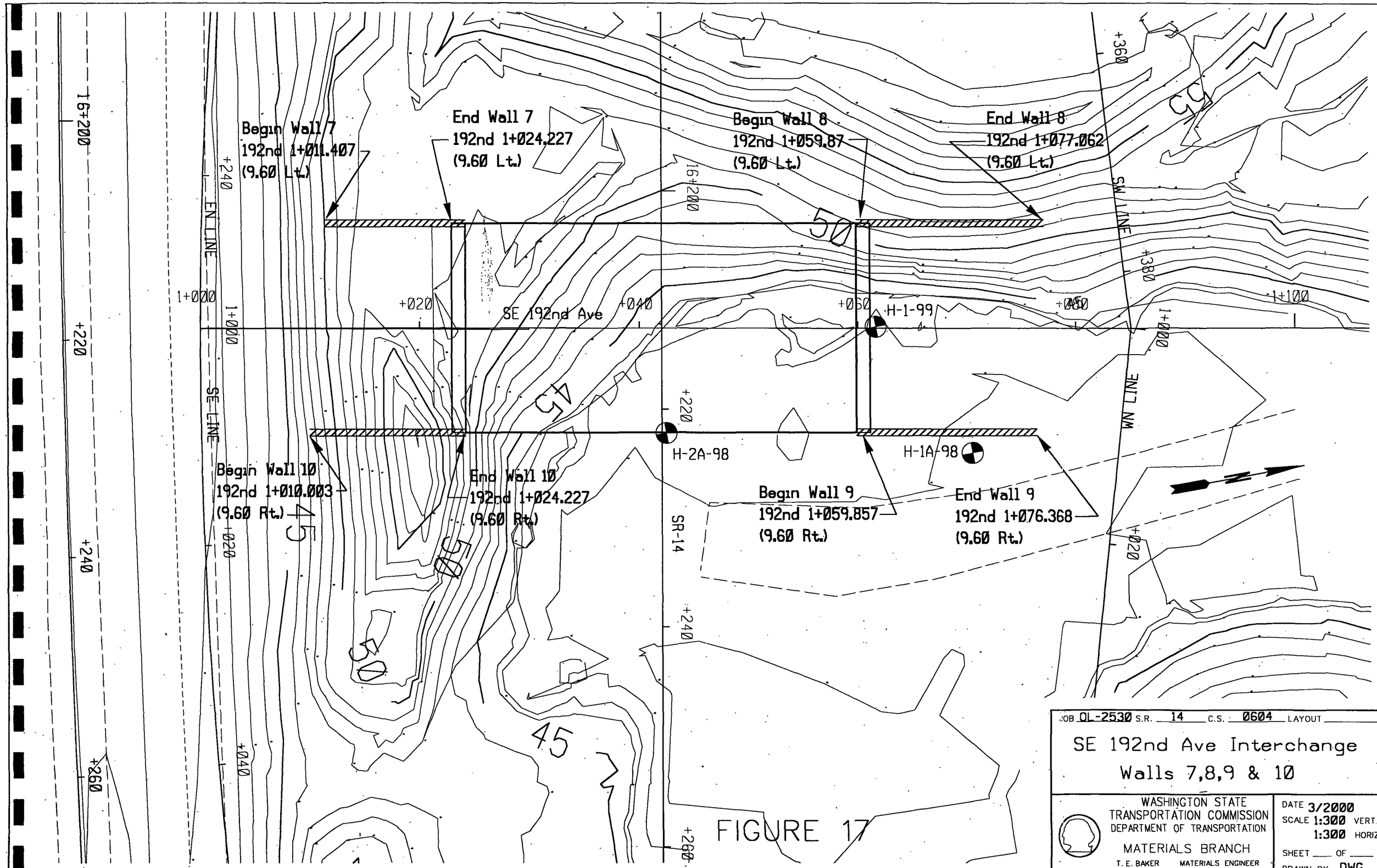

FIGURE 17

JOB OL-2530 S.R. 14 C.S. 0604 LAYOUT

SE 192nd Ave Interchange

Walls 7,8,9 & 10

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH

T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:300 VERT.
1:300 HORIZ.
SHEET ___ OF ___
DRAWN BY DWG

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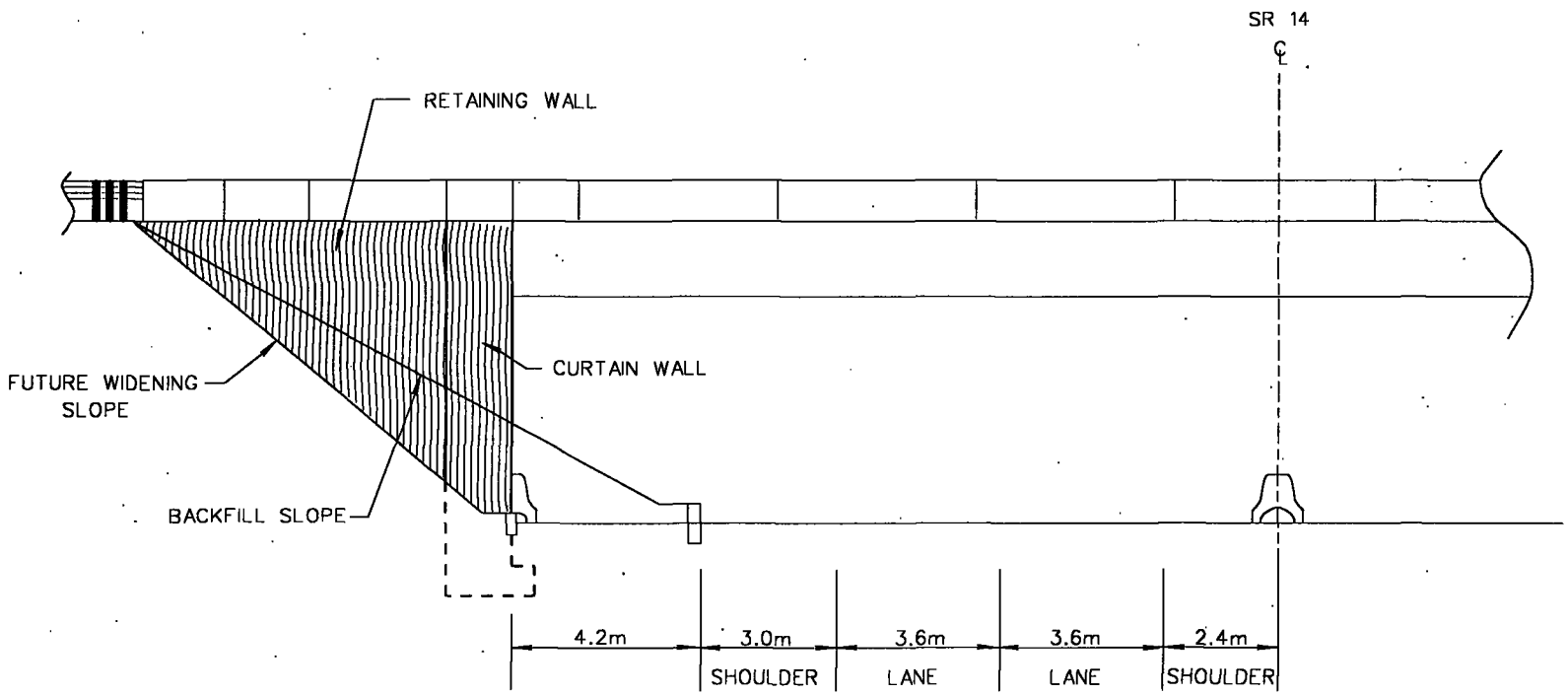


SLOPE DETAIL @ 192ND BRIDGE

FIGURE 18

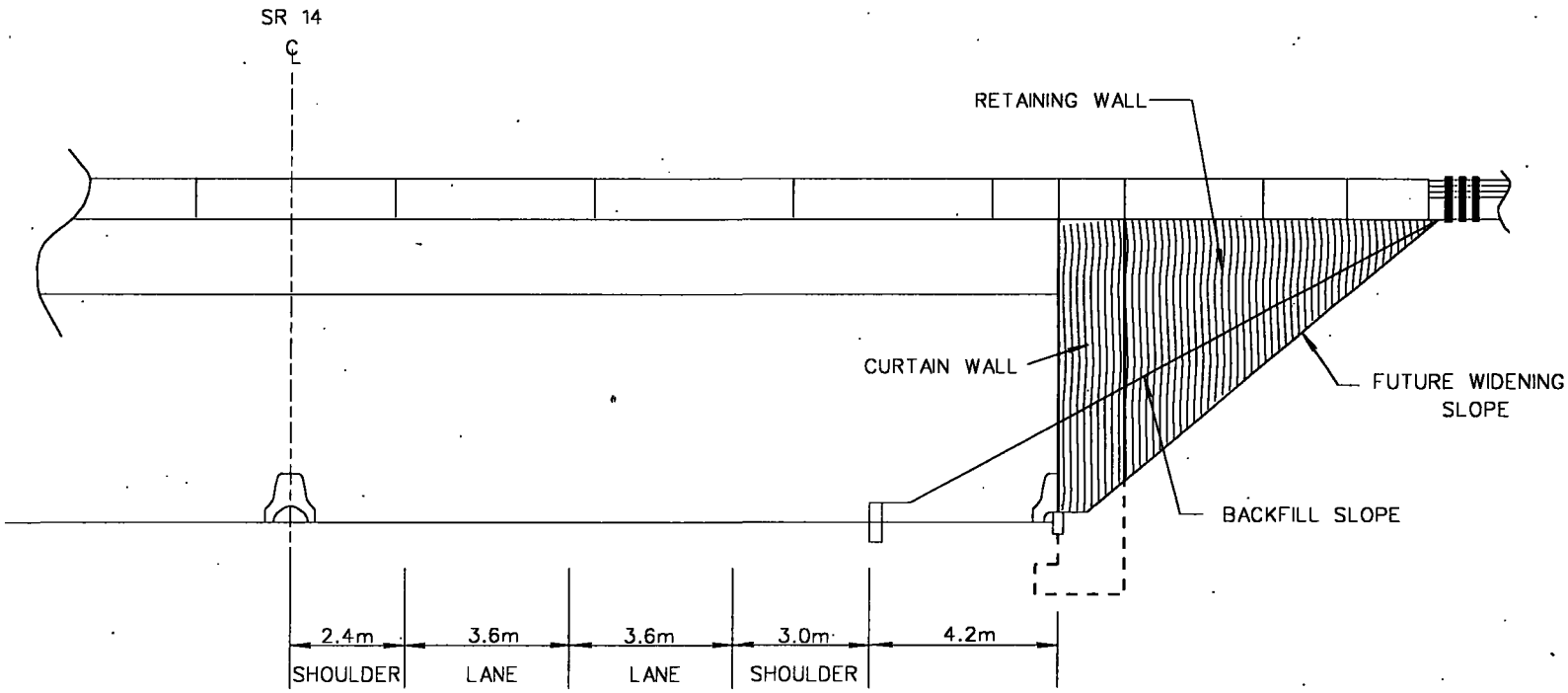
JOB OL-2530 S.R. 14 C.S. 0804 LAYOUT

SE 192nd AVE. INTERCHANGE
WALLS 7 & 10

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\2-18-00\geosyntheticwall.dgn Apr. 19, 2000 11:28:57



SLOPE DETAIL @ 192ND BRIDGE

FIGURE 19

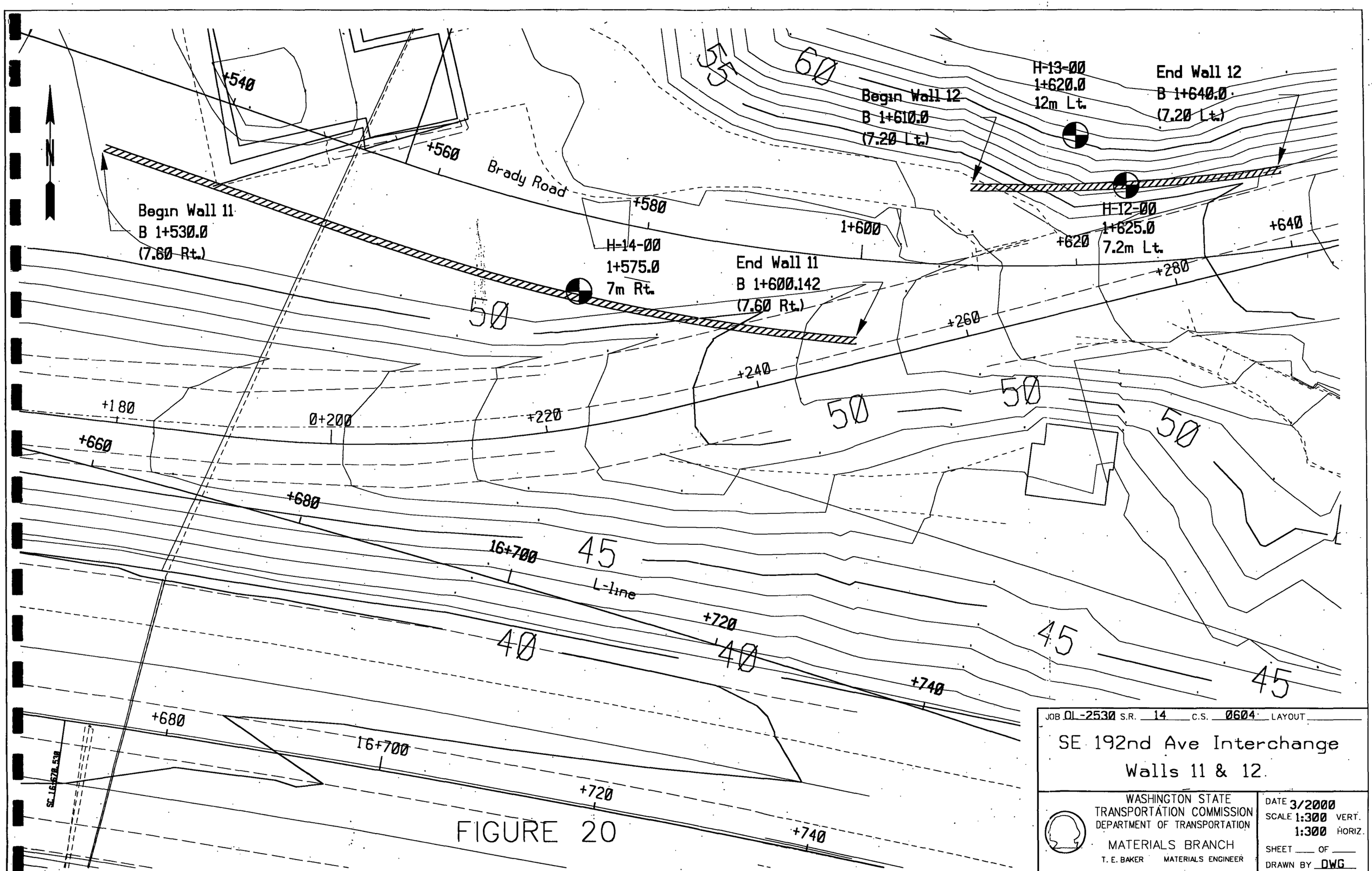
JOB OL-2530 S.R. 14 C.S. 0804 LAYOUT

SE 192nd AVE. INTERCHANGE
WALLS 8 & 9

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\2-18-00\geosyntheticwall.dgn Apr. 19, 2000 11:29:29



JOB OL-2530 S.R. 14 C.S. 0604 LAYOUT

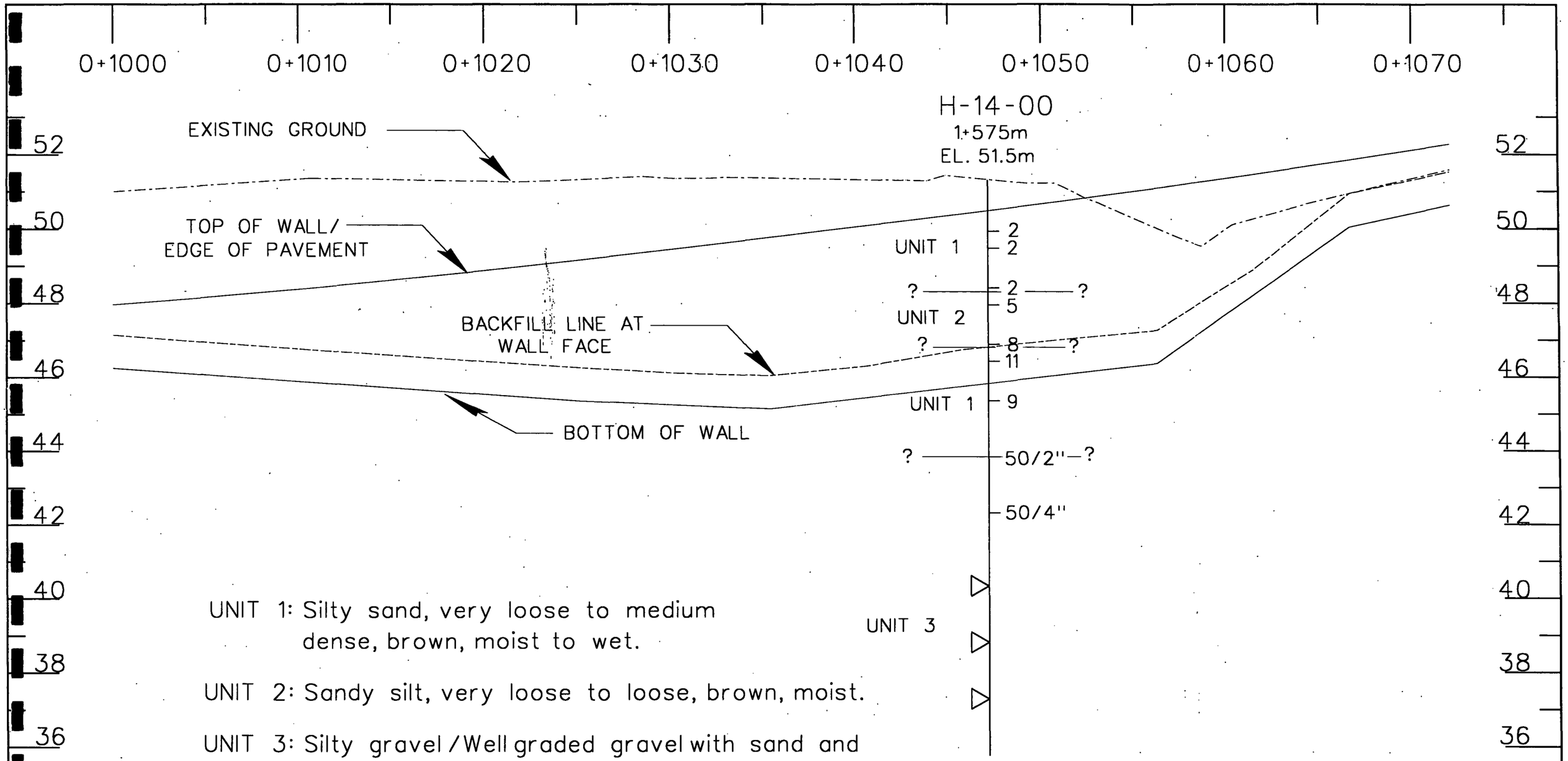
SE 192nd Ave Interchange
Walls 11 & 12.

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:300 VERT.
1:300 HORIZ.
SHEET ___ OF ___
DRAWN BY DWG

FIGURE 20

...\ol-2530 sc 14\se 192nd map.dgn Apr. 19, 2000 11:30:34



UNIT 1: Silty sand, very loose to medium dense, brown, moist to wet.

UNIT 2: Sandy silt, very loose to loose, brown, moist.

UNIT 3: Silty gravel / Well graded gravel with sand and cobbles, very dense, moist, brown.

FIGURE 21

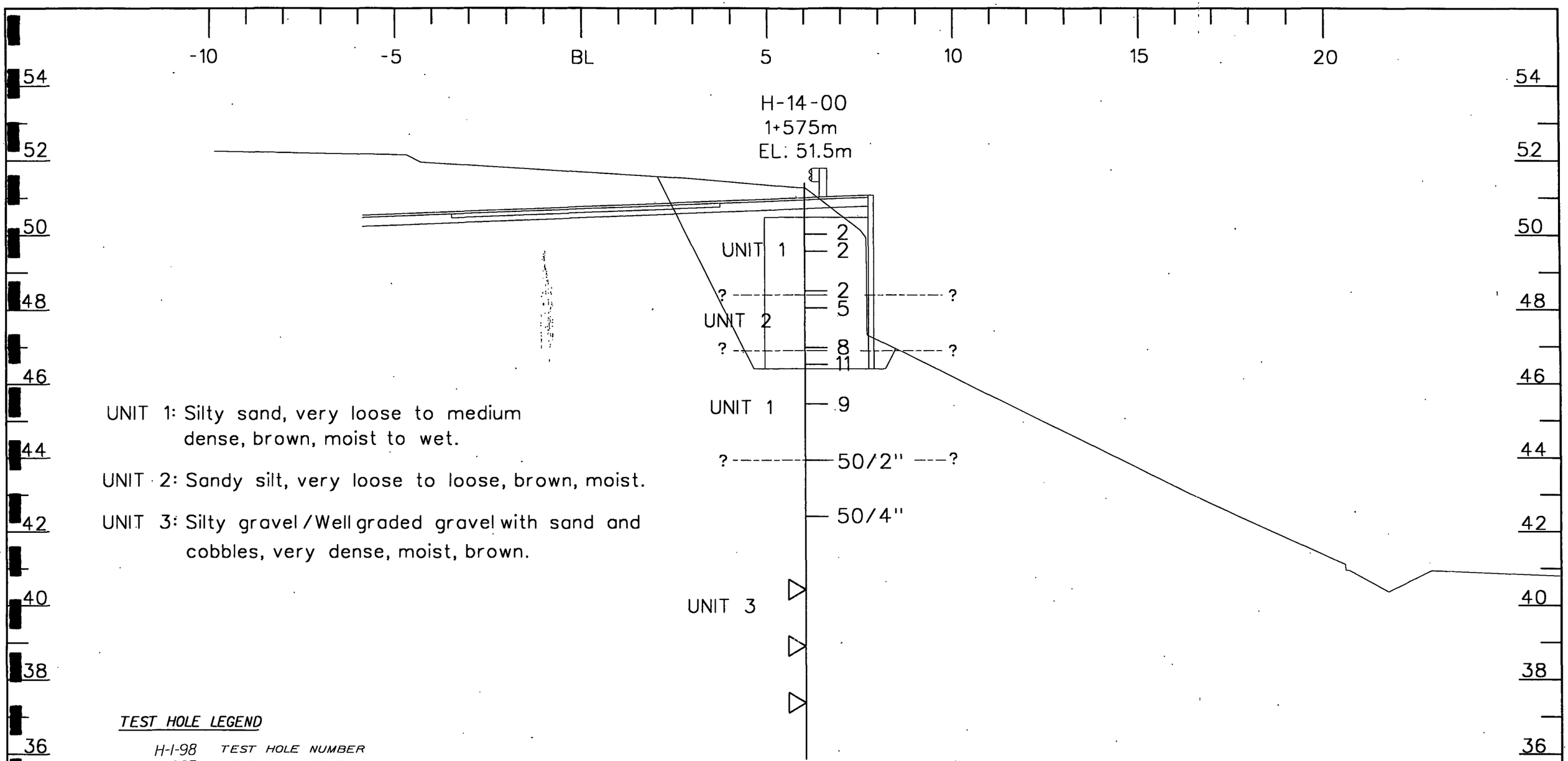
JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
TYPICAL RETAINING-WALL 11

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:200 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\4-4-00\profilewall11.dgn Apr. 24, 2000 10:13:31



UNIT 1: Silty sand, very loose to medium dense, brown, moist to wet.

UNIT 2: Sandy silt, very loose to loose, brown, moist.

UNIT 3: Silty gravel / Well graded gravel with sand and cobbles, very dense, moist, brown.

TEST HOLE LEGEND

H-1-98	TEST HOLE NUMBER
0+265	TEST HOLE STATION
3.5 m Rt.	TEST HOLE OFFSET
23	STANDARD PENETROMETER TEST (BLOWS PER FOOT)
	UNDISTURBED SAMPLE
W.L. 8-6-86	WATER LEVEL & DATE
?	? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
	INDICATES INTACT ROCK
86%	INDICATES CORE SAMPLE TAKEN
	ROCK QUALITY DESIGNATION

STA1+585

FIGURE 22

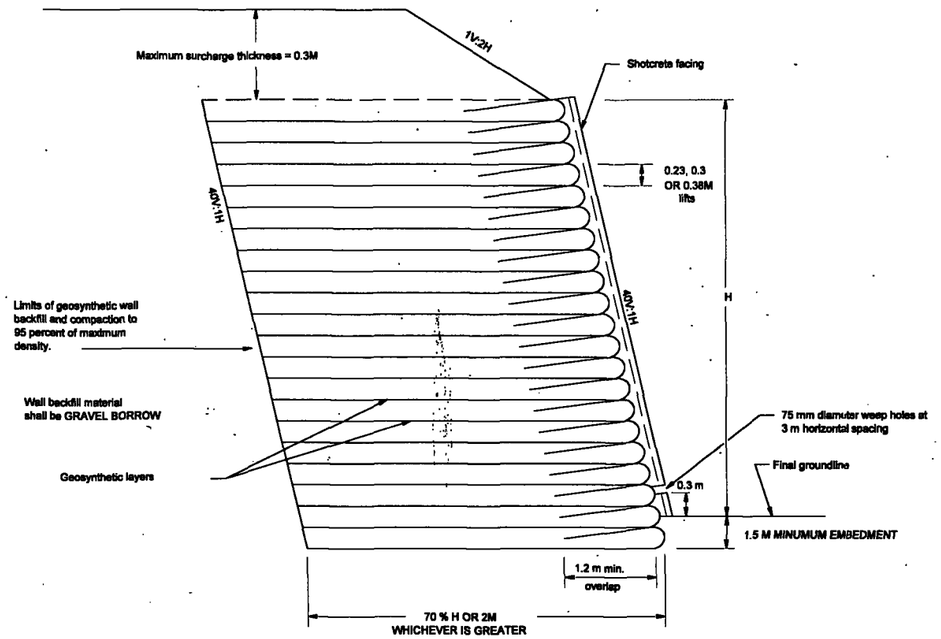
JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
TYPICAL SECTION-WALL 11

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

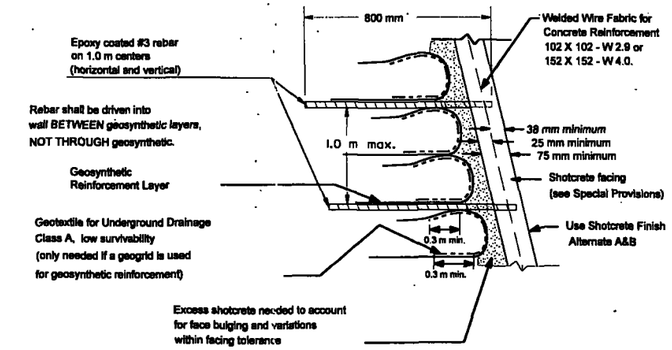
DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\4-4-00\profilewall11.dgn Apr. 20, 2000 08:57:07

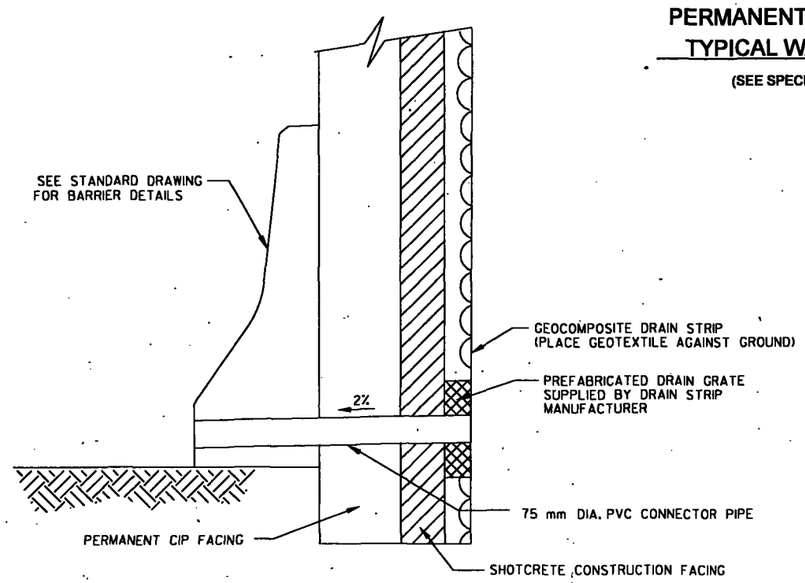


PERMANENT GEOSYNTHETIC TYPICAL WALL SECTION

(SEE SPECIAL PROVISIONS)



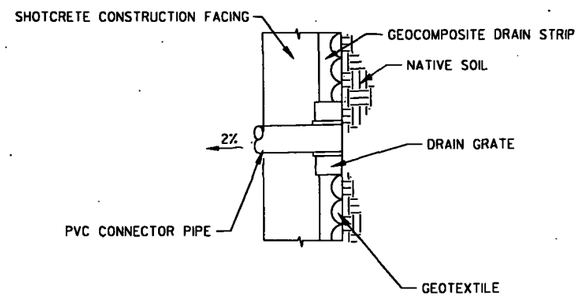
DETAIL: Mesh reinforced shotcrete facing for permanent wall.



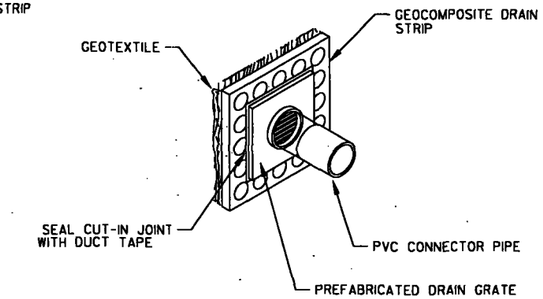
SEGMENTS C, D & E
TYPICAL WALL BASE DRAIN, TRAFFIC BARRIER AND PVC CONNECTOR PIPE DETAIL

4 / 49728

NOT TO SCALE



SECTIONAL VIEW



ISOMETRIC VIEW

NOTE: DRAIN GRATE INSTALLATION SHALL NOT DISRUPT GEOTEXTILE

6 / 49728

DRAIN GRATE DETAILS

NOT TO SCALE

FIGURE 23

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
WALL II

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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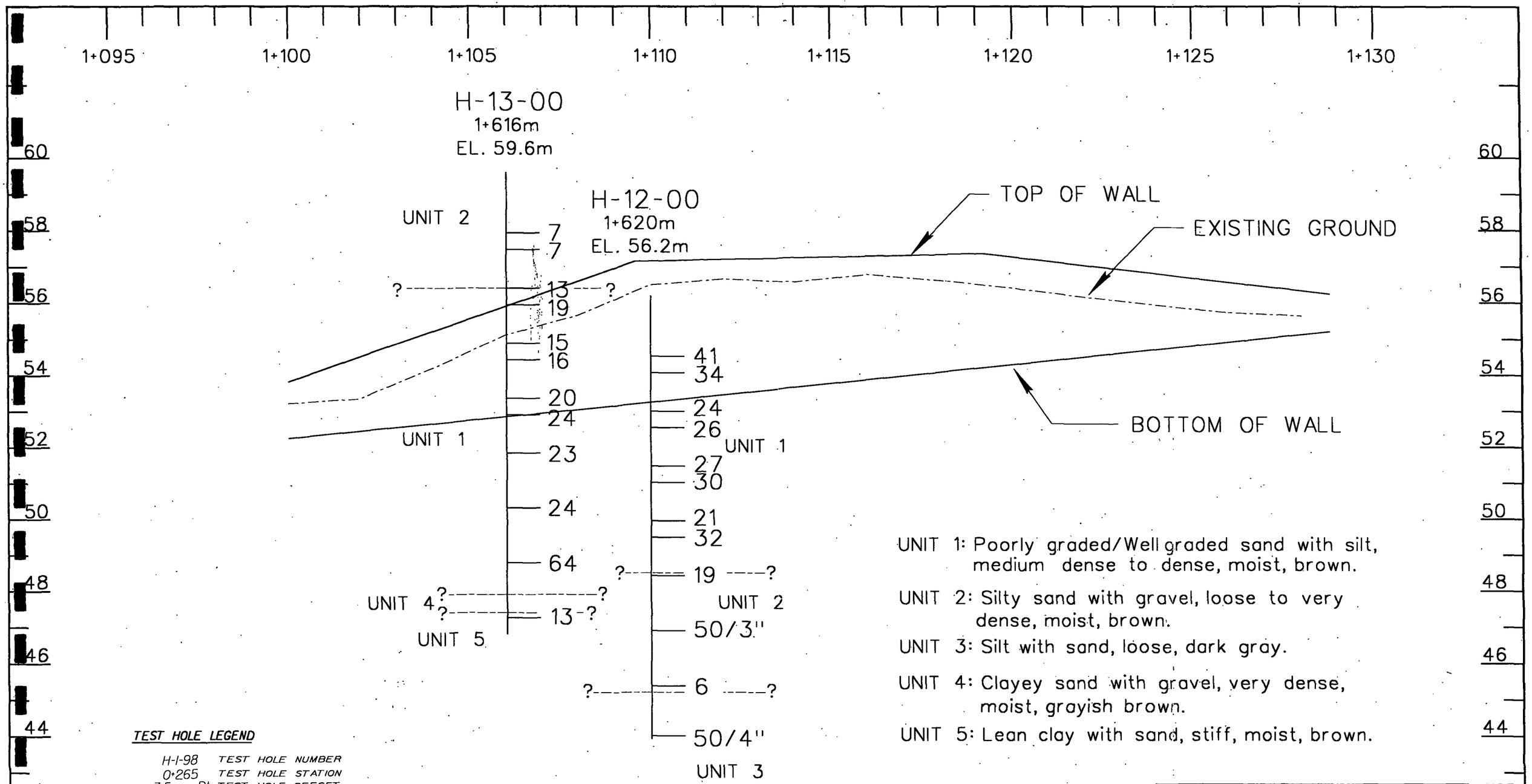


UNIT 1: Poorly graded/Well graded sand with silt, medium dense to dense, moist, brown.

UNIT 2: Silty sand with gravel, loose to very dense, moist, brown.

UNIT 3: Silt with sand, loose, dark gray.

UNIT 4: Clayey sand with gravel, very dense, moist, grayish brown.

UNIT 5: Lean clay with sand, stiff, moist, brown.

TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

FIGURE 24

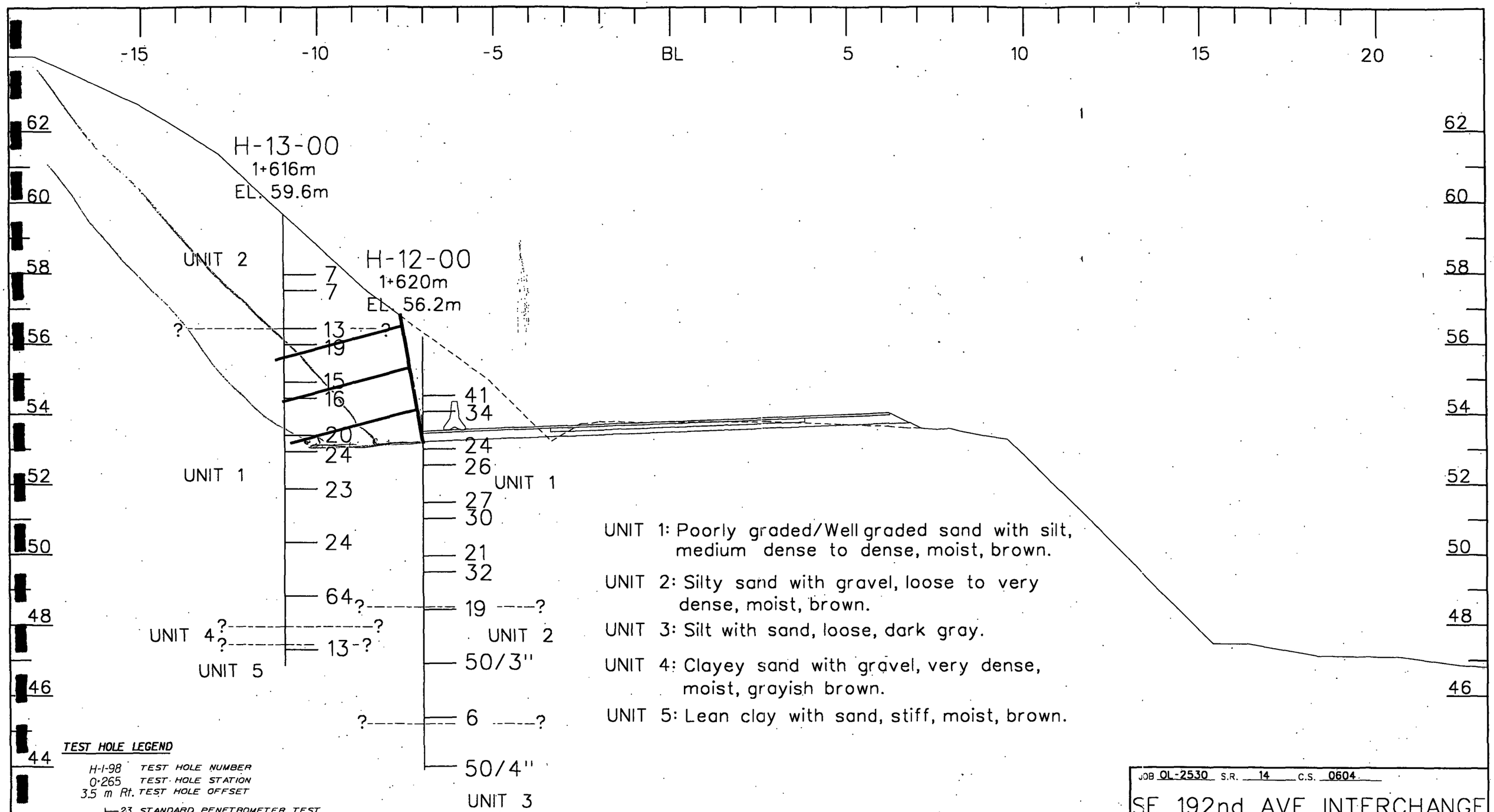
JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
TYPICAL RETAINING-WALL 12

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\4-4-00\profilewall12.dgn Apr. 24, 2000 09:18:19



UNIT 1: Poorly graded/Well graded sand with silt, medium dense to dense, moist, brown.

UNIT 2: Silty sand with gravel, loose to very dense, moist, brown.

UNIT 3: Silt with sand, loose, dark gray.

UNIT 4: Clayey sand with gravel, very dense, moist, grayish brown.

UNIT 5: Lean clay with sand, stiff, moist, brown.

TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
0+265 TEST HOLE STATION
3.5 m Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

STA1+620

FIGURE 25

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE
TYPICAL SECTION-WALL 12

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

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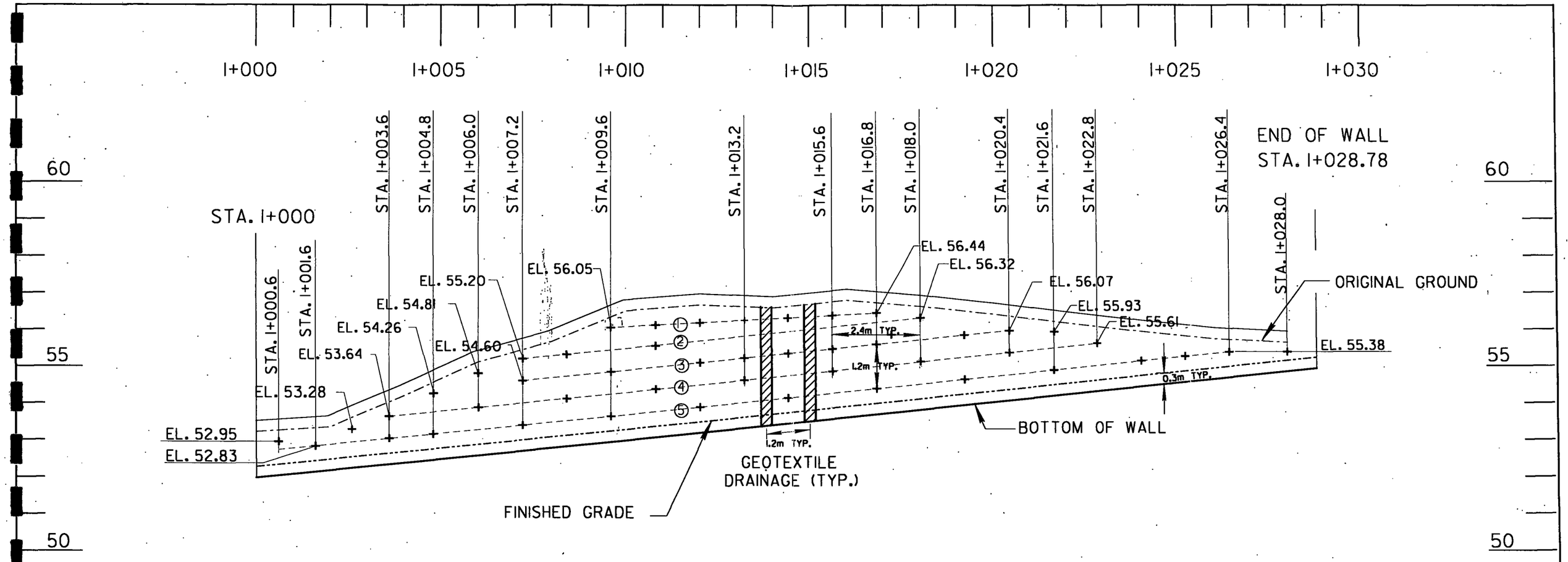


NAIL SCHEDULE

ROW	L	∝	S	BAR#	DLT
①	4.5	15	1.2	7	24.8
②	4.5	15	1.2	7	24.8
③	4.5	15	1.2	7	24.8
④	4.5	15	1.2	7	24.8
⑤	4.5	15	1.2	7	24.8

+ =NAIL

① =ROW

L =MINIMUM NAIL LENGHT(m)

∝ =NAIL DECLINATION (DEGREES)

S =HORIZONTAL NAIL SPACING (m)

BAR# =MINUMUM STEEL BAR SIZE

DLT=ULTIMATE DESIGN LOAD TRANSFER (kN/m)

NOTES TO BRIDGE/REGION:

1: THE STANDARD TEST NAIL DETAIL SHOULD INDICATE A MINIMUM LENGTH OF 1.5m FOR BOTH THE BONDED AND NON-BONDED ZONES.

2: END OF WALL TAPERS TO BE DESIGNED BY BRIDGE AND PROJECT OFFICE. EXTEND NAIL LAYOUT, AS REQUIRED.

3: GRADE 60 BARS WERE ASSUMED IN DESIGN.

JOB OL-2530 S.R. 14 C.S. 0604

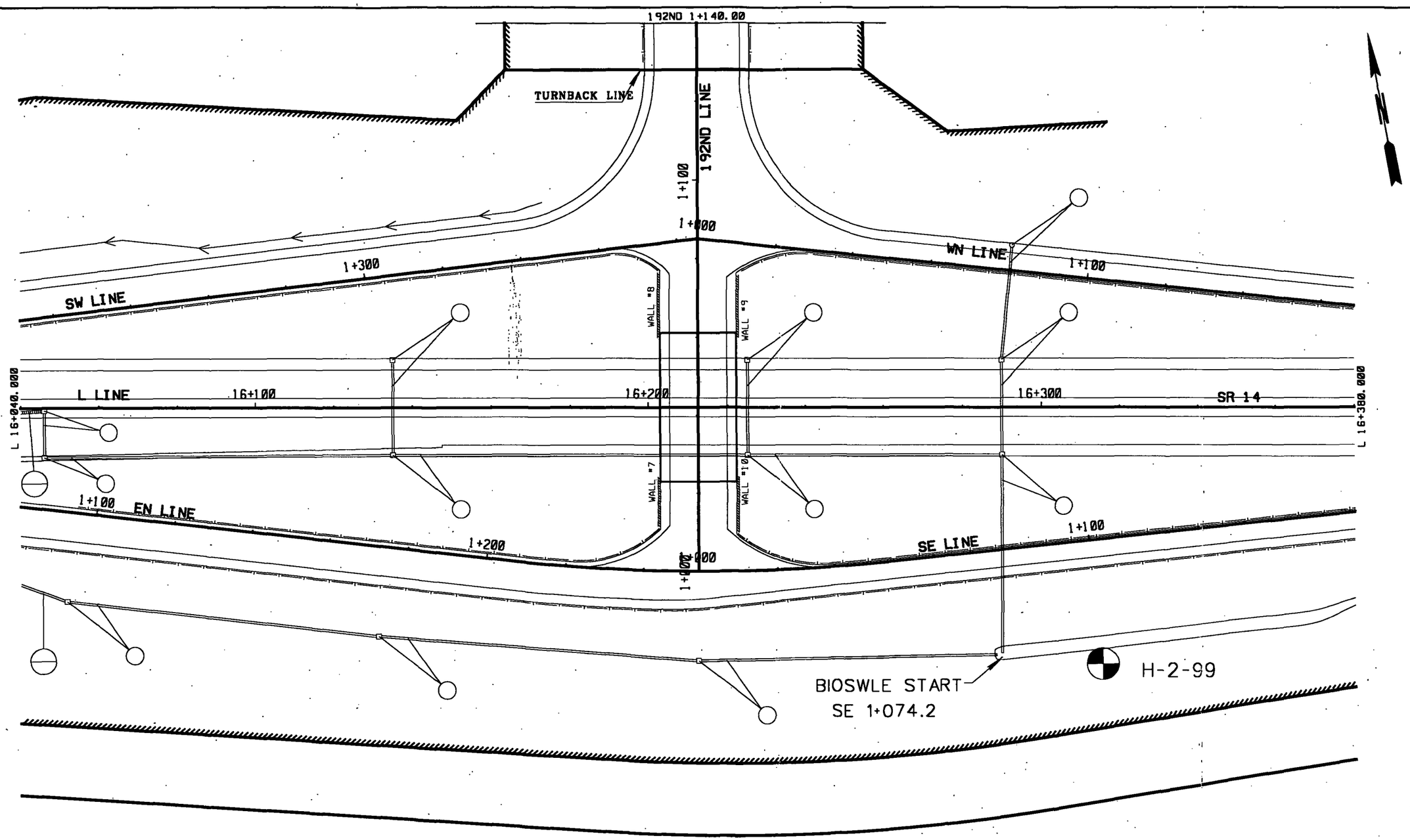
SE 192nd AVE. INTERCHANGE
PROFILE WALL 12

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 4/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

FIGURE 26

...\PROFILEWALL12.DGN 05/04/2000 10:14:26 AM



0 25
SCALE IN METERS

FIGURE 27

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\11-8-99\12530drn.dgn Apr. 20, 2000 08:58:39

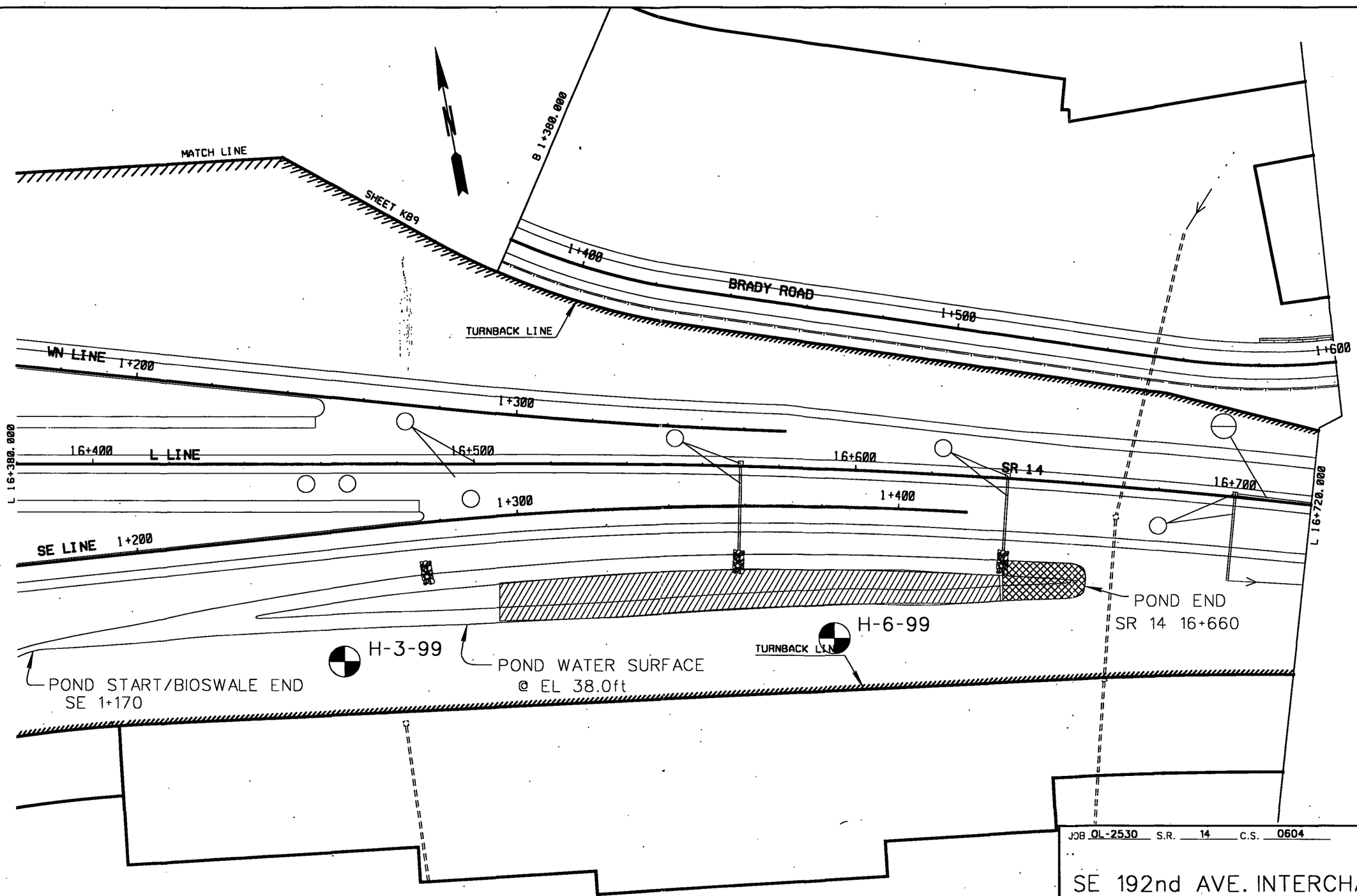


FIGURE 28

JOB OL-2530 S.R. 14 C.S. 0604

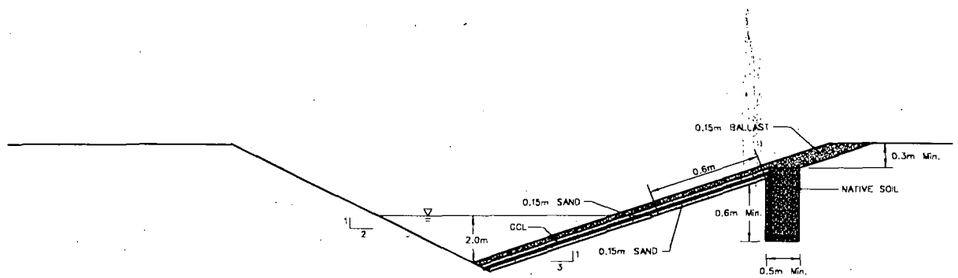
SE 192nd AVE. INTERCHANGE

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE 1:100 VERT.
1:100 HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\11-8-99\12530drn.dgn Apr. 20, 2000 09:02:26

FROM STA 1+290 to 16+640



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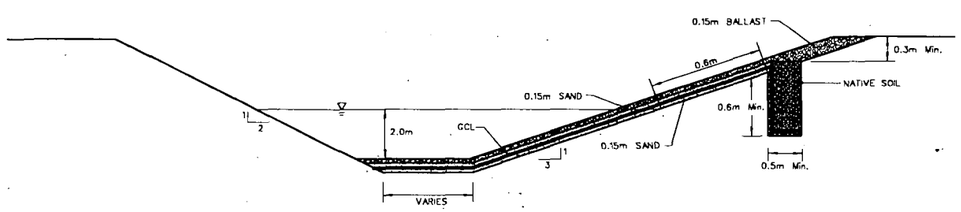
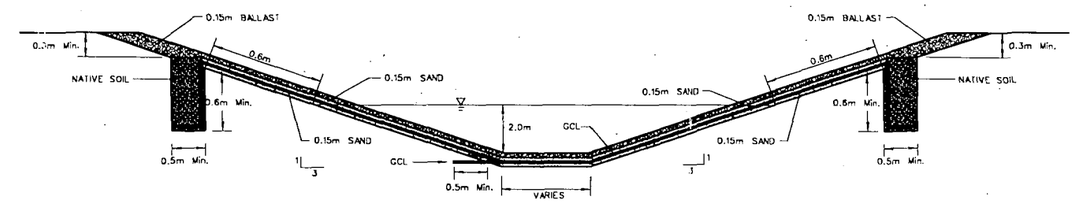


FROM STA 16+640 to 16+660



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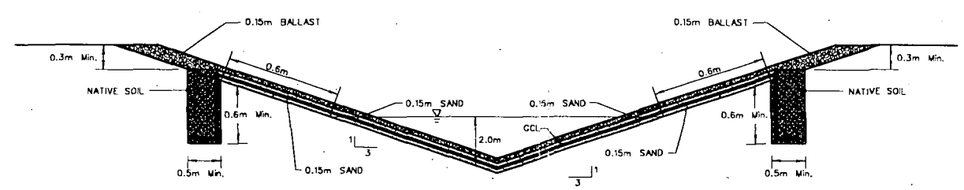

FIGURE 29

JOB OL-2530 S.R. 14 C.S. 0604

SE 192nd AVE. INTERCHANGE TYPICAL SECTIONS

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 3/2000
SCALE N.T.S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

...\2-18-00\geosyntheticwall.dgn Apr. 20, 2000 08:54:43

APPENDIX B

GENERAL SPECIAL PROVISIONS

Geosynthetic Retaining Wall

The Contractor shall furnish and construct temporary or permanent geosynthetic retaining walls in accordance with the details shown in the Plans, these specifications, or as directed by the Engineer.

Materials

Section 2-12.2 is supplemented with the following:

The provisions of this section shall also apply to geogrids.

Borrow

Section 9-03.14 is supplemented with the following:

Borrow for Geosynthetic Retaining Wall

All backfill material used in the reinforced soil zone of the geosynthetic wall shall conform to the requirements of Section 9-03.14(1) and shall be free draining, free from organic or otherwise deleterious material. The material shall be substantially free of shale or other soft, poor durability particles, and shall not contain recycled materials, such as glass, shredded tires, portland cement concrete rubble, or asphaltic concrete rubble. The backfill material shall meet the following requirements:

Property	Test Method	Allowable Test Value
Los Angeles Wear, 500 rev.	AASHTO T 96	35 percent max.
Degradation	WSDOT Test Method 113	15 min.
pH	AASHTO T 289-91	Quantity **

** 4.5 to 9 for permanent walls and 3 to 10 for temporary walls

Wall backfill material satisfying these gradation, durability and chemical requirements shall be classified as nonaggressive.

Geotextile and Thread for Sewing

Section 9-33.1 is supplemented with the following:

Geotextiles and Thread for Retaining Walls

The term geosynthetics shall include both geotextiles and geogrids.

Geotextile reinforcement in geosynthetic retaining walls shall conform to the properties specified in Tables 7 and 8 for permanent walls, and Tables 7 and 9 for temporary walls.

Geogrids shall consist of a regular network of integrally connected polymer tensile elements with an aperture geometry sufficient to permit mechanical interlock with the surrounding backfill. The long chain polymers in the geogrid tensile elements, not including coatings, shall consist of at least 95 percent by mass of the material of polyolefins or polyesters. The material shall be free of

defects, cuts, and tears. Geogrid reinforcement in geosynthetic retaining walls shall conform to the properties specified in Table 8 for permanent walls, and Table 9 for temporary walls.

For geosynthetic walls which use geogrid reinforcement, the geotextile material placed at the wall face to retain the backfill material as shown in the Plans shall conform to the properties for Construction Geotextile for Underground Drainage, Moderate Survivability, Class A.

The thread used to sew geotextile seams in exposed wall faces shall be resistant to ultraviolet radiation.

Geotextile Properties

Section 9-33.2 is supplemented with the following:

Geosynthetic Properties For Retaining Walls and Reinforced Slopes

All geotextile properties provided in Table 7 are minimum average roll values. The average test results for any sampled roll in a lot shall meet or exceed the values shown in the table. The test procedures specified in the table are in conformance with the most recently approved ASTM geotextile test procedures, except for geotextile sampling and specimen conditioning, which are in accordance with WSDOT Test Methods 914 and 915, respectively.

Table 7: Minimum properties required for geotextile reinforcement used in geosynthetic reinforced slopes and walls.

		Geotextile Property Requirements
Geotextile Property	**Test Method**	**Woven/Nonwoven**
Water Permittivity	ASTM D4491	.02 sec.$^{-1}$ min.
AOS	ASTM D4751	.84 mm max.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	900 N/530 N min.
Grab Failure Strain, in machine and x-machine direction	ASTM D4632	< 50% / ≥ 50%
Seam Breaking Strength[1]	ASTM D4632	700 N/430 N min.
Puncture Resistance	ASTM D4833	280 N/220 N min.
Tear Strength, min. in machine and x-machine	ASTM D4533	280 N/220 N min.

direction		
Ultraviolet (UV) Radiation Stability	ASTM D4355	70% (for polypropylene and polyethylene) and 50% (for polyester) Strength Retained min., after 500 Hr. in weatherometer

[1]Applies only to seams perpendicular to the wall face.

For geogrids, the summation of the geogrid joint strengths determined in accordance with Geosynthetic Research Institute test method GRI:GG2 occurring in a 300 mm length of grid in the direction of loading (i.e., perpendicular to the wall face) shall be greater than or equal to the ultimate strength (T_{ult}) of the grid element to which they are attached. For this determination, T_{ult} is to be determined using Geosynthetic Research Institute test method GRI:GG1. If the joint spacing is greater than or equal to 300 mm, two joints shall be included in this summation of joint strengths. The ultraviolet (UV) radiation stability, ASTM D4355, shall be a minimum of 70% strength retained after 500 hours in the weatherometer for polypropylene and polyethylene geogrids, and 50% strength retained after 500 hours in the weatherometer for polyester geogrids..

Geosynthetic Properties for Permanent Retaining Walls

Table 8: Long-term tensile strength, T_{al}, required for the geosynthetic reinforcement used in geosynthetic retaining walls.

[3]Wall No.	Vertical Spacing of Reinforcement Layers (m)	Reinforcement Layer Distance from Top of Wall (m)	[1,2,3]Minimum Long-Term Tensile Strength, T_{al} (kN/m)
2	0.23	0.0-3.0 3.0-6.0	5.7 9.0
2	0.30	0.0-3.0 3.0-6.0	7.0 11.5
2	0.38	0.0-3.0 3.0-6.0	8.5 14.7

[1]These long-term tensile strength requirements apply only in the geosynthetic direction perpendicular to the wall face.

[2]T_{al} shall be determined in accordance with WSDOT Test Method 925.

[3]This wall is classified as Class 1 structures.

Source Approval

Section 9-33.4(1) is supplemented with the following:

Permanent Geosynthetic Retaining Wall

Geosynthetic products which are qualified for use in geosynthetic reinforced structures (Classes 1, 2, or both) are listed in the current Qualified Products List (QPL).

For geosynthetic products proposed for use which are not listed in the current QPL, the Contractor shall submit test information and the calculations used in the determination of T_{al} performed in accordance with WSDOT Test Method 925 to the Olympia Service Center Materials Laboratory in Tumwater for evaluation. The Contracting Agency will require up to 30 calendar days after receipt of the information to complete the evaluation.

Source approval for retaining wall geosynthetic materials listed in the current QPL, or as approved based on data developed and submitted in accordance with WSDOT Test Method 925, will be based on conformance to the applicable values in Tables 7 and 8.

Acceptance Samples

Section 9-33.4(3) is supplemented with the following:

Permanent Geosynthetic Retaining Wall

Geotextile acceptance testing shall meet the requirements of Table 7, and both geotextile and geogrid acceptance testing shall meet the required ultimate tensile strength T_{ult} as provided in the QPL for the selected product(s). If the selected product(s) are not listed in the current QPL, the result of the testing for T_{ult} must be greater than or equal to T_{ult} as determined from the product data submitted and approved by the Olympia Service Center Materials Laboratory during source approval. If the results of the testing show that the retaining wall geosynthetic lot does not meet the specified properties, the roll or rolls which were sampled will be rejected, and additional sampling and testing will be performed as specified.

Acceptance by Certificate of Compliance

Section 9-33.4(4) is supplemented with the following:

Retaining Wall

The Contractor shall provide a Manufacturer's Certificate of Compliance to the Engineer, including polymer type in addition to all information as specified, for all quantities of retaining wall geosynthetic material.

Construction Requirements

Section 2-12.3 is supplemented with the following:

Geosynthetic Wall Construction Requirements

Submittals

The Contractor shall submit to the Engineer, a minimum of 14 calendar days prior to beginning construction of each wall, detailed plans for each wall and as a minimum, the submittals shall include the following:

1. Detailed wall plans showing the actual lengths proposed for the geosynthetic reinforcing layers and the locations of each geosynthetic product proposed for use in each of the geosynthetic reinforcing layers.

2. The Contractor's proposed wall construction method, including proposed forming systems, types of equipment to be used and proposed erection sequence.

3. Manufacturer's Certificate of Compliance, samples of the retaining wall geosynthetic and sewn seams for the purpose of acceptance as specified.

4. Details of geosynthetic wall corner construction, including details of the positive connection between the wall sections on both sides of the corner.

5. Details of terminating a top layer of retaining wall geosynthetic and backfill due to a changing retaining wall profile.

Approval of the Contractor's proposed wall construction details and methods shall not relieve the Contractor of their responsibility to construct the walls in accordance with the requirements of these Specifications.

Wall Construction

The Contractor shall excavate for the retaining wall in accordance with Section 2-09, and conforming to the limits and construction stages shown in the Plans.

The Contractor shall direct all surface runoff from adjacent areas away from the retaining wall construction site.

The Contractor shall begin wall construction at the lowest portion of the excavation and shall place each layer horizontally as shown in the Plans. The Contractor shall complete each layer entirely before beginning the next layer.

Geotextile splices shall consist of a sewn seam or a minimum 300 mm overlap. Geogrid splices shall consist of adjacent geogrid strips butted together and fastened using hog rings, or other methods approved by the Engineer, in such a manner to prevent the splices from separating during geogrid installation and backfilling. Splices exposed at the wall face shall prevent loss of backfill material through the face. The splicing material exposed at the wall face shall be as durable and strong as the material to which the splices are tied. The Contractor shall offset geosynthetic splices in one layer from those in the other layers such that the splices

shall not line up vertically. Splices parallel to the wall face will not be allowed, as shown in the Plans.

The Contractor shall stretch out the geosynthetic in the direction perpendicular to the wall face to ensure that no slack or wrinkles exist in the geosynthetic prior to backfilling.

For geogrids, the length of the reinforcement required as shown in the Plans shall be defined as the distance between the geosynthetic wrapped face and the last geogrid node at the end of the reinforcement in the wall backfill.

The Contractor shall place fill material on the geosynthetic in lifts such that 150 mm minimum of fill material is between the vehicle or equipment tires or tracks and the geosynthetic at all times. The Contractor shall remove all particles within the backfill material greater than 75 mm in size. Turning of vehicles on the first lift above the geosynthetic will not be permitted. The Contractor shall not end dump fill material directly on the geosynthetic without the prior approval of the Engineer.

Should the geosynthetic be damaged or the splices disturbed, the backfill around the damaged or displaced area shall be removed and the damaged strip of geosynthetic replaced by the Contractor at no expense to the Contracting Agency.

The Contractor shall use a temporary form system to prevent sagging of the geosynthetic facing elements during construction. A typical example of a temporary form system and sequence of wall construction required when using this form are detailed in the Plans. Soil piles or the geosynthetic manufacturer's recommended method, in combination with the forming system shall be used to hold the geosynthetic in place until the specified cover material is placed.

The Contractor shall place and compact the wall backfill in accordance with the wall construction sequence detailed in the Plans. The minimum compacted backfill lift thickness of the first lift above each geosynthetic layer shall be 150 mm. The maximum compacted lift thickness anywhere within the wall shall be 250 mm.

The Contractor shall compact each layer to 95 percent of maximum density. The water content of the wall backfill shall not exceed the optimum water content by more than 3 percent. The Contractor shall not use sheepsfoot rollers or rollers with protrusions. Rollers which have a mass of more than 2,700 Kg shall be used with the vibrator turned off. The Contractor may use rollers which have a mass of 2,700 Kg or less with the vibrator turned on with the prior approval of the Engineer. The Contractor shall compact the zone within 1 meter of the wall face without causing damage or distortion to the wall facing elements or reinforcing layers by using light mechanical tampers approved by the Engineer.

The Contractor shall construct wall corners at the locations shown in the Plans, and in accordance with the wall corner construction sequence and method submitted by the Contractor and approved by the Engineer. Wall angle points with an interior angle of less than 150 degrees shall be considered to be a wall corner. The wall corner shall provide a positive connection between the sections of the wall on each

side of the corner such that the wall backfill material cannot spill out through the corner at any time during the design life of the wall. The Contractor shall construct the wall corner such that the wall sections on both sides of the corner attain the full geosynthetic layer embedment lengths shown in the Plans.

Where required by retaining wall profile grade, the Contractor shall terminate top layers of retaining wall geosynthetic and backfill in accordance with the method submitted by the Contractor and approved by the Engineer. The end of each layer at the top of the wall shall be constructed in a manner which prevents wall backfill material from spilling out the face of the wall throughout the life of the wall. If the profile of the top of the wall changes at a rate of 1:1 or steeper, this change in top of wall profile shall be considered to be a corner.

Tolerances

The Contractor shall complete the base of the retaining wall excavation to within plus or minus 75 mm of the staked elevations unless otherwise directed by the Engineer. The Contractor shall place the external wall dimensions to within plus or minus 50 mm of that staked on the ground. The Contractor shall space the reinforcement layers vertically and place the overlaps to within plus or minus 25 mm of that shown in the Plans.

The completed wall(s) shall meet the following tolerances:

	Permanent Wall	**Temporary Wall**
Deviation from the design batter and horizontal alignment for the face when measured along a 3 meter straight edge at the midpoint of each wall layer shall not exceed:	75 mm	130 mm
Deviation from the overall design batter per 3 meters of wall height shall not exceed:	50 mm	75 mm
Maximum outward bulge of the face between backfill reinforcement layers shall not exceed:	100 mm	150 mm

Permanent Facing for Geosynthetic Retaining Wall

The Contractor shall apply a permanent wall facing to the surface of the geosynthetic retaining wall as shown in the Plans.

Installing Guardrail Posts in Geosynthetic Retaining Wall

The Contractor shall install guardrail posts as shown in the Plans after completing the wall, but before the permanent facing is installed. The Contractor shall install the posts in a manner that prevents bulging of the wall face and prevents ripping, tearing, or pulling of the geosynthetic reinforcement. Holes through the geosynthetic

reinforcement shall be the minimum size necessary for the post. The Contractor shall demonstrate to the Engineer prior to beginning guardrail post installation that the installation method will not rip, tear, or pull the geosynthetic reinforcement.

Measurement

Section 2-12.4 is supplemented with the following:

Geosynthetic retaining wall will be measured by the square meter of face of completed wall.

Gravel borrow incl. haul will be measured as specified in Section 2-03.4.

Structure excavation class B incl. haul will be measured as specified in Section 2-09.4 and to the limits shown in the Plans.

Payment

Section 2-12.5 is supplemented with the following:

"Geosynthetic Retaining Wall", per square meter.
"Gravel Borrow Including Haul", per tonne or per cubic meter.
"Structure Excavation Class B Incl. haul", per cubic meter.
The unit contract price per square meter for "Geosynthetic Retaining Wall" shall be full pay to perform the work as specified, including compaction of the backfill material and furnishing and installing the temporary forming system.

WSDOT General Special Provision - Metric

SHOTCRETE FACING

1.0 Description

This work shall consist of the application of one or more layers of pneumatically placed concrete to soil, geosynthetic, concrete, or steel surfaces.

2.0 Materials

2.1 Shotcrete Material Requirements

Portland cement shall be Type II.

Air entrainment shall be 6.0 percent, ± 1.5 percent.

Water for mixing and curing shall be clean and free from substances which may be injurious to concrete or steel, and shall be free of elements which would cause staining.

Reinforcement shall be in accordance with Section 9-07.

Aggregate for shotcrete shall meet the following gradation requirements:

Sieve Size	Percent Passing by Mass
12.5 mm	100
9.50 mm	90 to 100
4.75 mm	70 to 85
2.36 mm	50 to 70
1.18 mm	35 to 55
0.600 mm	20 to 35
0.300 mm	8 to 20
0.150 mm	2 to 10
0.075 mm	0 to 2.5

2.2 Shotcrete Coloration for Facing Alternate C

If facing Alternate C is required, the Contractor shall provide shotcrete coloration for finishing the sculptured shotcrete to match the color of the natural surroundings. Approval of the final appearance of the coloration will be based on the pre-production test panel. Approval of the long-term properties of the coloration material shall be based on a manufacturer's certification which verifies the following to be true about the product:

1. Resistance to alkalis in accordance with ASTM D 543.
2. Demonstrates no change in coloration after 1,000 hours of testing in accordance with ASTM D 822.
3. Does not oxidize when tested in accordance with ASTM D 822.

4. Demonstrates resistance to gasoline and mineral spirits when tested in accordance with ASTM D 543.

Additionally, the certification shall provide the product name, proposed mix design and application method, and evidence of at least one project where the product, using the proposed mix and application method, was applied and which has provided at least five years or more of acceptable durability and color permanency.

3.0 Construction Requirements

3.1 Submittals

The Contractor shall submit the following information to the Engineer at least 14 calendar days prior to beginning construction of the shotcrete facing:

1. Shotcrete mix design with compressive strength test results.
2. Method and equipment used to finish and cure the shotcrete facing.
3. Documentation of the experience of the nozzlemen in applying shotcrete.

The Contractor shall not begin construction of the shotcrete facing until receiving the Engineer's approval of the above submittals.

3.2 Mix Design

Shotcrete shall be proportioned to produce a 28 MPa compressive strength at 28 days. The Contractor shall submit the shotcrete mix design, proposed method of placement, and evidence that the proposed design and placement method will produce the desired compressive strength at 28 days, to the Engineer at least 14 calendar days prior to the anticipated beginning of shotcrete placement. Shotcrete placement will not be allowed until the Engineer has approved the mix design and method of placement.

Admixture shall be used only after receiving permission from the Engineer. If admixtures are used to entrain air, to reduce water-cement ratio, to retard or accelerate setting time, or to accelerate the development of strength, the admixtures shall be used at the rate specified by the manufacturer and approved by the Engineer.

3.3 Testing

The Contractor shall make shotcrete test panels for evaluation of shotcrete quality, strength, and aesthetics. Both preproduction and production test panels, shall be prepared. All cores obtained for the purpose of shotcrete strength testing shall have the following minimum dimensions:

a. The core diameter shall be at least 3 times the maximum aggregate size, but not less than 50 millimeters.

b. The core height shall be a minimum of 1.5 times the core diameter.

The Contractor shall remove at least three cores from each 900 by 900 millimeter shotcrete test panel in accordance with AASHTO T 24. Cores removed from the panel shall be immediately wrapped in wet burlap and sealed in a plastic bag. Cores shall be clearly marked to identify from where they were taken and whether they are for pre-production or production testing. If for production testing, the section of the wall represented by the cores shall be clearly marked on the cores. Cores shall be delivered to the Engineer within 2 hours of coring. The remainder of the panels shall remain the property of the Contractor.

3.3.1 Pre-production Testing

At least one 900 by 900 millimeter panel for each mix design shall be prepared for evaluation and testing of the shotcrete quality and strength. One 1200 by 1200 millimeter qualification panel shall be prepared for evaluation and approval of the proposed method for shotcrete installation, finishing, and curing. Both the 900 millimeter and the 1200 millimeter panels shall be constructed using the same methods and initial curing proposed to construct the shotcrete facing, except that the 900 millimeter panel shall not include wire reinforcement. The 900 millimeter panel shall be constructed to the minimum thickness necessary to obtain the required core samples. The 1200 millimeter panel shall be constructed to the same thickness as proposed for the production facing. Production shotcrete work shall not begin until satisfactory test results are obtained and the panels are approved by the Engineer.

3.3.2 Production Testing

The Contractor shall make at least one 900 by 900 millimeter panel for each section of facing shot, or as many as directed by the Engineer. A section is defined as one day's placement. The production panels shall be constructed using the same methods and initial curing used to construct the shotcrete wall, but without wire reinforcement. The panels shall be constructed to the minimum thickness necessary to obtain the required core samples. If the production shotcrete is found to be unsuitable based on the results of the test panels, the section(s) of the wall represented by the test panel(s) shall be repaired or replaced to the satisfaction of the Engineer at no cost to the Contracting Agency.

3.4 Qualifications of Contractor's Personnel

All nozzlemen shall have had at least one year of experience in the application of shotcrete. Each nozzleman will be qualified, by the Engineer, to place shotcrete, after successfully completing one test panel for each shooting position and surface type which will be encountered.

Qualification will be based on a visual inspection of the shotcrete density, void structure, and finished appearance along with a minimum 7-day compressive strength of 17 MPa determined from the average test results from two cores taken from each test panel.

The Contractor shall notify the Engineer not less than 2 days prior to the shooting of a qualification panel. The mix design for the shotcrete shall be the same as that slated for the wall being shot.

Shotcrete shall be placed only by personnel qualified by the Engineer.

If shotcrete finish Alternate B or C is required, evidence shall be provided that all shotcrete crew members have completed at least three projects in the last five years where such finishing, or sculpturing and texturing of shotcrete was performed.

3.5 Placing Wire Reinforcement

Reinforcement of the shotcrete shall be placed as shown in the Plans. The wire reinforcement shall be securely fastened to the steel reinforcing bars so that it will be 25 to 40 millimeters from the face of the shotcrete at all locations, unless otherwise shown in the Plans. Wire reinforcement shall be lapped 1.5 squares in all directions, unless otherwise shown in the Plans.

3.6 Alignment Control

The Contractor shall install non-corroding alignment wires and thickness control pins to establish thickness and plane surface. The Contractor shall install alignment wires at corners and offsets not established by formwork. The Contractor shall ensure that the alignment wires are tight, true to line, and placed to allow further tightening. The Contractor shall remove the alignment wires after facing construction is complete.

3.7 Shotcrete Application

A clean, dry supply of compressed air sufficient for maintaining adequate nozzle velocity for all parts for the work and for simultaneous operation of a blow pipe for cleaning away rebound shall be maintained at all times. Thickness, method of support, air pressure, and rate of placement of shotcrete shall be controlled to prevent sagging or sloughing of freshly-applied shotcrete.

The shotcrete shall be applied from the lower part of the area upwards. Surfaces to be shot shall be damp, but free of standing water.

The nozzles shall be held at an angle approximately perpendicular to the working face and at a distance that will keep rebound at a minimum and compaction will be maximized. Shotcrete shall emerge from the nozzle in a steady uninterrupted flow. If, for any reason, the flow becomes intermittent, the nozzle shall be diverted from the work until a steady flow resumes.

Surface defects shall be repaired as soon as possible after initial placement of the shotcrete. All shotcrete which lacks uniformity; which exhibits segregation, honeycombing, or lamination; or which contains any dry patches, slugs, voids, or sand pockets, shall be removed and replaced with fresh shotcrete by the Contractor, to the satisfaction of the Engineer at no cost to the Contracting Agency.

Construction joints in the shotcrete shall be uniformly tapered over a minimum distance of twice the thickness of the shotcrete layer. The surface of the joints shall be cleaned and

thoroughly wetted before adjacent shotcreting is performed. Shotcrete shall be placed in a manner which provides a finish with uniform texture and color across the construction joint.

The shotcrete shall be cured by applying a clear curing compound in accordance with Section 9-23.2. The curing compound shall be applied immediately after final gunning. The air in contact with shotcrete surfaces shall be maintained at temperatures above 5 C for a minimum of 7 days. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded unless positive measures such as sandblasting, are taken to completely remove the curing compounds prior to the application of such additional materials.

If field inspection or testing, by the Engineer, indicates that any shotcrete produced, fails to meet the requirements, the Contractor shall immediately modify procedures, equipment, or system, as necessary, and as approved by the Engineer to produce specification material. All substandard shotcrete already placed shall be repaired by the Contractor, to the satisfaction of the Engineer, at no cost to the Contracting Agency. Such repairs may include removal and replacement of all affected materials.

3.8 Shotcrete Finishing

The shotcrete face shall be finished using the alternate aesthetic treatment indicated in the Plans. The alternates are as follows:

Alternate A

After the surface has taken its initial set (crumbling slightly when cut), the surface shall be broom finished to secure a uniform surface texture.

Alternate B

Place shotcrete a fraction beyond the alignment wires and forms. Allow shotcrete to stiffen to the point where the surface will not pull or crack when screeded with a rod or trowel. Excess material shall be trimmed, sliced, or scraped to true lines and grade. Alignment wires shall be removed and the surface shall receive a steel trowel finish, leaving a smooth uniform texture and color. Once the shotcrete has cured, pigmented sealer shall be applied to the shotcrete face. The shotcrete surface shall be completed to within a tolerance of 12.5 millimeters of true line and grade.

Alternate C

Shotcrete shall be hand-sculptured, colored, and textured to simulate the relief, jointing, and texture of the natural backdrop surrounding the wall. The ends and base of the wall shall transition in appearance as appropriate to more nearly match the color and texture of the adjoining roadway fill slopes. This may be achieved by broadcasting fine and coarse aggregates, rocks, and other native materials into the final surface of the shotcrete while it is still wet, allowing sufficient embedment into the shotcrete to become a permanent part of the surface.

4.0 Measurement

Shotcrete facing will be measured by the square meter of completed shotcrete facing.

5.0 Payment

Payment will be made in accordance with Section 1-04.1, for the following bid items:

"Shotcrete Facing", per square meter.

Boring H-5-99 consisted of very loose silty sand in the top 1.6 m. Well graded gravel with cobbles and boulders was found between the depths of 1.6 m and 4.1 m in boring H-5-99. A very dense mixture of silt, sand, gravel and cobbles was found below the depth of 4.1 m in boring H-5-99. The boring was terminated at a depth of 19.3 m. No water table was observed in boring H-5-99.

Retaining walls

Wall 2

The surface slopes at approximately 1.5H:1V. The slope is densely vegetated with small trees. A concrete box culvert carrying fisher creek across the existing SR-14 was present at the bottom of the slope.

Test boring H-9-99 was drilled near the wall location. Test boring H-9-99 generally consisted of alternating layers of loose to medium dense silty sand and loose to medium dense silt layers in the top 4.2 m. A gravel unit was found at a depth of 4.2 m with varying contents of silt, sand and clay and continued until the bottom of the boring which was reached at approximately 18.2 m. This gravel unit was medium dense in the top 1 m and became dense to very dense below. The water table was found at a depth of 7.2 m.

We recommend using geosynthetic wall with shotcrete facing or welded wire MSE wall such as Hilfiker wall at this proposed location due to cost considerations. We understand from the region that the aesthetic appearance of this proposed wall was not a concern. To increase the stability of the wall, we recommend that the reinforcement length should not be less than 85% of the wall height. Concrete cantilever walls were not considered due to cost considerations.

Shotcrete faced Geotextile wall

Table 2 below presents the wide width strength requirements of the geotextile for different spacing in Permanent Geosynthetic Walls.

Vertical Height Range (m)	Vertical spacing of reinforcement layers (m)	Minimum Long Term Tensile Strength (ASTM D4595), Tall (kN/m)
0-3		5.5
3-6	0.23	9.4
0-3		7.0
3-6	0.30	11.5
0-3		8.3
3-6	0.38	14.5

Table 2: Long term tensile strength requirements for different vertical reinforcement spacing

SOIL NAILING

Description

This work consists of constructing soil nail walls.

Materials

Soil Nails

All soil nails shall be deformed steel reinforcing bars conforming to AASHTO M 31, Grade 60, and Section 9-07.2. All soil nails, except those specified in the Plans to be encapsulated, shall be epoxy-coated in accordance with Sections 6-02.3(24)H and 9-07.3.

Soil nail bars shall be of the type and size specified in the Plans. The bars shall not be spliced. The bars shall be threaded at the bearing plate end a minimum of six inches. The threading shall be continuous spiral deformed ribbing. Alternatively, threads may be cut into the reinforcing bar if the bar size is increased to the next larger size from the size shown in the Plans at no additional cost to the Contracting Agency.

Soil Nail Encapsulation

When the Plans require certain soil nails to be encapsulated to provide additional corrosion protection, the encapsulation shall be fabricated from one of the following:

1. Corrugated high density polyethylene (HDPE) sheathing conforming to the requirements of AASHTO M 252 and having a minimum wall thickness of 30 mils.

2. Corrugated polyvinyl chloride (PVC) sheathing conforming to ASTM D 1784, Class 1346-B, and having a minimum wall thickness of 30 mils.

The soil nail shall be centralized within the sheathing with a minimum 0.2 inch grout cover over the soil nail inside the sheath. The encapsulation shall be constructed at the factory under controlled conditions. Field construction of the encapsulation will not be permitted.

Bearing Plates

Bearing plates shall be as specified in the Plans and fabricated from steel conforming to AASHTO M 183.

Centralizers

Centralizers shall be fabricated from plastic, steel, or material non detrimental to the nail steel. Wood shall not be used. The centralizers shall provide a minimum of 0.5 inch of grout cover over the bar. Centralizers shall be spaced no further than 8 feet apart.

Nuts

Nuts shall conform to AASHTO M291, Grade B, Hexagonal. The nuts shall be fitted, where necessary, with a special washer or spherical seat such that the nut bears uniformly on the plate.

Reinforcing Steel

Deformed steel bars and welded wire fabric shall conform to Section 9-07.

Shotcrete (Air Placed Concrete)

Shotcrete shall conform to the requirements specified in the Special Provision **SHOTCRETE.**

Concrete

Cast-in-place concrete shall conform to Section 6-02.

Prefabricated Drainage Material

Prefabricated drainage material shall have a single or double dimpled polymeric core with a non-woven geotextile attached and meet the following requirements:

Property	Test Method	Prefabricated Drainage Material/Geotextile Property Requirements
Width		12 inches min.
Thickness	ASTM D 5199	0.4 inches min.
Compressive Strength at Yield	ASTM D 1621	100 psi min.
In Plan Flow Rate	ASTM D 4716	
Gradient = 0.1, Pressure = 5.5 psi		5.0 gal./min./ft.
Gradient = 1.0, Pressure = 14.5 psi		15.0 gal./min./ft.
Geotextile - AOS	ASTM D 4751	#60 US Sieve max.
Geotextile - Permittivity	ASTM D 4491	$\geq$ 0.4 SEC^{-1}
Geotextile - Grab Strength	ASTM D 4632	Nonwoven 110 lb. min.

Prefabricated drainage material will be accepted based on the manufacturer's certificate of compliance that the material furnished conforms to these Specifications. The Contractor shall submit the manufacturer's certificate of compliance to the Engineer in accordance with Section 1-06.3.

Installation shall be in accordance with the manufacturer's recommendations.

Construction Requirements

General Description

Soil nailing shall consist of excavating to the layer limits shown in the Plans, drilling holes at the specified angle into the native material, placing and grouting epoxy coated or encapsulated steel reinforcing bars (soil nails) in the drilled holes, placing prefabricated drainage material and steel reinforcement, and applying a shotcrete facing over the steel reinforcement. After completing the wall to full height, the Contractor shall construct the concrete fascia panels in accordance with the Plans and these Special Provisions.

All proprietary items used in the soil nailed structure shall be installed in accordance with the manufacturer's recommendations. In the event of a conflict between the manufacturer's recommendations and these Special Provisions these Special Provisions shall prevail.

Contractor's Experience Requirements

Within the last five years, the Contractor performing this work shall have successfully completed at least five projects involving construction of retaining walls using soil nails or ground anchors or shall have completed the construction of two or more projects totaling at least 15,000 square feet of retaining wall with a minimum total of 500 soil nails or ground anchors.

The Contractor shall assign an engineer with at least three years of experience in the design and construction of permanently anchored or nailed structures to supervise the work. The Contractor shall not use consultants or manufacturer's representatives in order to meet the requirements of this section. Drill operators and on-site supervisors shall have a minimum of one year experience installing permanent soil nails or ground anchors.

Submittals

Work shall not begin on any soil nail wall system until all of the required submittals have been approved by the Engineer. The Engineer may suspend the soil nailing work if the Contractor substitutes unqualified personnel or materials for approved personnel or materials during construction. If work is suspended due to substitutions, the Contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed. The Contractor shall submit the following information, in writing, to the Engineer not less than 30 working days prior to the start of wall excavation.

1. A brief description of each project satisfying the Contractors Experience Requirements with the Owner's name and current phone number.

2. A list identifying the following personnel assigned to this project and their experience with permanently anchored or nailed structures:

    A. Supervising Engineer
    B. Drill Operators
    C. On-site Supervisors who will be assigned to the project.

3. The proposed detailed construction procedure which includes:

    A. Proposed method(s) of excavation of the soil and/or rock.
    B. A plan for the removal and control of groundwater encountered during excavation, drilling, and other earth moving activities. Include a list of the equipment used to remove and control groundwater.
    C Proposed drilling methods and equipment.
    D. Proposed hole diameter(s).
    E. Proposed method of soil nail installation.
    F. Grout mix design and procedures for placing the grout.
    G. Shotcrete mix design with compressive strength test results.
    H. Procedures for placing the shotcrete (include placement in conditions when ground water is encountered).
    I. Encapsulation system for additional corrosion protection selected for the soil nails and anchorages requiring encapsulation.

4. Detailed plans of the method proposed for the soil nail testing which includes:

A. All necessary drawings and details to clearly describe the proposed system of jacking support, framing, and bracing to be used during testing.

B. Calibration data for each load cell, test jack, pressure gauge, stroke counter on the grout pump, and master gauge to be used. The calibration tests shall have been performed by an independent testing laboratory, and tests shall have been performed within 60 calendar days of the date submitted. Testing or work shall not commence until the Engineer has approved the load cell, jack, pressure gage, and master pressure gauge calibrations.

5. Certified mill test results and typical stress-strain curves along with samples from each heat, properly marked, for the soil nail steel. The typical stress-strain curve shall be obtained by approved standard practices. The guaranteed ultimate strength, yield strength, elongation, and composition shall be specified.

The soil nailed wall shall be constructed as follows:

Earthwork

The ground contour above the wall shall be established to is final configuration and backslope as shown in the Plans prior to beginning excavation of the soil for the first row of soil nails.

The excavation shall proceed from the top down in a horizontal lift sequence with the ground level excavated no more than 3 feet below the elevation of the row of nails to be installed in that lift. The excavated vertical wall face should not be left open more than 24 hours for any reason. A lift shall not be excavated until the nail installation and reinforced shotcrete placement for the preceding lift has been completed and accepted. After a lift is excavated, the cut surface shall be cleaned of all loose materials, mud, rebound, and other foreign matter that could prevent or reduce shotcrete bond.

The Contractor should review the geotechnical recommendations report prepared for this project for further information on the soil conditions at the location of each wall. Prospective bidders may review the geotechnical information prepared for this project at the location specified in Section 1-02.4 as supplemented in these Special Provisions. The geotechnical recommendations report is available for purchase by prospective bidders at the same locations as plans and specifications for this project.

Soil Nail Storage and Handling

The Contractor shall not handle and transport the encapsulated soil nails until the encapsulation grout has reached sufficient strength to resist damage during handling. The Contractor shall handle the encapsulated soil nails in such a manner to prevent large deflections or distortions during handling. When handling or transporting encapsulated soil nails, the Contractor shall provide slings or other equipment necessary to prevent damage to the soil nails and the corrosion protection. The Engineer may reject any encapsulated nail which is damaged during transportation or handling. Damaged or defective encapsulation shall be repaired in accordance with the manufacturer's recommendations and as approved by the Engineer.

Soil nails shall be handled and sorted in such a manner as to avoid damage or corrosion. Prior to inserting a soil nail in the drilled hole, the Contractor and the Engineer will examine the soil nail for damage. If in the opinion of the Engineer, the epoxy coating or bar have been damaged, the nail shall be repaired. If in the opinion of the Engineer, the damage is beyond repair, the soil nail shall be rejected.

If, in the opinion of the Engineer, the epoxy coating can be repaired, the Contractor shall patch the coating with an Engineer approved patching material.

Installation of Soil Nails

Nail holes shall be drilled at the locations shown in the Plans or as directed by the Engineer. The nails shall be positioned plus or minus 6 inches from the theoretical location shown in the Plans. The Contractor shall select the drilling method and the grouting pressure used for the installation of the soil nail. The drill hole shall be located so that the longitudinal axis of the drill hole and the longitudinal axis of the nail are parallel. At the point of entry the soil nail shall be installed within plus or minus three degrees of the inclination from horizontal shown in the Plans, and the nail shall be within plus or minus three degrees of a line drawn perpendicular to the face of the wall unless otherwise shown in the Plans.

Water or other liquids shall not be used to flush cuttings during drilling, but air may be used. After drilling, the nail shall be installed and fully grouted before placing the shotcrete facing. The nail shall be inserted into the drilled hole with centralizers to the desired depth without difficulty in such a manner as to prevent damage to the drilled hole, sheathing or epoxy during installation. When the soil nail cannot be completely inserted into the drilled hole, the Contractor shall remove the nail from the drilled hole and clean or redrill the hole to permit insertion. Partially inserted soil nails shall not be driven or forced into the hole. Subsidence, or any other detrimental impact from drilling shall be cause for immediate cessation of drilling and repair of all damages at the Engineer's direction and the Contractor's expense.

If caving conditions are encountered, no further drilling will be allowed until the Contractor selects a method to prevent ground movement. The Contractor may use temporary casing. The Contractor's method to prevent ground movement shall be approved by the Engineer. The casings for the nail holes, if used, shall be removed as the grout is being placed.

Where necessary for stability of the excavation face, a sealing layer of shotcrete may be placed before drilling is started, or the Contractor shall have the option of drilling and grouting of nails through a stabilizing berm of native soil at the face of the excavation. The stabilizing berm shall extend horizontally from the soil face and from the face of the shotcrete a minimum distance of one foot, and shall be cut down from that point at a safe slope, no steeper than 1H:1V unless approved by the Engineer. The berm shall be excavated to final grade after installation and full length grouting of the nails. Nails damaged during berm excavation shall be repaired or replaced by the Contractor, to the satisfaction of the Engineer, at no added cost to the Contracting Agency.

If sections of the wall are constructed at different times than the adjacent soil nail sections, the Contractor shall use stabilizing berms, temporary slopes, or other measures, as approved by the Engineer, to prevent sloughing or failure of the adjacent soil nail sections.

If cobbles and boulders are encountered at the soil face during excavation, the Contractor shall remove all cobbles and boulders that protrude from the soil face

into the design wall section and fill the void with shotcrete. All shotcrete used to fill voids created by removal of cobbles and boulders shall be incidental to shotcrete facing.

Grouting

The Contractor shall use a neat cement grout or a sand-cement grout. The cement shall not contain lumps or other indications of hydration. Admixtures if used, shall be mixed in accordance with the manufacturer's recommendations. The cement shall comply with Section 9-01.

The grout equipment shall produce a grout free of lumps and undispersed cement. A positive displacement grout pump shall be used. The pump shall be equipped with a pressure gauge to monitor grout pressures and a stroke counter. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer shall be capable of continuously agitating the grout.

The grout shall be injected from the lowest point of the drilled hole. The grout shall be pumped through grout tubes after insertion of the soil nail. The quantity of the grout and the grout pressures shall be recorded. The grout pressures and grout takes shall be controlled to prevent excessive ground heave.

Prefabricated Drainage Material

Prior to placing any shotcrete on an excavated layer, the Contractor shall vertically center prefabricated drainage material between the columns of nails as shown in the Plans. The permeable drain side shall be placed against the exposed soil face. The prefabricated drainage material shall be installed after each excavation lift and shall be hydraulically connected with the prefabricated drainage material previously placed, such that the vertical flow of water is not impeded. The Contractor shall tape all joints in the prefabricated drainage material to prevent shotcrete intrusion during shotcrete application.

Shotcrete Facing

The Contractor shall place steel reinforcing bars and welded wire fabric, and apply the shotcrete facing in accordance with the Special Provision **SHOTCRETE** and the details shown in the Plans.

Securing Soil Nails

Each soil nail shall be secured at the shotcrete facing with a steel plate as shown in the Plans. The plate shall be seated on a wet grout pad of a pasty consistency similar to that of mortar for brick-laying. The nut shall then be sufficiently tightened to achieve full bearing surface behind the plate. After the shotcrete and grout have had time to gain the specified strength, the nut shall be tightened with at least 100 ft.-lbs. of torque.

Nail Testing And Acceptance

Both verification and proof testing of the nails is required. The Contractor shall supply all materials, equipment, and labor to perform the tests. The Contractor shall submit all test data to the Engineer.

The testing equipment shall include a dial gauge or vernier scale capable of measuring to 0.001 inch of the ground anchor movement. A hydraulic jack and pump shall be used to apply the test load. The movement-measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total nail length plus 1 inch. The dial gauge or vernier scale shall be aligned so

that its axis is within 5 degrees from the axis of the nail and shall be monitored with a reference system that is independent of the jacking system and excavation face.

The jack and pressure gauge shall be calibrated by an independent testing laboratory as a unit. The pressure gauge shall be graduated in 100 psi increments or less. The pressure gauge will be used to measure the applied load in addition to an electronic load cell. The ram travel of the jack shall not be less than the theoretical elastic elongation of the total length at the maximum test load plus 1 inch. The jack shall be independently supported and centered over the nail so that the nail does not carry the weight of the jack. A calibrated master pressure gauge shall also be kept at the site. The master gauge shall be calibrated with the test jack and pressure gauge. The loads on the nails during the verification and proof tests shall be monitored with an electric load cell. The Contractor shall provide the electric load cell, the readout device, and a recent calibration curve. The stressing equipment shall be placed over the nail in such a manner that the jack bearing plates, load cell and stressing anchorage are in alignment.

Nails to be tested shall be initially grouted no closer to the excavation face than the dimension shown in the Plans. After placing the grout, the nail shall remain undisturbed until the grout has reached a strength sufficient to provide resistance during testing. Grouting to the excavation face shall be completed after successful testing has been performed. Test nails which are not part of the permanent wall may be left in the ground, provided the drill holes for the nails are completely filled with grout or non structural filler after testing.

Load testing shall be performed against a temporary bearing yoke or reaction frame which bears directly against the existing soil or the shotcrete facing. Temporary bearing pads shall be kept a minimum of 12 inches from the edges of the drilled hole unless a rigid steel plate is used to distribute the stress around the drilled hole. If a steel plate is used, it shall be a minimum of 3 feet square and of sufficient thickness that it will distribute the load evenly to the soil. Where the reaction frame bears directly against the shotcrete, the reaction frame shall be designed to prevent fracture of the shotcrete. No part of the reaction frame shall bear within 12 inches of the edge of the test nail blockout unless otherwise approved by the Engineer.

Verification Testing

Verification testing shall be performed on nails installed within the pattern of production nails to verify the Contractor's procedures, hole diameter, and design assumptions. No drilling or installation of production nails will be permitted in any ground/rock unit unless successful verification testing of anchors in that unit has been completed and approved by the Engineer, using the same equipment, methods, nail inclination, nail length, and hole diameter as planned for the production nails. Changes in the drilling or installation method may require additional verification testing as determined by the Engineer and shall be done at the Contractor's expense. Verification tests can be performed prior to excavation for the soil nail wall.

Successful verification tests are required within the limits as listed in the following table. Test nail locations within these limits shall be at locations selected by the Engineer.

Verification Test Limits	Number of Successful Verification Test Required
Between _Sta. 1_+_006.0_and Sta. 1_+_022.6	2 test in top row

The design details of the verification testing, including the system for distributing test load pressures to the excavation surface and appropriate nail bar size and reaction plate, shall be developed by the Contractor, subject to approval by the Engineer. The intent is to stress the bond between the grout and the surrounding soil/rock to at least twice the design load transfer.

The bar shall be proportioned such that the maximum stress at 200 percent of the test load does not exceed 80 percent of the yield strength of the steel. The jack shall be positioned at the beginning of the test such that unloading and repositioning of the jack during the test will not be required. The verification tests shall be made by incrementally loading the nails in accordance with the following schedule of hold time:

AL	1 minute
0.25TL	10 minutes
0.50TL	10 minutes
0.75TL	10 minutes
1.00TL	10 minutes
1.25TL	10 minutes
1.50TL	60 minutes
1.75TL	10 minutes
2.00TL	10 minutes_

AL = Nail Alignment Load
TL = Nail Test Load

The test load shall be determined by the following equation = Test Load (TL) = Bond Length (BL) X Design Load Transfer (DLT).

The load shall be applied in increments of 25 percent of the test load. Each load increment shall be held for at least 10 minutes. Measurement of nail movement shall be obtained at each load increment. The load-hold period shall start as soon as the load is applied and the nail movement with respect to a fixed reference shall be measured and recorded at 1 minute, 2, 3, 5, 6, 10, 20, 30, 50, and 60 minutes.

The Engineer will evaluate the results of each verification test and make a determination of the suitability of the test and of the Contractor's proposed production nail design and installation system. Tests which fail to meet the design criteria will require additional verification testing or an approved revision to the Contractor's proposed production nail design and installation system. If a nail fails in creep, retesting will not be allowed.

A verification tested nail with a 60 minute load hold at 1.50TL is acceptable if:

1. The nail carries the test load with a creep rate that does not exceed 0.08 inch per log cycle of time and is at a linear or decreasing creep rate.

2. The total movement at the test load exceeds 80 percent of the theoretical elastic elongation of the non-bonded length.

Furthermore, a pullout failure must not occur for the verification test anchor at the 2.0TL maximum load. Pullout failure load is defined as the load at which attempts to increase the test load result only in continued pullout movement of the test nail without a sustainable increase in the test load.

The nails used for verification tests shall be sacrificial and shall not be used for production. The Contractor shall cut and remove the exposed end of all soil nails used for verification tests a minimum of two feet inside the finished groundline.

Proof Testing

Proof tests shall be performed on production nails at the locations selected by the Engineer. Up to five percent of the production nails will be tested. Prior to testing, only the bond length (BL) portion of the nail shall be grouted. The Contractor shall maintain the side-wall stability of the drill hole for the non-grouted portion during the test. Once proof testing is completed, the remainder of the proof tested nail shall be grouted. The bond length shall be determined from the Nail Schedule and Test Nail Detail shown in the Plans.

Proof tests shall be performed by incrementally loading the nail in accordance with the schedule below. The anchor movement shall be measured and recorded to the nearest 0.001 inch with respect to an independent fixed reference point in the same manner as for the verification tests at the alignment load and at each increment of load. The load shall be monitored with a pressure gauge and electronic load cell. The scheduling of hold times shall be as follows:

AL	1 minute
0.25TL	5 minutes
0.50TL	5 minutes
0.75TL	5 minutes
1.00TL	5 minutes
1.25TL	5 minutes
1.50TL	10 minutes

AL = Nail Alignment Load
TL = Nail Test Load

The maximum load in a proof test shall be held for 10 minutes. The load hold period shall start as soon as the maximum load is applied and the nail movement with respect to an independent fixed reference shall be measured and recorded at 1, 2, 3, 4, 5, 6, and 10 minutes. The nail movement between 1 minute and 10 minutes shall not exceed 0.04 inches. If the nail movement between 1 and 10 minutes exceeds 0.04 inches, the maximum load shall be held an additional 50 minutes. If the load hold is extended, the nail movement shall be recorded at 20, 30, 50, and 60 minutes. If a nail fails in creep, retesting will not be allowed.

A proof tested nail is acceptable if:

1. The nail carries the maximum load with less than 0.04 inches of movement between 1 minute and 10 minutes, unless the load hold extended to 60 minutes, in which case the nail would be acceptable if the creep rate does not exceed 0.08 inches per log cycle of time.

2. The total movement at the maximum load exceeded 80 percent of the theoretical elastic elongation of the non-bonded length.

3 The creep rate is not increasing with time during the load hold period.

Due to the requirement for a non-bonded zone for testing purposes, the Contractor shall develop an installation method which will assure the stability of the non-bonded portion of the hole during testing and will allow for the non bonded zone to be grouted against the ground after testing.

If a proof test fails, the Engineer may direct the Contractor to replace some or all of the installed production nails between the failed test and an adjacent proof test nail that has met the test criteria. The Engineer may also require additional proof testing. Costs associated with additional proof tests or installation of additional or modified nails shall be at the Contractor's expense.

Concrete Fascia Panels

The Contractor shall construct the concrete fascia panels in accordance with Section 6-02 and the details in the Plans. The Contractor shall provide the specified surface finish as noted, and to the limits shown, in the Plans to the exterior concrete surface. When noted in the Plans, the Contractor shall apply pigmented sealer to the limits shown in the Plans.

Tolerances

The accuracy of the ground cut shall be such that the required thickness of shotcrete can be placed within a tolerance of plus or minus 2 inches from the defined face of the wall, and overexcavation does not damage overlying shotcrete sections by undermining or other causes.

The shotcrete shall be constructed to the minimum thickness as shown in the Plans. Costs associated with additional thickness of shotcrete due to overexcavation or irregularities in the cut face shall be borne by the Contractor.

Asphalt Concrete or Cement Concrete Gutter

Asphalt concrete or cement concrete gutter shall be constructed as shown in the Plans and as specified in Section 8-04.

Measurement

Soil nails will be measured per each soil nail installed and accepted.

All excavation for the walls has been calculated in the quantity of roadway excavation including haul and select roadway excavation for stockpile including haul.

Shotcrete facing will be measured as specified in the Special Provision **SHOTCRETE**.

Prefabricated drainage material will be measured by the square yard of material furnished and installed.

Verification Testing will be measured per each for each soil nail tested.

Concrete fascia panel will be measured by the square foot of the front face of the completed and accepted panel to the dimensions shown in the Plans.

Asphalt concrete gutter and cement concrete gutter will be measured as specified in Section 8-04.4.

Payment

Payment will be made in accordance with Section 1-04.1 for each of the following bid items included in the proposal:

1. "Soil Nail-Epoxy-Coated", and "Soil Nail-Encapsulated", per each, including all drilling, grouting, centralizers, bearing plates, welded shear connectors, nuts, proof testing, and other work required for installation of each soil nail.
2. "Shotcrete Facing", per square foot, as specified in the Special Provision **SHOTCRETE**.
3. "Prefabricated Drainage Material", per square yard.
4. "Verification Test", per each.
5. "Concrete Fascia Panel", per square foot, including all steel reinforcing bars, exterior surface finish, and pigmented sealer (when specified).
6. "Asphalt Conc. Gutter" and "Cement Conc. Gutter", per linear foot, as specified in Section 8-04.5.

For the purpose of payment, such wall items as pressure treated timber, premolded joint filler, polyethylene bond breaker strip, joint sealant, pvc pipe etc., for which there is no pay item included in the proposal, are considered as wall minor items. All costs in connection with furnishing and installing these wall minor items as shown and noted in the Plans and as outlined in these specifications and in the Standard Specifications shall be included in the applicable adjacent items of work.

GEOSYNTHETIC CLAY LINER

Description

This work shall consist of furnishing and installing a geosynthetic clay liner (GCL) in accordance with the details shown in the Plans, these Specifications, or as directed by the Engineer.

MATERIALS

General

The GCL shall consist of a layer of natural sodium bentonite clay encapsulated between two nonwoven geotextiles and shall comply with all of the criteria listed in Table 1. All GCLs must be needle punched, and in accordance with manufacturers recommendations for installation on slopes.

GCL Properties

All properties provided in Table 1 are minimum average roll values. The average test results for any sampled roll in a lot shall meet or exceed the values shown in the table

Table 1: Minimum properties required for geosynthetic clay liner

Property	Test Method	Clay Liner Property Requirements
GCL Index Flux	ASTM D5887	1×10^{-8} $m^3/m^2/sec.$
Bentonite Mass/Area at 0 % moisture content	ASTM D 5993	3.6 kg/m^2
Thickness	ASTM D1777	5 mm
Bentonite Fluid Loss	ASTM D 5891	18 ml max.
Upper and Lower Geotextile Weight	ASTM D 3776	200 g/m^2

The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer

Cover for Geosynthetic Clay Liner

All cover materials used in the project shall conform to the requirements of Sections 9-03.9(1) (Ballast), and 9-03-13 (Backfill for sand drains).

SUBMITTALS

The Contractor shall submit to the Engineer prior to beginning construction detailed GCL installation plans and as a minimum the submittals shall include the following:

1. Detailed plans showing the actual lengths and locations of the geosynthetic clay liners.

2. The Contractor's proposed construction method, including seaming, GCL placement around penetrating structures, types of equipment to be used, and the proposed construction sequence.

Approval of the Contractor's proposed construction details and methods shall not relieve the Contractor of their responsibility to construct the liners in accordance with the requirements of these Specifications.

Contractor Qualifications

The GCL contractor/installer will submit a list of at least five previous projects completed demonstrating installation experience. The list will include a brief description of the project, the amount and type of GCL installed, and the owners name and phone number. GCL Installers must either have installed a minimum of 100,000 square meters of GCL or a similar geosynthetic.

QUALITY ASSURANCE

The GCL manufacturer shall provide the Engineer with manufacturers certification including supporting test data for each shipment of GCL. The certifications shall verify that the GCL is in conformance with the material properties shown in Table 1.

Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand, and product code).

2. Lot number and roll number.

3. Roll length, width and weight.

The Engineer has the right to randomly sample the manufacturing plant. Additional testing may be conducted at the discretion of the engineer. If any GCL does not conform to the physical requirements or if it is damaged in any way it may be rejected by the Engineer.

CONSTRUCTION REQUIREMENTS

Shipping and Handling

The manufacturer shall assume responsibility for initial loading and shipping of the GCL. Unloading, onsite storage and handling are the responsibility of the contractor.

The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

The GCL shall be shipped and handled so that premature hydration does not occur.

Storage

Storage of the GCL is the responsibility of the contractor. The onsite storage area should be away from high traffic, dry, level and free drained.

All GCL rolls and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

Earthwork

Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the project specifications and drawings. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction Debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes.
8. Standing water.
9. Cracks larger than 6 mm in width.
10. Any other foreign matter that could contact the GCL.

Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularities shall exist in the subgrade. Furthermore, all protrusions extending more than 12 mm from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

GCL Placement

GCL rolls should be delivered to the working area of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the manufacturers recommendations or as directed by the Engineer.

Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement. The rub sheet shall be removed after construction.

The GCL panels shall be placed parallel to the direction of the slope. All GCL panels shall lie flat on the underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present it shall be rejected.

Anchorage

As directed by the project drawings and specifications, the end of the GCL roll shall be placed in an anchor trench at the top of the slope or an equivalent runout design shall be utilized. When utilizing an anchor trench design, the front edge of the trench shall be rounded so as to eliminate any sharp corners. Loose soil will be removed from the floor of the trench. The GCL must cover the entire trench floor and reach the rear trench wall.

Seaming

The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required for reinforced GCL.

The minimum dimension of the longitudinal overlap shall be 150 mm. End-of-roll overlapped seams should be similarly constructed, but the minimum overlap should measure 300 mm.

Seams of the panels must be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

Bentonite-enhanced seams are constructed between the overlapping adjacent panels described above. The underlying edge of the longitudinal overlap is exposed and then a continuous bead of granular sodium bentonite is applied along a zone defined by the edge of the underlying panel and the 150 mm line. A similar bead of granular sodium bentonite is applied at the end-of-roll overlap. The granular bentonite shall be applied at a minimum application rate of 0.4 kg/m.

Detail Work

The GCL shall be sealed around penetrations and embedded structures in accordance with the design drawings and recommendations of the GCL Manufacturer.

Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

Damage Repair

If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be repaired at the discretion of the Engineer by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 300 mm is achieved around all of the damaged area. Granular bentonite or bentonite mastic will also be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

Cover Placement

GCL cover soils shall meet the WSDOT Standard Specifications for backfill for sand drains. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 300 mm of cover shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process. This thickness recommendation does not apply to frequently trafficked areas or roadways, for which a minimum thickness of 600 mm is required.

Soil cover must be placed in a manner that prevents the soil from entering the GCL overlap zones. Cover soil shall be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used to facilitate the installation of any geosynthetic material placed over the GCL. The GCL supplier or CQA engineer should be contacted with specific recommendations on the appropriate procedures in this situation.

MEASUREMENT

Geosynthetic Clay Liner will be measured by the square meter in place.

Backfill for sand drains including haul will be measured by the tonne.

Roadway Excavation will be measured by the cubic meter as specified in Section 2-03.4.
Ballast incl. haul will be measured by the tonne or cubic meter.

PAYMENT

The unit contract price per square meter for "Geosynthetic Clay Liner" shall be full pay to perform the work as specified.

The unit contract price for "Backfill for Sand Drains including haul" shall be full pay for furnishing, hauling, placing and leveling the backfill material.

"Roadway Excavation", as specified in section 2-03.5.

The unit contract price for "Ballast" shall be full pay for furnishing, hauling, placing and leveling the material.

APPENDIX C

BORING LOGS AND CORE PHOTOS

Washington State
Department of Transportation

Test Boring Legend

Sampler Symbols

	Standard Penetration Test
	Oversized Penetration Test (Dames & Moore, California)
	Shelby Tube
P	Piston Sample
	Washington Undisturbed
	Vane Shear Test
	Core
	Becker Hammer
B	Bag Sample

Well Symbols

	Cement Surface Seal
	Piezometer Pipe in Granular Bentonite Seal
	Piezometer Pipe in Sand
	Well Screen in Sand
	Granular Bentonite Bottom Seal
	Inclinometer Casing in Concrete Bentonite Grout

Laboratory Testing Codes

UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
UC	Unconfined Compression Test
DS	Direct Shear Test
CN	Consolidation Test
GS	Grain Size Distribution
MC	Moisture Content
SG	Specific Gravity
OR	Organic Content
DN	Density
AL	Atterberg Limits
PT	Point Load Compressive Test
SL	Slake Test
DG	Degradation
LA	LA Abrasion

Soil Density Modifiers

Gravel, Sand & Non-plastic Silt		Elastic Silts and Clay	
SPT Blows/ft	Density	SPT Blows/ft	Consistency
0-4	Very Loose	0-1	Very Soft
5-10	Loose	2-4	Soft
11-24	Medium Dense	5-8	Medium Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

Angularity of Gravel & Cobbles

Angular	Coarse particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Coarse graine particles are similar to angular but have rounded edges.
Subrounded	Coarse grained particles hav nearly plane sides but have well rounded corners and edges.
Rounded	Coarse grained particles have smoothly curved sides and no edges.

Soil Moisture Modifiers

Dry	Absence of moisture; dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water

Soil Structure

Stratified	Alternating layers of varying material or color at least 6mm thick; note thickness and inclination.
Laminated	Alternating layers of varying material or color less than 6mm thick; note thickness and inclination.
fissured	Breaks along definite planes of fracture with little resistance to fracturing..
Slickensided	Fracture planes appear polished or glossy, somtimes stiated.
Blocky	Cohesive soil that can be broken down into smaller angular lumps which resist further breakdown.
Disrupted	Soil Structure is broken and mixed. Infers that material has moved substantially - landslide debris.
Homogeneous	Same color and appearance throughout.

HCL Reaction

No HCL Reaction	No visible reaction.
Weak HCL Reaction	Some reaction with bubbles forming slowly.
Strong HCL Reaction	Violent reaction with bubbles forming imediately.

Degree of Vesicularity of Pyroclastic Rocks

Slightly Vesicular	5 to 10 percent of total
Moderately Vesicular	10 to 25 percent of total
Highly Vesicular	25 to 50 percent of total
Scoriaceous	Greater than 50 percent of total

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Washington State Department of Transportation

Test Boring Legend

Grain Size

Fine Grained	< 1mm	Few crystal Boundaries/grains are distinguishable in the field or with hand lense.
Medium Grained	1mm to 5mm	Most crystal Boundaries/grains are distinguishable with the aid of a hand lense.
Coarse Grained	> 5mm	Most crystal Boundaries/grains are distinguishable with the naked eye.

Weathered State

Term	Description	Grade
Fresh	No visible sign of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as core stone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	1 to 25 MPa
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket Knife. Geological hammer point indents deeply with firm blow.	25 to 50 MPa
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	50 to 100 MPa
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	100 to 200 MPa
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 200 MPa

Discontinuities

Spacing	
Very Widely	Greater than 3 m
Widely	1 m to 3 m
Moderately	0.3 m to 1 m
Closely	50 mm to 300 mm
Very Closely	Less than 50 mm

RQD (%)

$$\frac{100(\text{length of core in pieces} > 100\text{mm})}{\text{Length of core run}}$$

Condition	
Excellent	Very rough surfaces, no separation, hard discontinuity wall
Good	Slightly rough surfaces, separation less than 1 mm, hard discontinuity wall.
Fair	Slightly rough surfaces, separation greater than 1 mm, soft discontinuity wall.
Poor	Slickensided surfaces,or soft gouge less than 5 mm thick, or open discontinuities 1 to 5 mm.
Very Poor	Soft gouge greater than 5 mm thick, or open discontinuities greater than 5 mm.

Fracture Frequency (FF) is the average number of fractures per 300 mm of core.
Does not include mechanical breaks caused by drilling or handling.

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-99

PROJECT SE 192nd Avenue Interchange — Job No. OL-2530

SW Region — S.R. 14

Station 16+272 — Offset 18m Lt. — C.S. 0604

Equipment CME 850 w/ autohammer — Casing HQ x 100' — Ground El 139.1 (42.41 m)

Method of Boring Wet Rotary

Start Date June 29, 1999 — Completion Date July 2, 1999 — Sheet 1 of 5

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 81 FF 5		C-1		BASALT, fine grained, slightly weathered, very strong rock, no HCl reaction. Discontinuities are closely spaced and in poor condition, vesicles are infilled, upper 1.5' of sample is more fractured and weathered., Percent Recovered 70.0%		
	1									
5				RQD 82 FF 2		C-2		Slightly Vesicular BASALT, fine grained, slightly weathered, very strong rock, no HCl reaction. Discontinuities are closely spaced and in good condition, Aphanitic, Percent Recovered 100.0%		
	2								▼ 06/30/1999	
10	3			RQD 10 FF 10		C-3		Slightly Vesicular BASALT, fine grained, moderately weathered, strong rock, no HCl reaction. Discontinuities are closely spaced and in very poor condition, 12-13.5' is highly weathered and very weak rock, 13.5 to 15' is moderately weathered and moderately weak rock, Percent Recovered 100.0%		
	4									
15	5			RQD 0 FF 10		C-4		Moderately Vesicular BASALT, fine grained, highly weathered, moderately weak rock, no HCl reaction. Discontinuities are closely spaced and in very poor condition, aphanitic, Percent Recovered 100.0%		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-99**

Sheet **2** of **5**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 19 FF 10		C-5		Moderately Vesicular BASALT, fine grained, highly weathered, moderately strong rock, no HCl reaction. Discontinuities are closely spaced and in poor condition, aphanitic; Percent Recovered 70.0%		
	7									
25				RQD 0 FF 20		C-6		Slightly Vesicular BASALT, fine grained, highly weathered, moderately weak rock, no HCl reaction. Discontinuities are closely spaced and in very poor condition, aphanitic, Percent Recovered 0.8% 07/01/1999	▽	
	8									
	9									
30				RQD 18 FF 5		C-7		Slightly Vesicular BASALT, fine grained, moderately weathered, moderately strong rock, no HCl reaction. Discontinuities are closely spaced and in very poor condition, aphanitic, encountered Trout dale Formation at 34.5', Percent Recovered 100.0%		
	10									
35						C-8		TROUT DALE FORMATION Well graded GRAVEL with sand and silt, cobbles up to 6.5", subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 5.0 ft, Length Retained 5.0 ft		
	11									
	12									
40			◆	50/3" (50/3")		D-9 C-10		Well graded GRAVEL with sand, subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 0.2 ft, Length Retained 0.2 ft Well graded GRAVEL with sand and silt, cobbles up to 6.5", subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction Percent Recovered 100.0%		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-99**

Sheet **3** of **5**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14					C-11		Well graded GRAVEL with sand and silt, cobbles, subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction, conglomerate like but not cemented well enough, Silty SAND encountered at 47.5' Length Recovered 2.3 ft, Length Retained 2.3 ft		
	15									
50						C-12		No Recovery 100% water loss		
	16									
55	17		>>	18 16 50 85 (66)		D-13		Slightly Vesicular BASALT, very dense, light olive brown, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft		
						C-14		Silty SAND, very dense, light olive brown, moist, Homogeneous, no HCl reaction Percent Recovered 100.0%		
	18									
60			>>	15 25 33 (58)		D-15		Silty SAND, very dense, light olive brown, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.0 ft		
	19					C-16		Silty SAND, very dense, light olive brown, moist, Homogeneous, no HCl reaction Percent Recovered 100.0%		
65	20		>>	12 23 29 (52)		D-17	GS MC	SM, MC=30% Silty SAND, very dense, light olive brown, moist, Homogeneous, no HCl reaction, 100% water loss Length Recovered 1.5 ft, Length Retained 1.0 ft		
						C-18		Silty SAND, very dense, light olive brown, moist, Homogeneous, no HCl reaction Percent Recovered 100.0%		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-99**

Sheet **4** of **5**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				12 21 27 (48)		D-19		Silty SAND, dense, light olive brown, wet, Homogeneous, no HCl reaction, 100% water loss Length Recovered 1.5 ft, Length Retained 1.0 ft		
	22					C-20		Silty SAND, dense, light olive brown, wet, Homogeneous, no HCl reaction, 100% water loss Percent Recovered 100.0%		
75	23			12 21 25 (46)		D-21		Silty SAND, dense, light olive brown, wet, Homogeneous, no HCl reaction, 100% water loss Length Recovered 1.5 ft, Length Retained 1.0 ft		
						C-23		Silty SAND, dense, light olive brown, wet, Homogeneous, no HCl reaction, 100% water loss Percent Recovered 100.0%		
	24									
80				50/1" (50/1")		D-23 C-24		TROUT DALE FORMATION No Recovery Poorly graded GRAVEL with sand, cobbles, subrounded, very dense, grayish brown, wet, Homogeneous, no HCl reaction Percent Recovered 100.0%		
	25									
85	26					C-25		Poorly graded GRAVEL with sand and silt, cobbles, subrounded, very dense, grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 5.0 ft, Length Retained 5.0 ft		
	27									
90						C-26		Poorly graded GRAVEL with sand and silt, cobbles, subrounded, very dense, grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 5.0 ft, Length Retained 5.0 ft		
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-99**

Sheet **5** of **5**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	29					C-27		Poorly graded GRAVEL with sand and silt, cobbles, subrounded, very dense, grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 5.0 ft, Length Retained 5.0 ft		
	30									
100								End of test hole boring at 100 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	31									
105	32									
	33									
110										
	34									
115	35									
	36									
120										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1A-98

PROJECT SE 192nd Avenue Interchange

Job No. OL-2530

S.R. 14

Station 16+22~~0~~

Offset ~~2~~2m Lt.

C.S. 0604

Equipment CME850

Casing HQ 30'

Ground El 141.6 (43.17 m)

Method of Boring WET ROTARY

Start Date

Completion Date November 4, 1998

Sheet 1 of 2

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 47% FPF 5		C-1		BASALT, dark gray, very fine grained, fresh, very strong rock, discontinuities closely to moderately spaced, in good condition. Some joints have very light clay infilling. CR=95%		
	1									
5				RQD 37% FPF 6		C-2		BASALT, dark gray, very fine grained, fresh, very strong rock, discontinuities closely to moderately spaced, in fair condition. Clay infilling in joints. CR=98%		
	2									
10	3			RQD 0% FPF 8+		C-3		BASALT, slightly vesicular, dark gray, very fine grained, highly weathered, discontinuities closely spaced, in poor condition. Clay infilling. CR=73%		
	4									
15				RQD 0% FPF 8+		C-4		BASALT, slightly vesicular, dark gray, very fine grained, highly weathered, discontinuities closely spaced, in poor condition. Clay infilling. CR=98%		
	5									
	6									
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1A-98**

Sheet 2 of 2

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 0% FPF 4		C-5		BASALT, slightly vesicular, dark gray, very fine grained, slightly weathered, discontinuities closely spaced, in poor condition. Clay infilling CR = 98% Some joints clean.		
	7									
25				RQD 18% FPF 3		C-6		BASALT, slightly vesicular, dark gray, very fine grained, highly weathered, discontinuities closely spaced, in poor condition. Clay infilling. CR = 98%		
	8									
	9									
30								End of Test Hole Boring at 30 feet below ground elevation. No water table was determined during drilling. This is a summary log of Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	10									
35										
	11									
	12									
40										
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2A-98

PROJECT SE 192nd Avenue Interchange

Job No. OL-2530

S.R. 14

Station 16+227

Offset 33m Rt.

C.S. 0604

Equipment CME850

Casing

Ground El 139.1 (42.41 m)

Method of Boring WET ROTARY

Start Date November 3, 1998

Completion Date November 3, 1998

Sheet 1 of 2

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 0% FPF 8+		C-1		BASALT, very slightly vesicular, dark gray, very fine grained, slightly weathered, very strong rock, discontinuities closely spaced, in poor condition. Some infilled with clay. CR=88%		
	1									
5				RQD 0% FPF 8+		C-2		BASALT, very slightly vesicular, dark gray, very fine grained, weathered, discontinuities closely spaced, in poor condition. Some infilled with clay. CR=87% Large clay seam from approximately 5.5' to 7.5' vertical		
	2									
10	3			RQD 0% FPF 6+		C-3		BASALT, slightly vesicular, dark gray, very fine grained, slightly weathered, discontinuities closely spaced, in poor condition. Some joints infilled with clay. CR=90%		
	4									
15				RQD 0% FPF 6+		C-4		BASALT, slightly vesicular, dark gray, very fine grained, slightly weathered, discontinuities closely spaced, in poor condition. Some joints infilled with clay. CR=93%		
	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2A-98

Sheet 2 of 2

PROJECT SE 192nd Avenue Interchange

Job No. OL-2530

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 6% FPF 3+		C-5		BASALT, slightly vesicular, dark gray, very fine grained, slightly weathered, very strong rock, discontinuities closely spaced, in poor condition. Some joints infilled with clay. CR = 87% Some fractures vertical.		
	7									
25				RQD 33% FPF 3		C-6		BASALT, slightly vesicular, dark gray, very fine grained, highly weathered, very strong rock, discontinuities closely spaced, in poor condition. Some joints infilled with clay. CR = 98%		
	8									
	9									
30				RQD 0% FPF 8+		C-7		BASALT, slightly vesicular, dark gray, very fine grained, highly weathered, very strong rock, discontinuities closely spaced, in poor condition. Some joints infilled with clay, turning to sand at approximately 34.5' to 35' CR = 80%		
	10									
35				RQD 0% FPF 0		C-8		Slightly vesicular, dark gray, very fine grained, weathered, very strong rock, discontinuities closely spaced, in poor condition. Some joints infilled with flood deposits of sand and gravel. CR = 72%		
	11									
	12									
40								End of Test Hole Boring at 40 feet below ground elevation. No water table was determined during drilling. This is a summary log of Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **16+312** Offset **62m Rt (12m Rt of cl SR14)** C.S. **0604**

Equipment **CME 55 w/ autohammer** Casing **(HW x 12.0)(HQ x 25.0)** Ground El **128.0 (39.00 m)**

Method of Boring **Wet Rotary**

Start Date **August 16, 1999** Completion Date **August 16, 1999** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
				9 9 12 6 (21)		D-1		GW-GM, MC=9% Well graded GRAVEL with silt and sand, angular, medium dense, brown, moist, Homogeneous, no HCl reaction. (100% drilling fluid recovery). Length Recovered 0.8 ft, Length Retained 0.8 ft		
5	1			2 4 5 3 (9)		D-2		Well graded GRAVEL with silt and sand, angular, loose, brownish gray, moist, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 0.3 ft, Length Retained 0.3 ft		
	2									
				5 3 6 2 (9)		D-3		Well graded GRAVEL with silt and sand, angular, loose, moderate brown, moist, Homogeneous, no HCl reaction, Changed at 8.0' to silty GRAVEL with sand. (100% drilling fluid recovery). Length Recovered 0.4 ft, Length Retained 0.4 ft		
10	3			5 6 14 21 (20)		D-4		Well graded GRAVEL with silt and sand, angular, medium dense, brownish gray, moist, Homogeneous, no HCl reaction, (100% drilling fluid loss starting at 8.0'). Length Recovered 0.4 ft, Length Retained 0.4 ft		
				50/4 (50/4") RQD 43 FF 20		D-5 C-6		No Recovery BASALT, fine grained, slightly weathered, very strong rock, no HCl reaction. Discontinuities are closely spaced *and in good condition*, (100% drilling fluid loss in upper soil formation). Percent Recovered 66.0%		
15	4									
	5			50/1 (50/1") RQD 62 FF 2		D-7 C-8		No Recovery BASALT, fine grained, slightly weathered, very strong rock, no HCl reaction. Discontinuities are closely spaced and in good condition. Percent Recovered 100.0%		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-99**

Sheet **2** of **2**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								End of test hole boring at 21 ft below ground elevation.		
	7							No water table determined during drilling.		
25								This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	8									
	9									
30										
	10									
35										
	11									
	12									
40										
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **16+474** Offset **51m Rt (13m Rt of cl SR14)** C.S. **0604**

Equipment **CME 55 w/ autohammer** Casing **(HW x 6.0)(35.0)** Ground El **128.0 (39.00 m)**

Method of Boring **Wet Rotary**

Start Date **August 16, 1999** Completion Date **August 16, 1999** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m. Asphalt. Silty GRAVEL with sand (fill).		
	1			7 8 17 15 (25)		D-1	GS MC	SM, MC=15% Silty SAND with gravel, dense, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.8 ft, Length Retained 1.0 ft		
5			>>	3 27 50/2" (77)		D-2		Silty SAND with gravel, very dense, brown, moist, Homogeneous, no HCl reaction, Note changed over to HQ coring at 6.0' (100% drilling fluid loss starting at 4.0'). Length Recovered 0.4 ft, Length Retained 0.4 ft		
	2					C-3		Clayey GRAVEL with sand, cobbles and boulders, angular, dense, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid loss). Length Recovered 2.3 ft, Length Retained 2.3 ft		
10	3			9 10 29 7 (39)		D-4		Clayey GRAVEL with sand, cobbles and boulders, angular, dense, brown, moist, Homogeneous, no HCl reaction. Length Recovered 0.4 ft, Length Retained 0.4 ft		
	4					C-5		Clayey GRAVEL with sand, cobbles and boulders, angular, dense, brown, moist, Homogeneous, no HCl reaction (100% drilling fluid recovery). Length Recovered 2.5 ft, Length Retained 2.5 ft		
15	5			5 31 14 7 (45)		D-6	GS MC	ML, MC=25% Sandy SILT, cobbles and boulders, dense, brown, moist, Homogeneous, no HCl reaction (100% drilling fluid loss). Length Recovered 0.5 ft, Length Retained 0.5 ft		
	6					C-7		Silty GRAVEL, cobbles and boulders, angular, very dense, gray, moist, Homogeneous, no HCl reaction, (100% drilling fluid loss). Length Recovered 2.5 ft, Length Retained 2.5 ft		
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-99**

Sheet **2** of **2**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				50/3 (50/3") RQD 45 FF 5		D-8 C-9		Silty GRAVEL, cobbles and boulders, angular, very dense, gray, moist, Homogeneous, no HCl reaction, (100% drilling fluid loss). Length Recovered 0.2 ft, Length Retained 0.2 ft BASALT, fine grained, slightly weathered, very strong rock, no HCl reaction. Discontinuities are closely spaced and in good condition, (100% drilling fluid loss in upper soil formation). Percent Recovered 100.0%		
25	7									
	8			RQD 77 FF 1		C-10		BASALT, fine grained, slightly weathered, very strong rock, no HCl reaction. Discontinuities are closely spaced and in good condition. Percent Recovered 100.0%		
30	9									
								End of test hole boring at 31 ft below ground elevation. (Dry hole). 8/16/99.		
	10							No water table determined during drilling.		
								This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
35	11									
40	12									
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **15+227** Offset **6m Lt.** C.S. **0604**

Equipment **CME 850 w/ autohammer** Casing **HW X 17.0** Ground El **190.3 (58.00 m)**

Method of Boring **Wet Rotary**

Start Date **June 22, 1999** Completion Date **June 22, 1999** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m. 0.0-0.2ft Asphalt 0.2-0.5ft Subgrade		
5	1			3 14 12 (26)		D-1		SM, M.C.= 25% Silty SAND with organics, dense, moderate brown, moist, homogeneous, no HCl reaction. Recovered 0.9 ft, Retained 0.9 ft		
10	2			2 2 4 (6)		D-2		Silty SAND, loose, gray, moist, homogeneous, no HCl reaction. Recovered 0.5 ft, Retained 0.5 ft		
15	3			13 26 2 (28)		D-3		Well graded GRAVEL, dense, gray, moist, homogeneous, no HCl reaction. Note encountered 1.3' boulder from 13.0' to 14.3'. Recovered 0.2 ft, Retained 0.2 ft		
	4					C-4		GRAVEL with cobbles to 8" in size. Recovered 100%		
20	5									
	6									

LOG OF TEST BORING

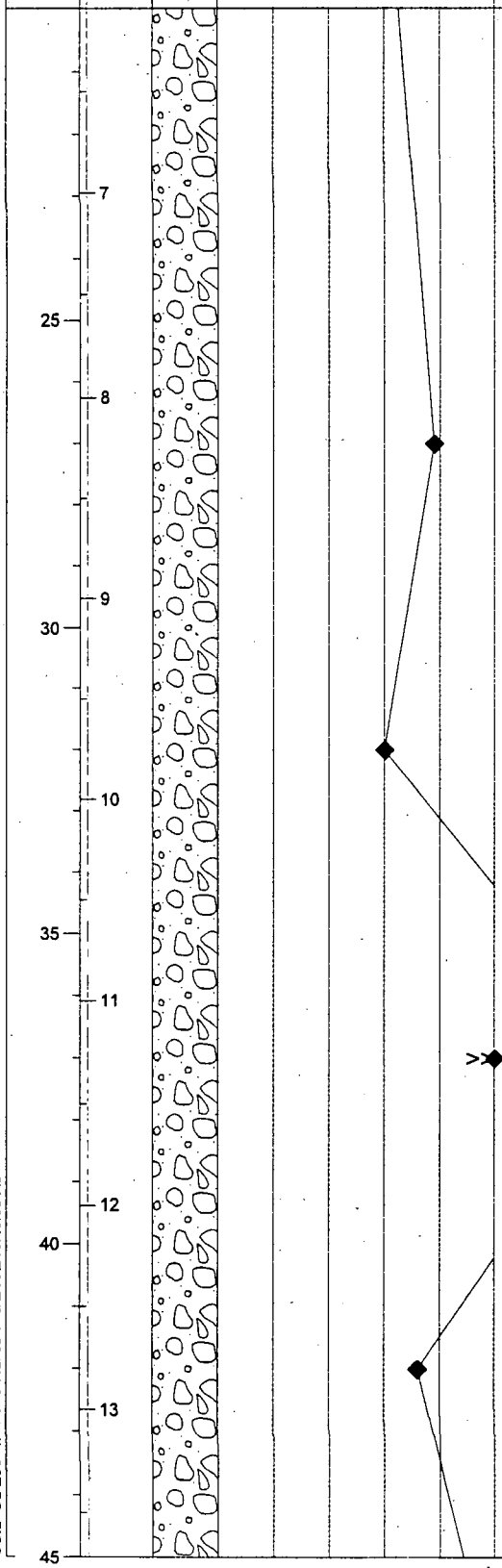
Washington State Department of Transportation

HOLE No. **H-4-99**

Sheet **2** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**



SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		C-5		GRAVEL with cobbles up to 10" with silty sand matrix, dense. Recovered 90%		
27 19 20 (39)		D-6		Silty SAND with gravel, dense, dark yellowish orange, moist, homogeneous, no hcl reaction. Recovered 1.5 ft, Retained 1.5 ft		
		C-7		GRAVEL, dark yellowish orange, moist, homogeneous, no hcl reaction, very weak structure Recovered 23%		
11 16 14 (30)		D-8		Silty SAND with gravel, dense, dark yellowish orange, completely weathered, very weak rock, no HCl reaction. Recovered 1.5 ft, Retained 1.5 ft		
		C-9		GRAVEL, dark gray, no HCl reaction. Recovered 11%		
>9 25 50/1" (75)		D-10		Silty SAND with gravel, very dense, dark yellowish orange, moist, highly weathered, homogeneous, no HCl reaction. Recovered 1.0 ft, Retained 1.0 ft		
		C-11		GRAVEL, 6" boulder angular, dark gray, no HCl reaction. Recovered 23%		
15 19 17 (36)		D-12		GRAVEL with boulders up to 6", angular, dense, moderate brown, moist, homogeneous, no HCl reaction, (Note blocked off at 46.0'). Recovered 0.5 ft, Retained 0.5 ft		
		C-13		GRAVEL with boulders up to 1.0', subrounded, moderate brown, moist, homogeneous, no HCl reaction. Recovered 3.5 ft, Retained 3.5 ft		

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-99**

Sheet **3** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			50/6 (50/6")		D-14		GRAVEL, very dense, dark yellowish orange, moist, no HCl reaction, Changed at 47.0'. Recovered 0.3 ft, Retained 0.3 ft		
						C-15		GRAVEL with boulders up to 1.0', subrounded, dark yellowish orange, moist, no HCl reaction, (100% drilling fluid loss). Recovered 4.0 ft, Retained 4.0 ft		
	15									
50										
	16		>>	40 38 30 (68)		D-16		GM-GW, M.C.=13% Well graded GRAVEL with silt and sand, angular, very dense, dark yellowish orange, moist, no HCl reaction. Recovered 0.7 ft, Retained 0.7 ft		
						C-17		GRAVEL with boulders, angular, dark yellowish orange, moist, no HCl reaction. Recovered 2.0 ft, Retained 2.0 ft		
55										
	17			38 25 23 (48)		D-18		Well graded GRAVEL with silt and sand, angular, dense, moderate brown, moist, no HCl reaction, . Recovered 0.8 ft, Retained 0.8 ft		
	18					C-19		GRAVEL with boulders, angular, brown, moist, no HCl reaction. Recovered 3.0 ft, Retained 3.0 ft		
60										
	19		>>	17 25 37 (62)		D-20		Well-graded GRAVEL with silt and sand, angular, very dense, moderate brown, moist, no HCl reaction. Recovered 0.6 ft, Retained 0.6 ft		
65								End of test hole boring at 63.5 ft below ground elevation. No water table determined during drilling.		
	20							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **15+212** Offset **7m Lt.** C.S. **0604**

Equipment **BK-81 w/ autohammer** Casing **HWX15 HQX75** Ground El **190.3 (58.00 m)**

Method of Boring **Wet Rotary**

Start Date **June 21, 1999** Completion Date **June 24, 1999** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
	1			1 1 1 (2)		D-1		SM, M.C.=23% Silty SAND, very loose, olive brown, moist, Homogeneous, no HCl reaction Recovered 1.5 ft, Retained 1.5 ft		
5						C-2		Well graded SAND with gravel and basalt cobbles up to 6" in size, no HCl reaction. Recovered 33.0%		
	2									
10	3			3 4 5 (9)		D-3		Well graded SAND and gravel, loose, olive brown, moist, homogeneous, no HCl reaction Recovered 1.5 ft, Retained 1.5 ft		
						C-4		Well graded SAND and gravel with basalt cobbles up to 6" in size. Recovered 25.0%		
	4							CONGLOMERATE		
15				50/5" (50/5")		D-5 C-6		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 0.5 ft, Retained 0.5 ft CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 80.0%		
	5									
						C-7		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 80.0%		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-99**

Sheet **2** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				28 50/5" (50/5")		D-8		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 1.0 ft, Retained 1.0 ft		
						C-9		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 75.0%		
	7									
25				12 14 16 (30)		D-10		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 1.5 ft, Retained 1.5 ft		
	8					C-11		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 80.0%	▽ 6/23/99	
	9									
30				6 8 7 (15)		D-12		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 1.5 ft, Retained 1.5 ft		
						C-13		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 80.0%		
	10									
35			>>	32 50/4" (50/4")		D-14		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 1.0 ft, Retained 1.0 ft		
	11					C-15		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 80.0%		
	12									
40						C-16		CONGLOMERATE consisting of well graded sand and gravel, highly weathered, very dense, gray, no HCl reaction. Recovered 75.0%		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-99**

Sheet **3** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14					C-17		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 100.0%		
	15									
50						C-18		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 100.0%		
	16									
55						C-19		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 100.0%		
	17									
	18									
60						C-20		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 100.0%		
	19									
65						C-21		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 100.0%		
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-99**

Sheet **4** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	22					C-22		CONGLOMERATE consisting of well graded sand and gravel , highly weathered, very dense, gray, no HCl reaction. Recovered 100.0%		
75	23							End of test hole boring at 75 ft below ground elevation.		
								Water table not determined during drilling.		
	24							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
80										
	25									
85	26									
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **16+599** Offset **42m Rt (11m Rt of cl SR14)** C.S. **0604**

Equipment **CME 55 w/ autohammer** Casing **(HW x 17.0)(HQ x 27.0)** Ground El **128.0 (39.00 m)**

Method of Boring **Wet Rotary**

Start Date **August 17, 1999** Completion Date **August 17, 1999** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
								Asphalt		
								Basalt		
								Silty GRAVEL with sand		
				8 8 6 5 (14)		D-1		Silty SAND with gravel, medium dense, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 1.0 ft, Length Retained 1.0 ft		
5	1			8 5 3 8 (8)		D-2		Silty SAND with gravel, loose, brown, moist, Homogeneous, no HCl reaction, Note started losing 100% drilling fluid at 4.0'. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	2			1 4 6 2 (10)		D-3		Silty SAND with gravel, Cobbles and boulders, loose, brown, moist, Homogeneous, no HCl reaction, Fill material. (100% drilling fluid recovery). Length Recovered 0.4 ft, Length Retained 0.4 ft		
10	3			2 11 10 4 (21)		D-4		SW-SM, MC=20% Well graded SAND with silt and gravel, medium dense, dark reddish brown, moist, Stratified, no HCl reaction, (fill) 100% drilling fluid loss. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	4			5 26 18 8 (44)		D-5		SM, MC=28% Silty SAND with gravel, cobbles and boulders, dense, brown, moist, Homogeneous, no HCl reaction, (Note tried SPT at 15.0' sampler bouncing on rock no recovery). Switched over HQ coring at 15.0'. Length Recovered 1.0 ft, Length Retained 1.0 ft		
15	5					C-6		Silty GRAVEL with sand, cobbles and boulders, angular, very dense, gray, moist, no HCl reaction, (Fill) 100% drilling fluid loss in upper soil strata. Length Recovered 4.0 ft, Length Retained 4.0 ft		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-99**

Sheet **2** of **2**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	7					C-7		Well graded GRAVEL, cobbles, boulders, angular, very dense, gray, moist, no HCl reaction, From 23.5' to 25.0' old road bed 0.2' of asphalt, 0.6' of concrete stratified with well graded gravel, angular. (100% drilling fluid loss in upper soil strata). Length Recovered 3.0 ft, Length Retained 3.0 ft		
25	8							End of test hole boring at 25 ft below ground elevation. (Dry hole), 8/17/99. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
30	9									
	10									
35	11									
40	12									
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-7-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **16+700** Offset **8m Lt (8m Rt cl Brady Rd)** C.S. **0604**

Equipment **CME 55 w/ autohammer** Casing **(HW x 22.0)(HQ x 45.0)** Ground El **158.1 (48.20 m)**

Method of Boring **Wet Rotary**

Start Date **August 3, 1999** Completion Date **August 3, 1999** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				3 3 4 2 (7)		D-1		Well graded GRAVEL with sand, angular, loose, brown, dry, Homogeneous, no HCl reaction. Length Recovered 0.4 ft, Length Retained 0.4 ft		
	1			2 4 4 4 (8)		D-2		Well graded GRAVEL with sand, angular, loose, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 0.8 ft, Length Retained 0.8 ft		
5				2 1 7 6 (8)		D-3		Silty SAND with gravel, loose, brown, moist, Homogeneous, no HCl reaction, sand is fine grained with some coarser grains. (100% drilling fluid recovery). Length Recovered 0.8 ft, Length Retained 0.8 ft		
	2			1 2 4 4 (6)		D-4	GS MC	SM, MC=22% Silty SAND, loose, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.0 ft, Length Retained 1.0 ft		
10	3			3 6 2 1 (8)		D-5		Well graded GRAVEL with sand, angular, loose, brown, moist, Homogeneous, no HCl reaction, Note started losing 100% drilling fluid at 9.0'. Length Recovered 0.3 ft, Length Retained 0.3 ft		
	4			2 4 4 5 (8)		D-6	GS MC	SP-SM, MC=20% Poorly graded SAND with silt, laminated with thin seams of dark reddish brown oxidized stains, traces of mica, loose, brown, moist, no HCl reaction, (100% drilling fluid loss). Length Recovered 1.0 ft, Length Retained 1.0 ft		
15				3 3 3 4 (6)		D-7		Poorly graded SAND, loose, brown, moist, Homogeneous, no HCl reaction, Note started getting 100% drilling fluid back at 16.0'. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	5			3 4 7 15 (11)		D-8a D-8b		Well graded GRAVEL with silt and sand, stratified with 1.0' of fine grained sand with gravel, angular, loose, brown, moist, no HCl reaction, (Split samples D-8a and D-8b). (100% drilling fluid loss). Length Recovered 2.0 ft, Length Retained 2.0 ft		
20	6			28 50/5"		D-9	GS MC	GW-GM, MC=18% Well graded GRAVEL with silt and sand, angular, very		

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-7-99**

Sheet **2** of **2**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				(50/5")				dense, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid loss). Length Recovered 0.9 ft, Length Retained 0.9 ft		
				50/3 (50/3")		D-10 C-11		Well graded GRAVEL with sand cemented together with a silty clay matrix, slightly weathered, gravel are subrounded, very dense, brown, moist, Homogeneous, no HCl reaction. Length Recovered 0.3 ft, Length Retained 0.3 ft		
	7							Well graded GRAVEL with sand, subangular, very dense, brown, moist, no HCl reaction, (98% drilling fluid recovery). Length Recovered 4.0 ft, Length Retained 4.0 ft		
25						C-12		Well graded GRAVEL with sand, subrounded, very dense, brown, moist, no HCl reaction, (Note checked water table after 15 minutes hole depth 30.0' water table in casing=18.0'). Length Recovered 4.0 ft, Length Retained 4.0 ft		
	8									
	9									
30						C-13		Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, gray, wet, Homogeneous, no HCl reaction, Moist of fines washed away. (Approximately 95 to 98% drilling fluid recovery). Length Recovered 4.0 ft, Length Retained 4.0 ft		
	10									
35						C-14		Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, gray, wet, Homogeneous, no HCl reaction, Length Recovered 1.7 ft, Length Retained 1.7 ft		
	11									
	12								▽	
40								End of test hole boring at 40 ft below ground elevation.		
	13							Water table after bailing out hole to 39.0' and monitoring water in hole every 3 minutes for 15 minutes stabilized at 39.0'. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-8-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **1+600** Offset **13m Rt (6m Rt cl Brady Rd)** C.S. **0604**

Equipment **CME 55 w/ autohammer** Casing **(HW x 42.0)(HQ x 97.0)** Ground El **164.0 (50.00 m)**

Method of Boring **Wet Rotary**

Start Date **July 27, 1999** Completion Date **July 28, 1999** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
				1 3 5 8 (8)		D-1		Sandy SILT, loose, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.3 ft, Length Retained 1.0 ft		
	1			4 4 6 6 (10)		D-2		Silty SAND, loose, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 1.5 ft, Length Retained 1.0 ft		
5										
	2			3 5 5 5 (10)		D-3	GS MC	SP-SM, MC=18% Poorly graded SAND with silt, loose, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.8 ft, Length Retained 1.0 ft		
				4 5 5 6 (10)		D-4	GS MC	SP-SM, MC=12% Poorly graded SAND with silt, loose, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 1.6 ft, Length Retained 1.0 ft		
10	3									
				4 5 7 8 (12)		D-5		Well graded SAND, loose, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.8 ft, Length Retained 1.0 ft		
	4			6 7 8 9 (15)		D-6		Poorly graded SAND, medium dense, dark brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.0 ft		
15										
	5			5 8 10 11 (18)		D-7	GS MC	SP-SM, MC=11% Poorly graded SAND with silt, medium dense, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.5 ft, Length Retained 1.0 ft		
				7 10 11 11 (21)		D-8		Poorly graded SAND, medium dense, brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.4 ft, Length Retained 1.0 ft		
	6									
20										

LOG OF TEST BORING

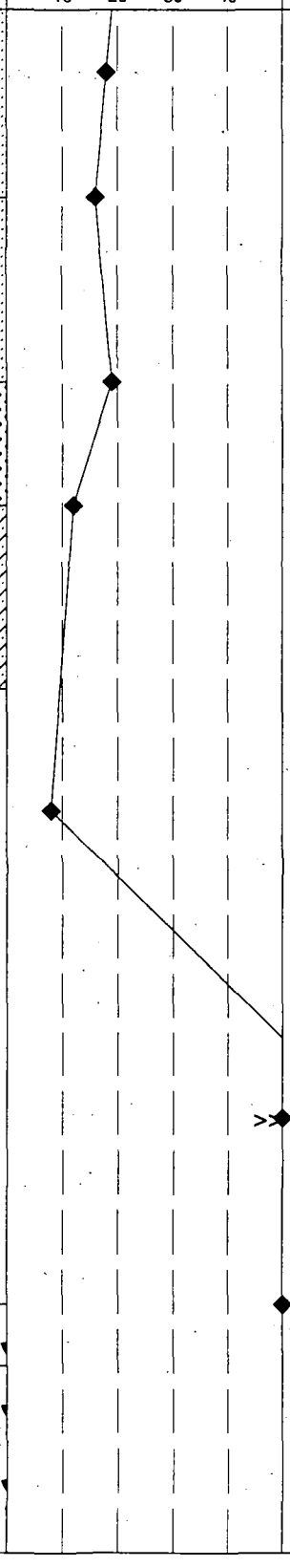
Washington State Department of Transportation

HOLE No. **H-8-99**

Sheet **2** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		6 9 9 10 (18)		D-9a D-9b		Poorly graded SAND, medium dense, dark brown, moist, Stratified, no HCl reaction, D-9b silty SAND. (100% drilling fluid recovery). Length Recovered 2.0 ft, Length Retained 2.0 ft		
7		7 8 8 10 (16)		D-10	GS MC	SM, MC=16% Silty SAND, medium dense, dark brown, moist, Homogeneous, no HCl reaction, traces of mica. Length Recovered 1.2 ft, Length Retained 1.2 ft		
25								
8		8 9 10 10 (19)		D-11	GS MC	SW, MC=16% Well graded SAND with gravel, medium dense, dark brown, moist, Stratified, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 2.0 ft, Length Retained 1.5 ft		
9		4 6 6 7 (12)		D-12	GS MC PI	SC, MC=34%, PI=15 Clayey SAND, loose, dark reddish brown, moist, Homogeneous, no HCl reaction, Changed at 28.0' to Elastic SILT laminated with silty SAND. (100% drilling fluid recovery). Length Recovered 2.0 ft, Length Retained 1.0 ft		
30								
				S-13		Elastic SILT, loose, dark reddish brown, moist, Homogeneous, no HCl reaction, Elastic SILT (100 PSI to push shelby tube 2.0'. Length Recovered 2.0 ft, Length Retained 2.0 ft		
10		3 3 5 5 (8)		D-14		Elastic SILT, loose, dark reddish brown, moist, Homogeneous, no HCl reaction, grayish purple and brown orange oxidized stains. (100% drilling fluid recovery). Length Recovered 2.0 ft, Length Retained 1.5 ft		
35								
11				U-15 A B C D		Sandy Elastic SILT with gravel, very dense, pale yellowish brown, moist, Homogeneous, no HCl reaction. Length Recovered 1.4 ft, Length Retained 1.4 ft		
		>> 9 65/6" (65/6")		D-16		Gravelly Elastic SILT with sand, very dense, dark yellowish brown, moist, no HCl reaction, (100% drilling fluid recovery). Length Recovered 1.0 ft, Length Retained 1.0 ft		
12								
40								
		26 50/5" (50/5")		D-17 C-18	GS MC	GP-GM, MC=15% Poorly graded GRAVEL with sand, subrounded, very dense, medium dark gray, moist, Laminated, Fissured, no HCl reaction, laminated with dark reddish brown oxidized stains. (100% drilling fluid recovery). Length Recovered 0.8 ft, Length Retained 0.8 ft Silty GRAVEL with sand and cobbles and boulders, subrounded, very dense, light brown, wet, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 2.3 ft, Length Retained 2.3 ft		
13								
45								

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-8-99**

Sheet **3** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14									
				>> 52/6" (52/6")		D-19 C-20		Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, light brown, wet, Homogeneous, no HCl reaction. Length Recovered 0.5 ft, Length Retained 0.5 ft		
	15							Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction. (100% drilling fluid recovery). Length Recovered 4.0 ft, Length Retained 4.0 ft	▽	
50										
	16			50/2" (50/2")		D-21 C-22		Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction. Length Recovered 0.2 ft, Length Retained 0.2 ft Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction. Length Recovered 3.5 ft, Length Retained 3.5 ft		
55										
	17			50/2" (50/2")		D-23 C-24		Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction. Length Recovered 0.2 ft, Length Retained 0.2 ft Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction. Length Recovered 4.5 ft, Length Retained 4.5 ft		
60										
	18									
	19			50/2" (50/2")		D-25 C-26		Silty GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Length Recovered 0.2 ft, Length Retained 0.2 ft		
65								Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction, (98% drilling fluid recovery). Length Recovered 4.3 ft, Length Retained 4.3 ft		
	20									
				50/3" (50/3")		D-27 C-28		Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, brownish gray, wet, Homogeneous, no HCl reaction. Length Recovered 0.3 ft, Length Retained 0.3 ft		
	21							Well graded GRAVEL with sand and cobbles and boulders, subrounded, very dense, brownish gray, wet, Homogeneous, no HCl reaction. (Approximately 98%		
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-8-99**

Sheet **4** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								drilling fluid recovery). Length Recovered 3.5 ft, Length Retained 3.5 ft		
	22			50/2" (50/2")		D-29 C-30		Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, brownish gray, wet, Homogeneous, no HCl reaction. Length Recovered 0.2 ft, Length Retained 0.2 ft Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, moderate yellowish brown, wet, Homogeneous, no HCl reaction, (100% drilling fluid loss at times). Length Recovered 1.2 ft, Length Retained 1.2 ft		
75	23									
						C-31		Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, moderate yellowish brown, wet, Homogeneous, no HCl reaction. Length Recovered 2.6 ft, Length Retained 2.6 ft		
	24									
80										
	25					C-32		Well graded GRAVEL with sand, cobbles and boulders, subrounded, very dense, moderate yellowish brown, wet, Homogeneous, no HCl reaction, (started getting 95% drilling fluid back at 82.0'). Length Recovered 3.0 ft, Length Retained 3.0 ft		
85	26									
						C-33		Well graded GRAVEL with sand and cobbles and boulders, subrounded, very dense, moderate yellowish brown, wet, Homogeneous, no HCl reaction, Note gravel are conglomerate with moist of fines washed away. Length Recovered 2.5 ft, Length Retained 2.5 ft		
	27									
90										
	28									
								End of test hole boring at 92 ft below ground elevation. Water table elevation at 49.2 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-9-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **14+700** Offset **13.6m LT. C. Line** C.S. **0604**

Equipment **CME 55 w/ autohammer** Casing **(HW x 22.0) (HQ x 67.0)** Ground El **150.9 (46.00 m)**

Method of Boring **Wet Rotary**

Start Date **August 12, 1999** Completion Date **August 13, 1999** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 8 7 6 (15)		D-1		Silty SAND with gravel, medium dense, grayish brown, dry, Homogeneous, no HCl reaction Recovered 1.5 ft, Retained 1.0 ft		
	1			6 5 3 3 (8)		D-2	GS MC	SM, MC=19% Silty SAND with gravel, loose, brown, moist, Homogeneous, no HCl reaction, (100% drilling fluid recovery). Recovered 1.0 ft, Retained 1.0 ft		
5				7 6 8 7 (14)		D-3	GS MC PI	ML, MC=25%, PI=5 Sandy SILT, medium dense, brown, moist, stratified with 0.5' of dark gray silt with gravel., no HCl reaction, (100% drilling fluid recovery). Recovered 1.8 ft, Retained 1.0 ft		
	2			4 2 4 4 (6)		D-4		Sandy SILT, loose, brown, moist, Homogeneous, no HCl reaction. Recovered 1.2 ft, Retained 1.0 ft		
10	3			1 2 3 3 (5)		D-5	GS MC	SM, MC=29% Silty SAND, loose, brown, moist, no HCl reaction. (100% drilling fluid recovery). Recovered 2.0 ft, Retained 1.0 ft		
	4			3 4 8 8 (12)		D-6		Silty SAND, medium dense, brown, moist, no HCl reaction, (100% drilling fluid recovery). Recovered 1.0 ft, Retained 1.0 ft		
15	5			6 12 11 18 (23)		D-7	GS MC	SM, MC=36% Silty SAND, laminated with dark reddish brown and dark yellowish brown oxidized stains, medium dense, moist, no HCl reaction, (100% drilling fluid recovery). Recovered 1.8 ft, Retained 1.0 ft		
	6			16 19 22 22 (41)		D-8		Silty SAND, loosely bonded together with a clayey sand matrix, angular, dense, brown, wet, Homogeneous, no HCl reaction. Recovered 0.8 ft, Retained 0.8 ft		
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-9-99**

Sheet **2** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				12 22 44 50/5" (66)		D-9	GS MC	GC, MC=27%, PI=13 Clayey GRAVEL with sand ,dark reddish brown and moderate yellowish brown oxidized stains, angular, very dense, moderate yellowish brown, moist, no HCl reaction, (100% drilling fluid recovery). Recovered 1.2 ft, Retained 1.0 ft		
						C-10		Silty GRAVEL with sand, subrounded, very dense, dark yellowish brown, moist, Homogeneous, no HCl reaction, Note changed over to NQ-coring at 22.0'. Moist of fines washed away by coring. (100% drilling fluid recovery). Recovered 1.2 ft, Retained 1.2 ft 08/13/1999	▽	
25	7			21 41 50/2" (>91)		D-11	GS MC	GW, MC=17% Well graded GRAVEL with sand, subrounded, very dense, dark yellowish brown, moist, Homogeneous, no HCl reaction Recovered 1.2 ft, Retained 1.2 ft		
	8					C-12		Clayey GRAVEL with sand, laminated with brownish gray and dark yellowish brown colors, subrounded, very dense, dark yellowish brown, moist, no HCl reaction. (95 to 98% drilling fluid recovery). Recovered 2.5 ft, Retained 2.5 ft		
30	9			18 50/4 (50/4")		D-13 C-14		Well graded GRAVEL with sand, subrounded, very dense, dark yellowish brown, moist, no HCl reaction, Same as above. Recovered 0.8 ft, Retained 0.8 ft Clayey GRAVEL with sand, cobbles and boulders, laminated with dark yellowish brown and gray colors, subrounded, very dense, dark yellowish brown, moist, no HCl reaction, (95 to 98% drilling fluid recovery).. Recovered 3.2 ft, Retained 3.2 ft		
35	10			15 30 50/3" (>83)		D-15 C-16		Well graded GRAVEL with sand, subrounded, very dense, dark yellowish brown, moist, no HCL reaction Recovered: 1.3 ft. Retained: 1.3 ft. Well graded GRAVEL, cobbles and boulders, stratified with 1.0' of clayey gravel with sand, subrounded, very dense, dark yellowish brown, moist, no HCl reaction, (Approximately 98% drilling fluid recovery). Recovered 3.4 ft, Retained 3.4 ft		
40	11			50/1 (50/1")		D-17 C-18		No Recovery Well graded GRAVEL, cobbles and boulders, stratified with 1.0' of clayey gravel with sand, subrounded, very dense, dark yellowish brown, moist, no HCl reaction.		
45	12 13									

SOIL OL-253-1.GPJ SOIL.GDT 3/1/00 2:15:06 P3

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-9-99**

Sheet **3** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14					C-19		Well graded GRAVEL, cobbles and boulders, slightly weathered fine washed away by coring, subrounded, very dense, dark yellowish brown, moist, no HCl reaction, (98% drilling fluid recovery). Recovered 3.2 ft, Retained 3.2 ft		
	15									
50						C-20		Clayey GRAVEL with sand, cobbles and boulders, subrounded, very dense, moderate yellowish brown, moist, no HCl reaction, slightly weathered. (98% drilling fluid recovery). Recovered 3.0 ft, Retained 3.0 ft		
	16									
55						C-21		Clayey GRAVEL with sand, cobbles and boulders, subrounded, very dense, moderate yellowish brown, moist, no HCl reaction, Same as above. Recovered 1.8 ft, Retained 1.8 ft		
	17									
	18									
60								End of test hole boring at 60 ft below ground elevation. (Water table next day reading was 24.0' in casing, depth of hole at time of reading was 40.0'. 8/13/99.) This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	19									
65										
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-9A-00**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **14+696.9** Offset **17.6m Lt.** C.S. **0604**

Equipment **CME 45 w/ autohammer** Casing **HQ-30.5** Ground El **138.5 (42.20 m)**

Method of Boring **Wet Rotary**

Start Date **March 28, 2000** Completion Date **March 29, 2000** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
						C-1		Silty GRAVEL with sand, boulders, subrounded, very dense, gray, moist, Stratified, no HCl reaction Length Recovered 3.0 ft, Length Retained 3.0 ft		
5	1									
	2			2 7 7 (14)		D-2		Silty SAND with gravel, medium dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 0.8 ft, Length Retained 0.8 ft		
				3 7 7 (14)		D-3		Silty SAND with gravel, medium dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft		
						C-4		Silty GRAVEL with sand, cobbles, subrounded, medium dense, gray, moist, Stratified, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
10	3			2 5 3 (8)		D-5		Silty SAND with gravel, loose, grayish brown, moist, Stratified, no HCl reaction Length Recovered 0.9 ft, Length Retained 0.9 ft		
	4									
15	5			3 4 4 (8)		D-6		Sandy SILT, loose, brown, moist, Stratified, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
20	6									

SOIL OL-253-1.GPJ SOIL.GDT 4/24/00 11:29:05 A4

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-9A-00**

Sheet **2** of **2**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			>>	12 34 50/3" (84)		D-7		Silty GRAVEL with sand, subrounded, very dense, olive, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
25	7			50/3" (50/3")		D-8 C-9		Silty GRAVEL with sand, subrounded, very dense, pale olive, moist, Homogeneous, no HCl reaction Length Recovered 0.2 ft, Length Retained 0.2 ft Silty GRAVEL with sand, subrounded, very dense, olive, moist, Homogeneous, no HCl reaction Length Recovered 4.0 ft, Length Retained 4.0 ft		
30	8 9			50/6" (50/6")		D-10		Silty GRAVEL with sand, subrounded, very dense, olive, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 31 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
35	10 11									
40	12 13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-10-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **16+615** Offset **23m Lt (25 Lt cl Brady Rd)** C.S. **0604**

Equipment **CME 45 w/ autohammer** Casing **HQ x 53'** Ground El **157.5 (48.00 m)**

Method of Boring **Wet Rotary**

Start Date **September 21, 1999** Completion Date **September 22, 1999** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
	1									
5				8 10 13 (23)		D-1		Silty SAND with gravel, medium dense, dark brown, wet, Homogeneous, no HCl reaction Length Recovered 0.3 ft		
	2									
10	3			4 8 14 (22)		D-2	GS MC	SM, MC=33% Silty SAND with gravel, medium dense, black, wet, Stratified, no HCl reaction, with SILT interbeds, dark yellowish brown. Length Recovered 1.5 ft		
	4									
15	5			2 7 9 (16)		D-3	GS MC	SM, MC=3% Silty SAND, medium dense, dark yellowish brown, moist, Homogeneous, no HCl reaction, modeled. Length Recovered 1.5 ft		
20	6			10 9		D-4		Silty SAND with gravel, medium dense, dark brown, moist, Homogeneous, no HCl reaction		

LOG OF TEST BORING

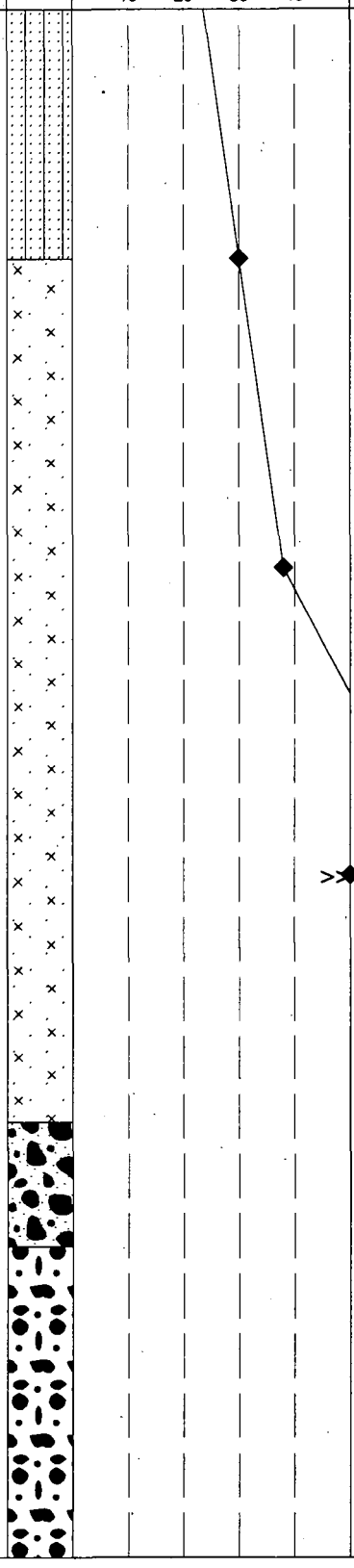
Washington State Department of Transportation

HOLE No. **H-10-99**

Sheet **2** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		13 (22)				Length Recovered 1.5 ft		
	7							
25		30 18 12 (30)		D-5	GS MC	ML, MC=36% Sandy SILT, dense, olive yellow, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft		
	8							
30	9	28 10 28 (38)		D-6		Sandy SILT, dense, olive yellow, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft		
	10							
35		>> 4 17 50/4" (67)		D-7		Sandy SILT, very dense, olive yellow, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft		
	11							
	12			C-8		Well graded GRAVEL with sand, with cobbles, rounded, very dense, dark greenish grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
40				C-9		Poorly graded GRAVEL with sand, with cobbles, rounded, dense, dark grey, moist, Homogeneous, no HCl reaction Length Recovered 3.0 ft		
	13							
45								

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-10-99**

Sheet **3** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14					C-10		Well graded GRAVEL with sand, with cobbles, rounded, very dense, dark grey, moist, Homogeneous, no HCl reaction Length Recovered 2.5 ft		
	15									
50								End of test hole boring at 50 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-11-99**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **16+840** Offset **25m Lt (30m Lt of cl SR14)** C.S. **0604**

Equipment **CME 45 w/ autohammer** Casing **HQ x 72 HW x 12** Ground El **159.1 (48.50 m)**

Method of Boring **Wet Rotary**

Start Date **September 8, 1999** Completion Date **September 16, 1999** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
5	1, 2			9 13 13 (26)		D-1	GS MC	SW-SM, MC=12% Well graded SAND with silt and gravel, dense, dark brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
10	3			50/6" (50/6")		D-2 C-3	GS MC	SW-SM, MC=15% Well graded SAND with silt and gravel, very dense, dark yellowish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.5 ft		
	4							Well graded GRAVEL with sand and cobbles, subrounded, very dense, light grey, moist, Homogeneous, no HCl reaction Length Recovered 3.0 ft		
15	5					C-4		Well graded GRAVEL with sand and cobbles, rounded, very dense, dark grey and red, moist, Homogeneous, no HCl reaction Length Recovered 4.0 ft	▽ 09/14/1999	
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-11-99**

Sheet **2** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				50/3" (50/3")		D-5 C-6		Well graded GRAVEL with sand, angular, very dense, dark olive grey, wet, Homogeneous, no HCl reaction Length Recovered 0.2 ft Well graded GRAVEL with sand and cobbles, rounded, very dense, light grey, moist, Homogeneous, no HCl reaction Length Recovered 3.5 ft		
	7									
25										
	8					C-7		Well graded GRAVEL with sand and cobbles, subrounded, very dense, light grey, wet, Homogeneous, no HCl reaction Length Recovered 3.0 ft 09/16/1999	▼	
	9									
30										
						C-8		Well graded GRAVEL with sand and cobbles, rounded, very dense, grey and dark olive brown, moist, Homogeneous, no HCl reaction Length Recovered 3.0 ft		
	10									
35				50/2" (50/2")		D-9		No Recovery		
	11									
	12									
40				50/6" (50/6")		D-10		Well graded SAND with silt and gravel, very dense, dark grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.3 ft		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-11-99**

Sheet **3** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			3 9 15 (24)		D-11	GS MC	ML, MC=34% Sandy SILT with sand interbeds, medium dense, light olive brown, wet, no HCl reaction Length Recovered 1.5 ft		
	15									
50				3 7 15 (22)		D-12		Sandy SILT, medium dense, light yellowish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft		
	16									
55				3 9 20 (29)		D-13		Sandy SILT, dense, yellowish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft		
	17									
	18									
60				30 50/6" (50/6")		D-14	GS MC	GW-GM, MC=16% Well graded GRAVEL with silt and sand, angular, very dense, light olive brown and black, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	19									
65				50/0" (50/0")		D-15		No Recovery		
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-11-99**

Sheet **4** of **4**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				19 50/6" (50/6")		D-16	GS MC PI	GC, MC=43%, PI=26 Clayey GRAVEL with sand, angular, very dense, light yellowish brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	22							End of test hole boring at 71 ft below ground elevation.		
								This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
75	23									
	24									
80										
	25									
85	26									
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-12-00**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **1+620** Offset **7.2m Lt** C.S. **0604**

Equipment **CME 45 w/ autohammer** Casing **HQ-40.0** Ground El **184.4 (56.20 m)**

Method of Boring **Wet Rotary**

Start Date **March 14, 2000** Completion Date **March 15, 2000** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
5	1			11 22 19 (41)		D-1		Poorly graded SAND with silt, dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	2			20 20 14 (34)		D-2	GS MC	SP-SM, MC=15% Poorly graded SAND with silt, dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 0.9 ft, Length Retained 0.9 ft		
10	3			5 12 12 (24)		D-3		Poorly graded SAND with silt, medium dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	4			10 12 14 (26)		D-4		Poorly graded SAND with silt, dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 0.9 ft, Length Retained 0.9 ft		
15	5			10 13 14 (27)		D-5		Poorly graded SAND with silt, dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
				11 14 16 (30)		D-6		Poorly graded SAND with silt, dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
20	6									

LOG OF TEST BORING

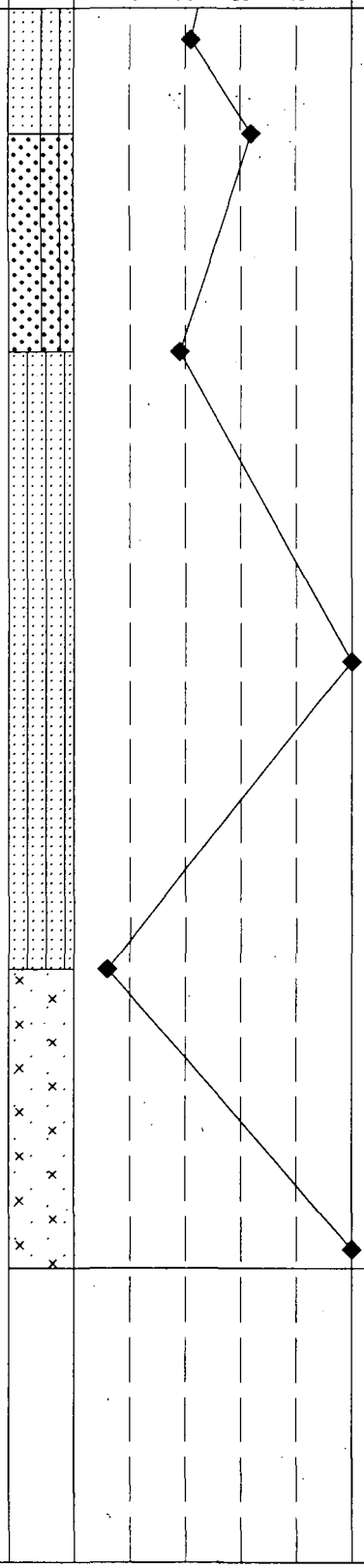
Washington State Department of Transportation

HOLE No. **H-12-00**

Sheet **2** of **2**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		7 9 12 (21)		D-7		Poorly graded SAND with silt, medium dense, brown, moist, Stratified, no HCl reaction, silty sand w/gravel - 21.6' Length Recovered 1.4 ft, Length Retained 1.4 ft		
	7	33 18 14 (32)		D-8	GS MC	SW-SM, MC=12% Well graded SAND with silt and gravel, dense, brown, moist, Homogeneous, no HCl reaction Length Recovered 0.9 ft, Length Retained 0.9 ft		
25								
	8	10 13 6 (19)		D-9		Silty SAND with gravel, medium dense, dark reddish brown, moist, Stratified, no HCl reaction, change at 26.0' Length Recovered 1.4 ft, Length Retained 1.4 ft		
	9							
30		22 50/3" (50/3")		D-10	GS MC	SM, MC=31% Silty SAND with gravel, very dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 0.7 ft, Length Retained 0.7 ft		
	10							
35								
	11	1 2 4 (6)		D-11	GS MC PI	ML, MC=29%, PI=7 SILT with sand, loose, dark gray, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	12							
40		50/4" (50/4")		D-12		No Recovery		
						End of test hole boring at 40.3 ft below ground elevation.		
	13					This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45								

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-13-00**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **1+616** Offset **12m Lt** C.S. **0604**

Equipment **CME 45 w/ autohammer** Casing **HQ-42.0** Ground El **195.6 (59.62 m)**

Method of Boring **Wet Rotary**

Start Date **March 16, 2000** Completion Date **March 20, 2000** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
5	1									
				2 3 4 (7)		D-1		Silty SAND, loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	2			2 3 4 (7)		D-2	GS MC	SM, MC=21% Silty SAND, loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	3									
				4 6 7 (13)		D-3		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	4			7 8 11 (19)		D-4		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
15										
	5			5 7 8 (15)		D-5		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
				7 8 8 (16)		D-6		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
20	6									

LOG OF TEST BORING

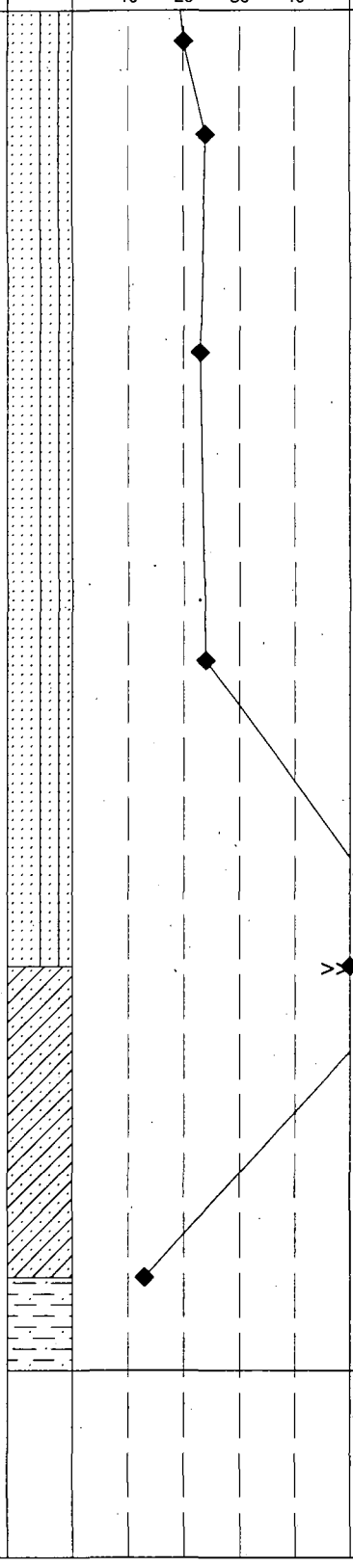
Washington State Department of Transportation

HOLE No. **H-13-00**

Sheet 2 of 2

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		7 8 12 (20)		D-7		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
		8 11 13 (24)		D-8		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
25	7							
		7 10 13 (23)		D-9		Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
	8							
	9							
30		8 10 14 (24)		D-10	GS MC	SP-SM, MC=17% Poorly graded SAND with silt and gravel, medium dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	10							
35								
	11	5 14 50/3" (64)		D-11	GS MC PI	SC, MC=17%, PI=15 Clayey SAND with gravel, very dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	12							
40		3 6 7 (13)		D-12	GS MC PI	CL, MC=32%, PI=25 Lean CLAY with sand, stiff, reddish brown, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	13					End of test hole boring at 42 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45								

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-14-00**

PROJECT **SE 192nd Avenue Interchange** Job No. **OL-2530**

SW Region S.R. **14**

Station **1+575** Offset **7 Rt** C.S. **0604**

Equipment **CME 45 w/ autohammer** Casing **HQ-51.0** Ground El **168.8 (51.45 m)**

Method of Boring **Wet Rotary**

Start Date **March 21, 2000** Completion Date **March 22, 2000** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
	1									
5				1 1 1 (2)		D-1		Silty SAND, organic material, very loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 0.9 ft, Length Retained 0.9 ft		
	2			1 1 1 (2)		D-2	GS MC	SM, MC=27% Silty SAND, very loose, brown, moist, Stratified, no HCl reaction, change at 7.1 Length Recovered 1.5 ft, Length Retained 1.5 ft		
10	3			1 1 1 (2)		D-3	GS MC	ML, MC=27% Sandy SILT, very loose, brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
				1 2 3 (5)		D-4		Sandy SILT, loose, brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	4									
15				3 4 4 (8)		D-5		Silty SAND, loose, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
	5			3 5 6 (11)		D-6	GS MC	SM, MC=27% Silty SAND, medium dense, brown, moist, Stratified, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
	6			3		D-7		Silty SAND with gravel, loose, grayish brown, wet,		
20										

SOIL OL-253-1.GPJ SOIL.GDT 4/25/00 10:18:11 A4

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-14-00**

Sheet **2** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 5 (9)				Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	7									
25				30 50/2" (50/2")		D-8	GS MC PI	GM, MC=36%, PI=12 Silty GRAVEL with sand, very dense, grayish brown, moist, Stratified, no HCl reaction Length Recovered 0.7 ft, Length Retained 0.7 ft		
	8									
	9			50/4" (50/4")		D-9		Silty GRAVEL with sand, very dense, dark gray, moist, Homogeneous, no HCl reaction Length Recovered 0.3 ft, Length Retained 0.3 ft		
30										
	10									
35										
	11					C-10		Silty GRAVEL, cobbles, subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 3.1 ft, Length Retained 3.1 ft		
	12									
40										
						C-11		Well graded GRAVEL, cobbles, subrounded, very dense, dark gray, moist, Stratified, no HCl reaction Length Recovered 3.3 ft, Length Retained 3.3 ft		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-14-00**

Sheet **3** of **3**

PROJECT **SE 192nd Avenue Interchange**

Job No. **OL-2530**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14					C-12		Well graded GRAVEL, cobbles, subrounded, very dense, dark gray, moist, Stratified, no HCl reaction Length Recovered 3.4 ft, Length Retained 3.4 ft		
	15									
50										
	16							End of test hole boring at 51 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

APPENDIX D

LABORATORY TEST DATA

Job No. **OL2530** Date **October 20, 1999**

Hole No. **H-1-99** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

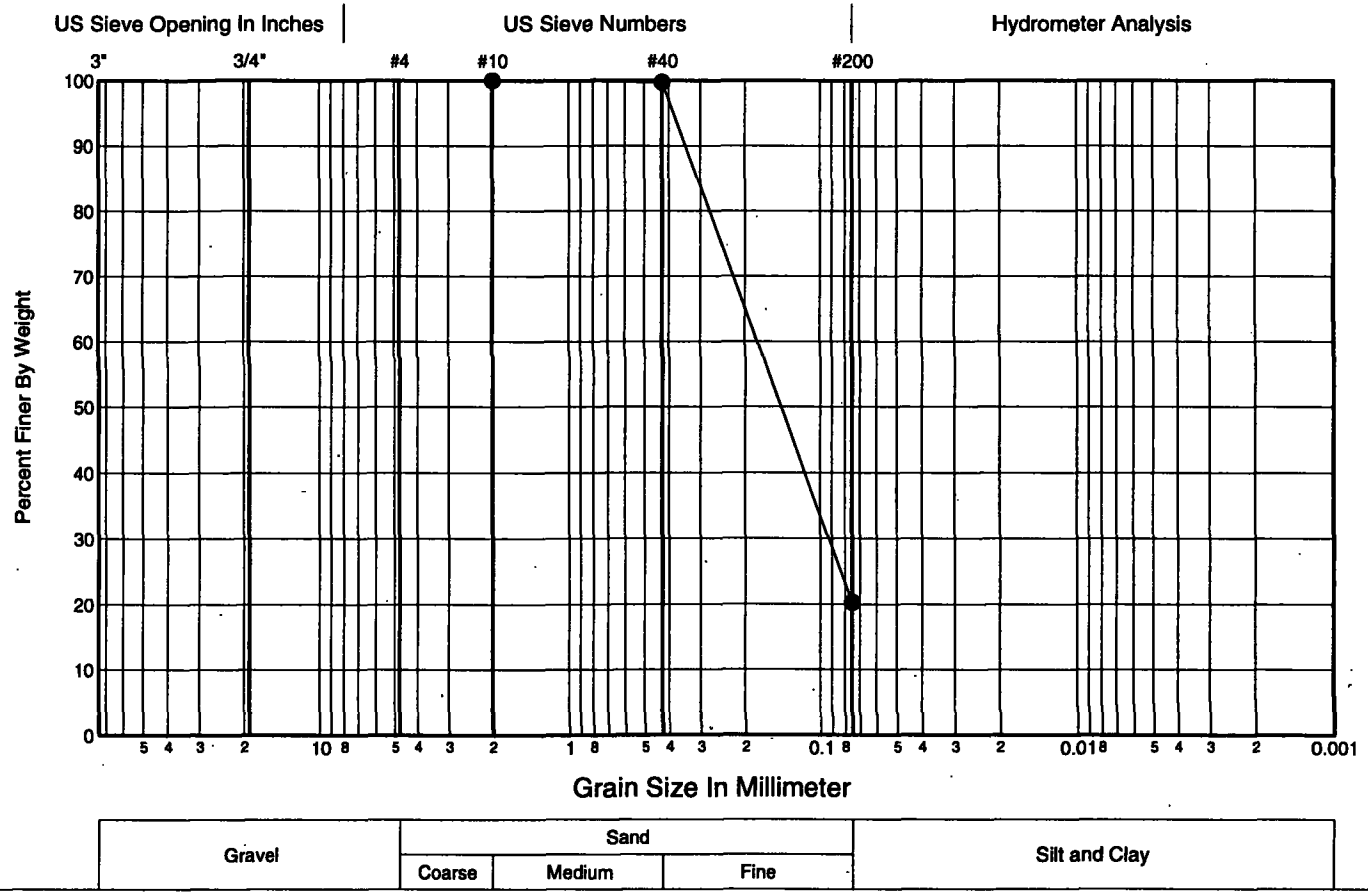
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	65.0	19.81	D-17	SM	See Boring Log	SILTY SAND	30	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	79.7	20.3		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.25	0.21	0.12		



Job No. OL2530 | Date September 9, 1999

Hole No. H-2-99 | Sheet 1 of 1

Project SE 192nd Avenue Interchange

Laboratory Summary

Washington State Department of Transportation

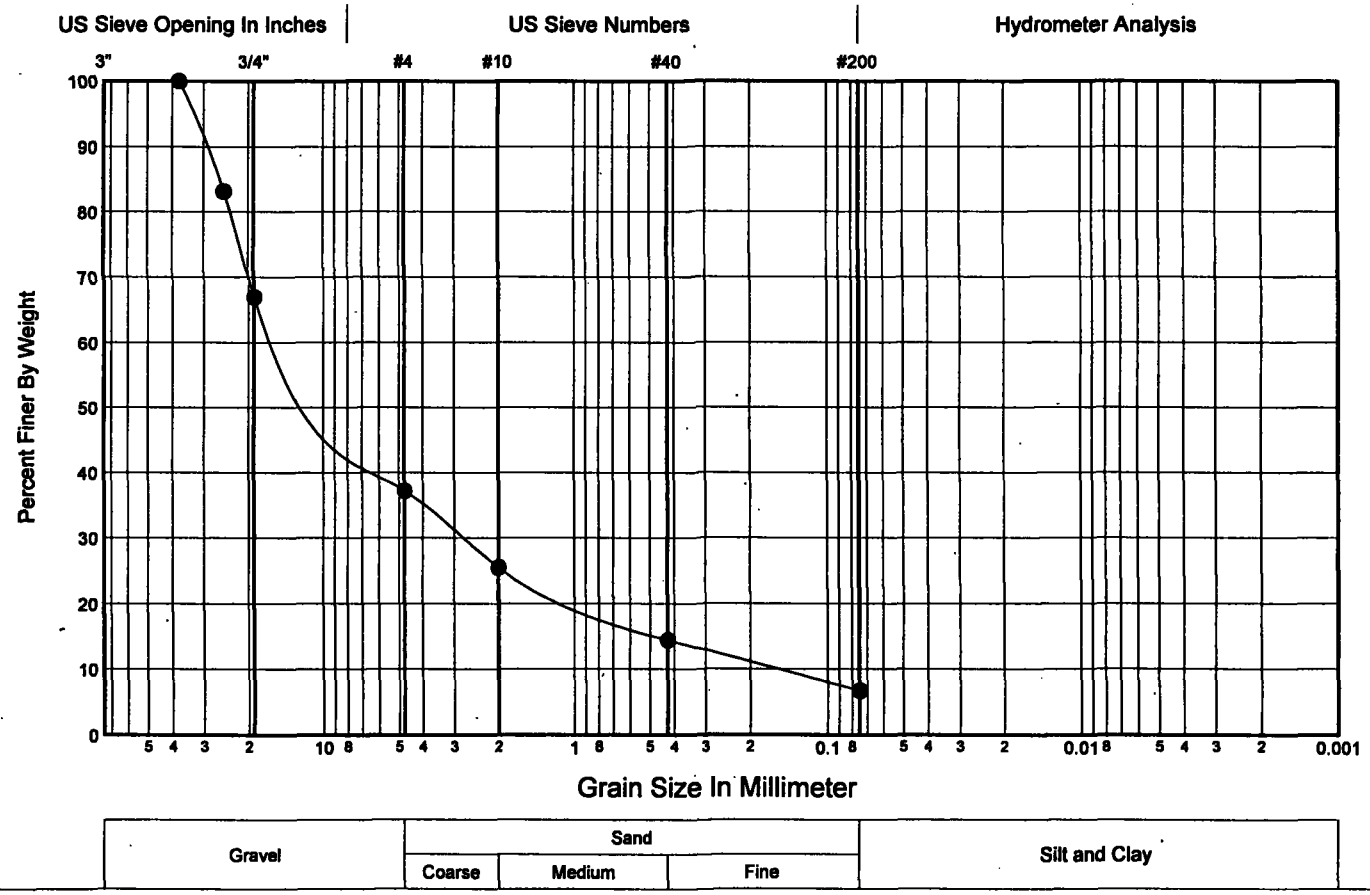
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	GW-GM	See Boring Log	WELL-GRADED GRAVEL with SILT and SAND	9	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	62.8	30.5	6.7	2.7	70.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	15.66	10.86	3.05	1.21	0.22



Job No. **OL2530** Date **September 14, 1999**

Hole No. **H-3-99** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

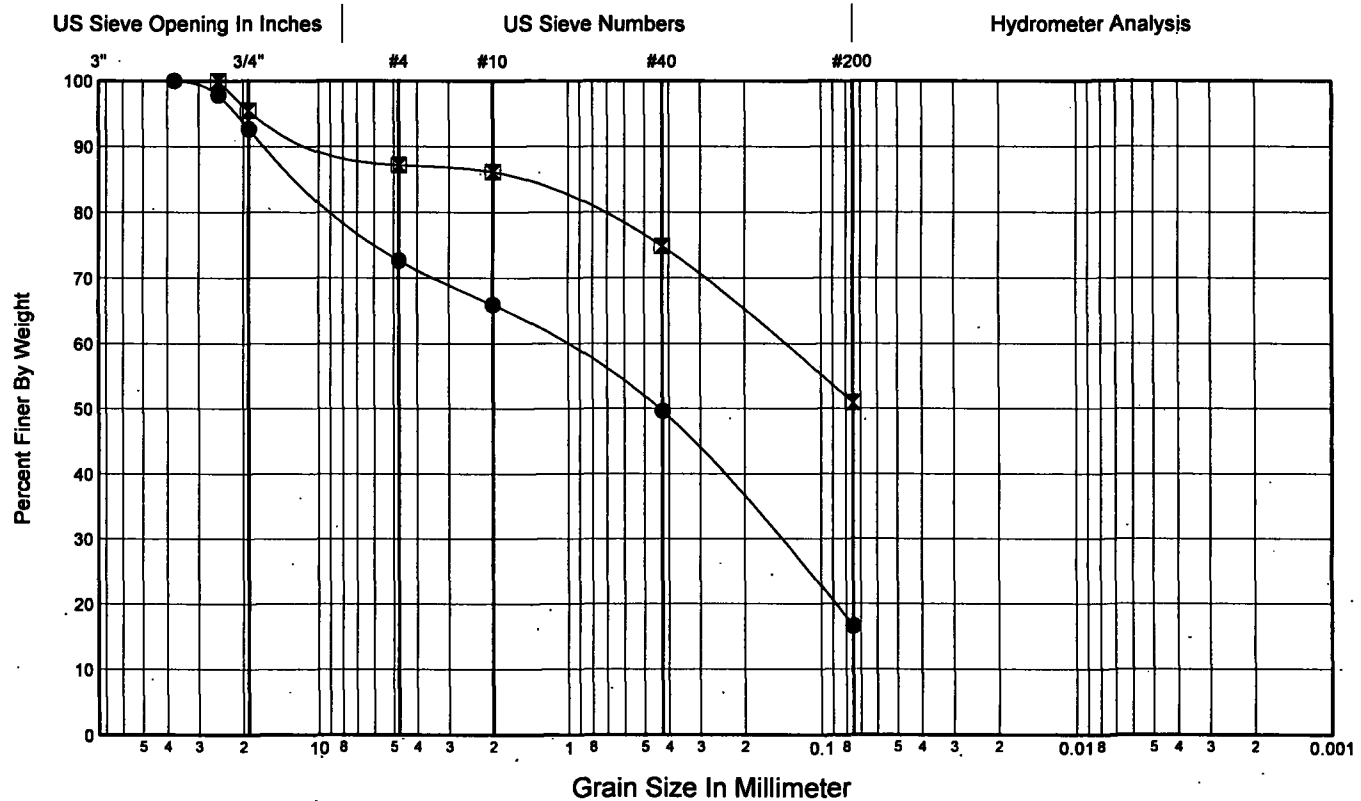
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	SM	See Boring Log	SILTY SAND with GRAVEL	15	NP	NP	NP
⊠	16.0	4.88	D-6	ML	See Boring Log	SANDY SILT	25	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	27.3	56.1	16.6		
⊠	12.8	36.2	51.0		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.42	0.46	0.22	0.11	
⊠	0.21				



Job No. OL-2530
Hole No. H-4-99
Project SE 192ND AVE. I/C

Date July 7, 1999
Sheet 1 of 1

Laboratory Summary

Washington State Department of Transportation

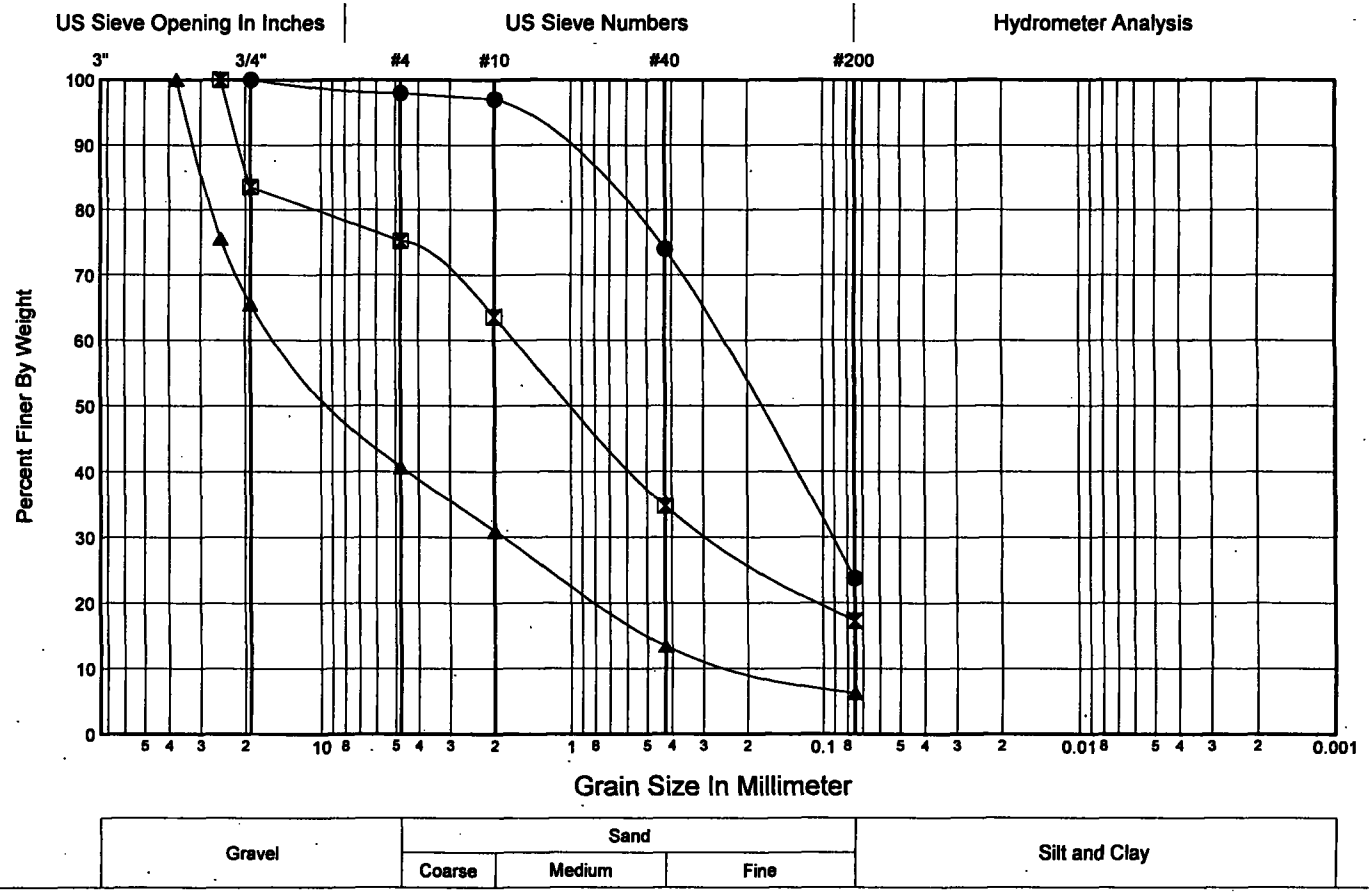
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SM	See Boring Log	SILTY SAND	25	NP	NP	NP
⊠	27.0	8.23	D-6	SM	See Boring Log	SILTY SAND with GRAVEL	16011	NP	NP	NP
▲	52.0	15.85	D-16	GW-GM	See Boring Log	WELL-GRADED GRAVEL with SILT and SAND	13	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	2.0	74.2	23.8		
⊠	24.8	57.9	17.3		
▲	59.3	34.4	6.3	1.3	75.7

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.26	0.19	0.09		
⊠	1.65	0.96	0.26	0.10	
▲	13.94	7.98	1.84	0.76	0.18



Job No. OL2530 | Date July 23, 1999

Hole No. H-5-99 | Sheet 1 of 1

Project SE 192nd Avenue Interchange

Laboratory Summary

Washington State Department of Transportation

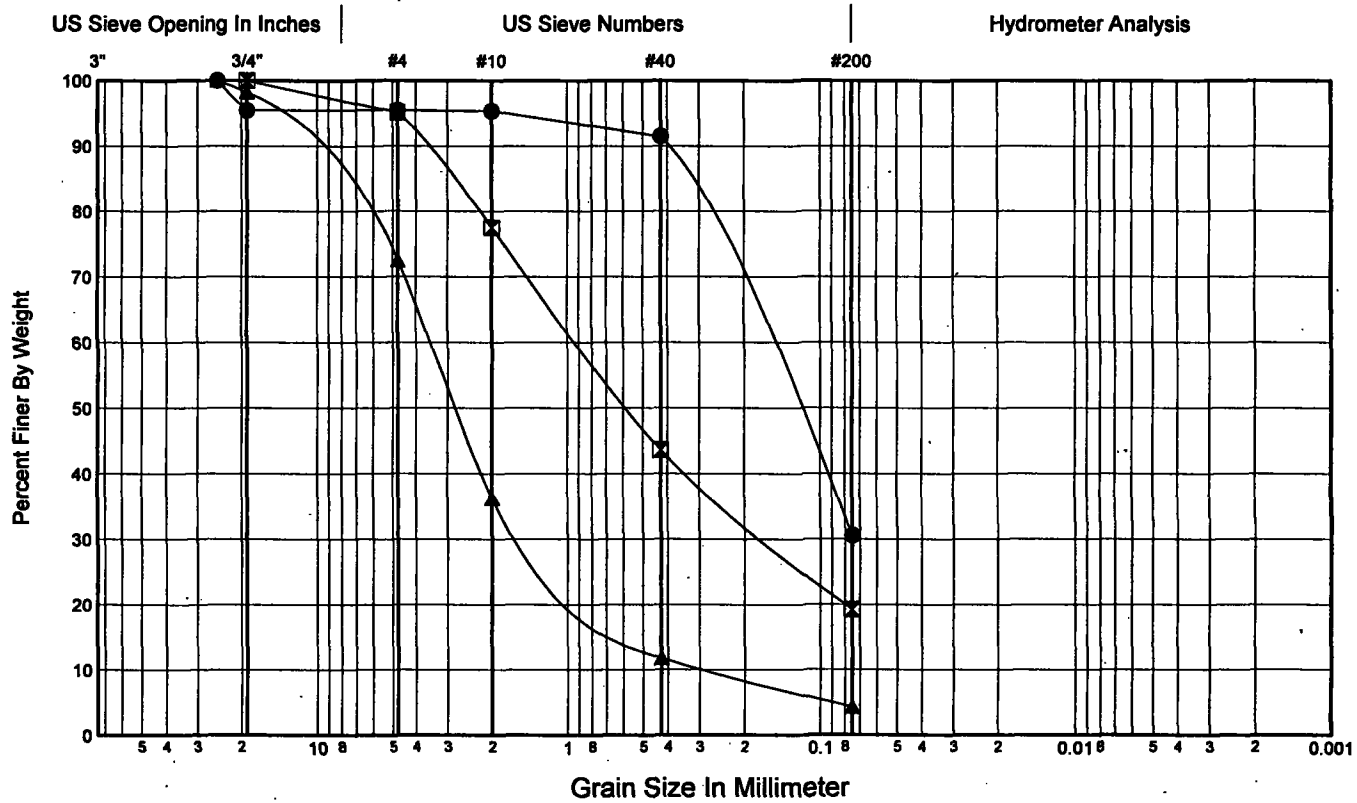
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	3.5	1.07	D-1	SM	See Boring Log	SILTY SAND	23	NP	NP	NP
⊠	25.0	7.62	D-10	SM	See Boring Log	SILTY SAND	32	NP	NP	NP
▲	30.0	9.14	D-12	SW	See Boring Log	WELL-GRADED SAND with GRAVEL	32	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	4.5	64.9	30.6		
⊠	4.9	75.8	19.3		
▲	27.5	68.2	4.3	1.8	12.5

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.17	0.13			
⊠	0.90	0.57	0.16	0.08	
▲	3.53	2.78	1.35	0.72	0.28



Job No. OL2530 | Date September 9, 1999

Hole No. H-6-99 | Sheet 1 of 1

Project SE 192nd Avenue Interchange

Laboratory Summary

Washington State Department of Transportation

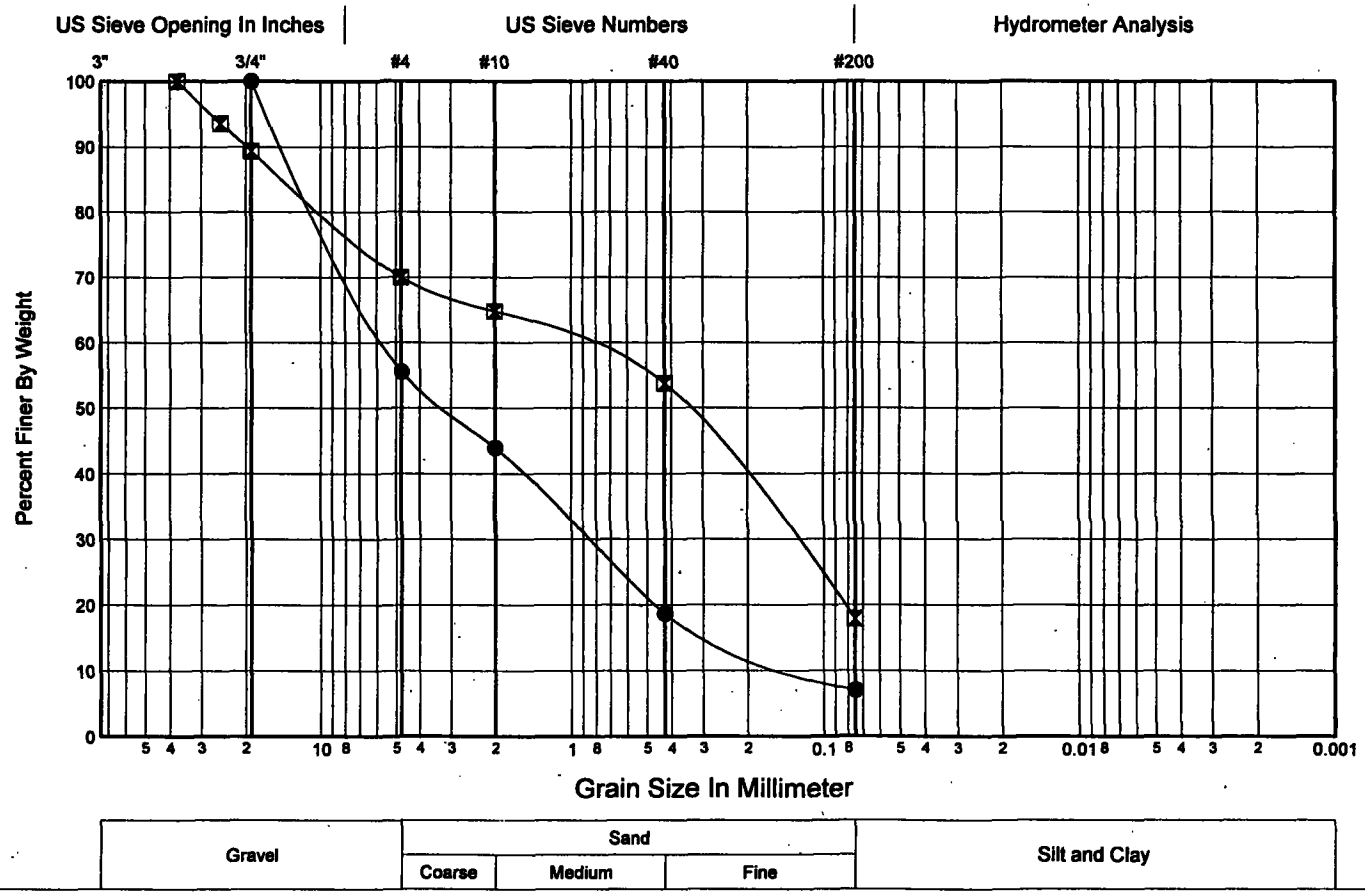
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	10.0	3.05	D-4	SW-SM	See Boring Log	WELL-GRADED SAND with SILT and GRAVEL	20	NP	NP	NP
⊠	13.0	3.96	D-5	SM	See Boring Log	SILTY SAND with GRAVEL	28	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	44.5	48.5	7.1	1.3	37.8
⊠	30.0	52.1	17.9		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	6.18	3.43	1.13	0.51	0.16
⊠	1.31	0.39	0.19	0.10	



Job No. **OL2530** Date **September 9, 1999**

Hole No. **H-7-99** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

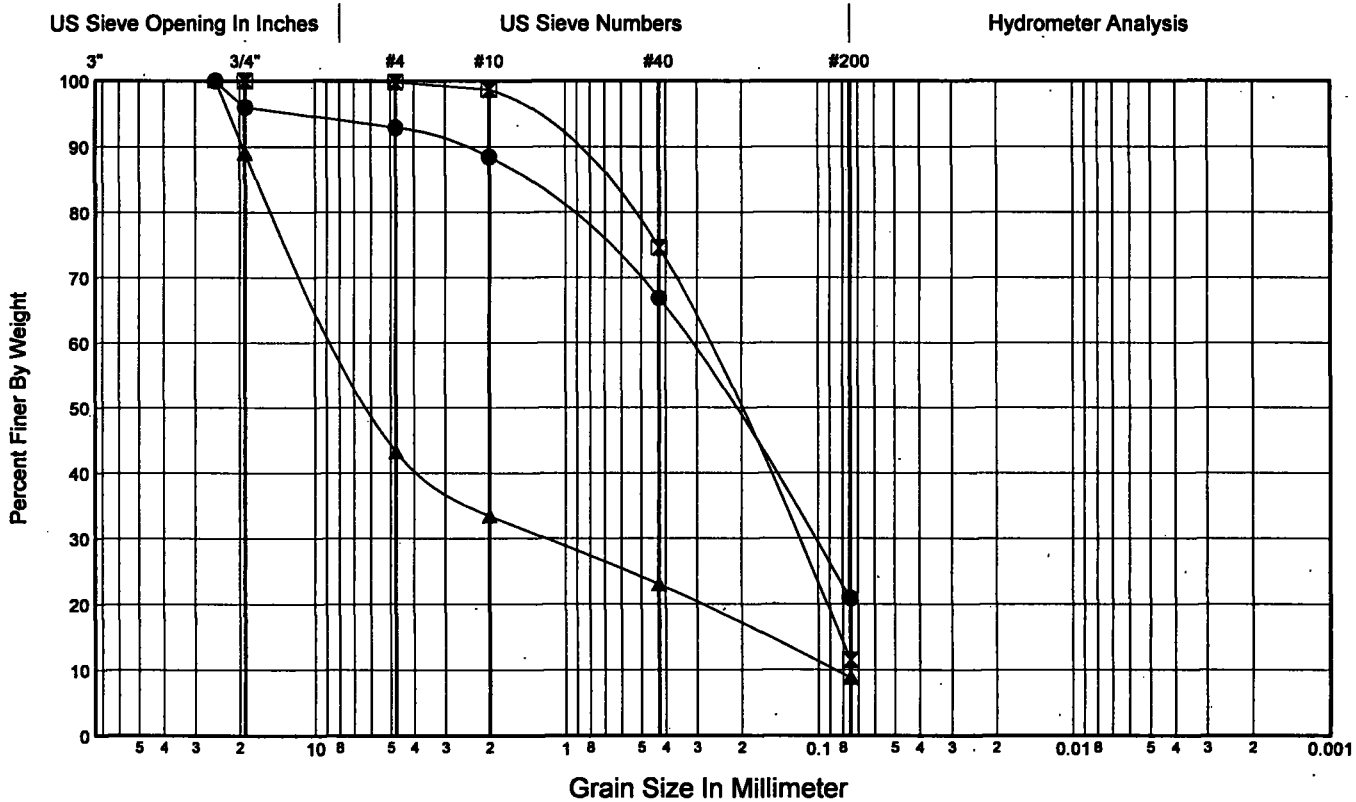
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.0	2.13	D-4	SM	See Boring Log	SILTY SAND	22	NP	NP	NP
⊠	12.0	3.66	D-6	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	20	NP	NP	NP
▲	19.0	5.79	D-9	GW-GM	See Boring Log	WELL-GRADED GRAVEL with SILT and SAND	18	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	7.1	71.9	20.9		
⊠	0.2	88.2	11.5	1.4	5.2
▲	56.8	34.4	8.8	2.1	96.2

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.37	0.30	0.14		
⊠	0.34	0.29	0.18	0.12	
▲	9.97	6.85	1.48	0.35	0.10



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. OL2530
Hole No. H-8-99
Project SE 192nd Avenue Interchange

Date September 9, 1999
Sheet 1 of 2

Laboratory Summary

Washington State Department of Transportation

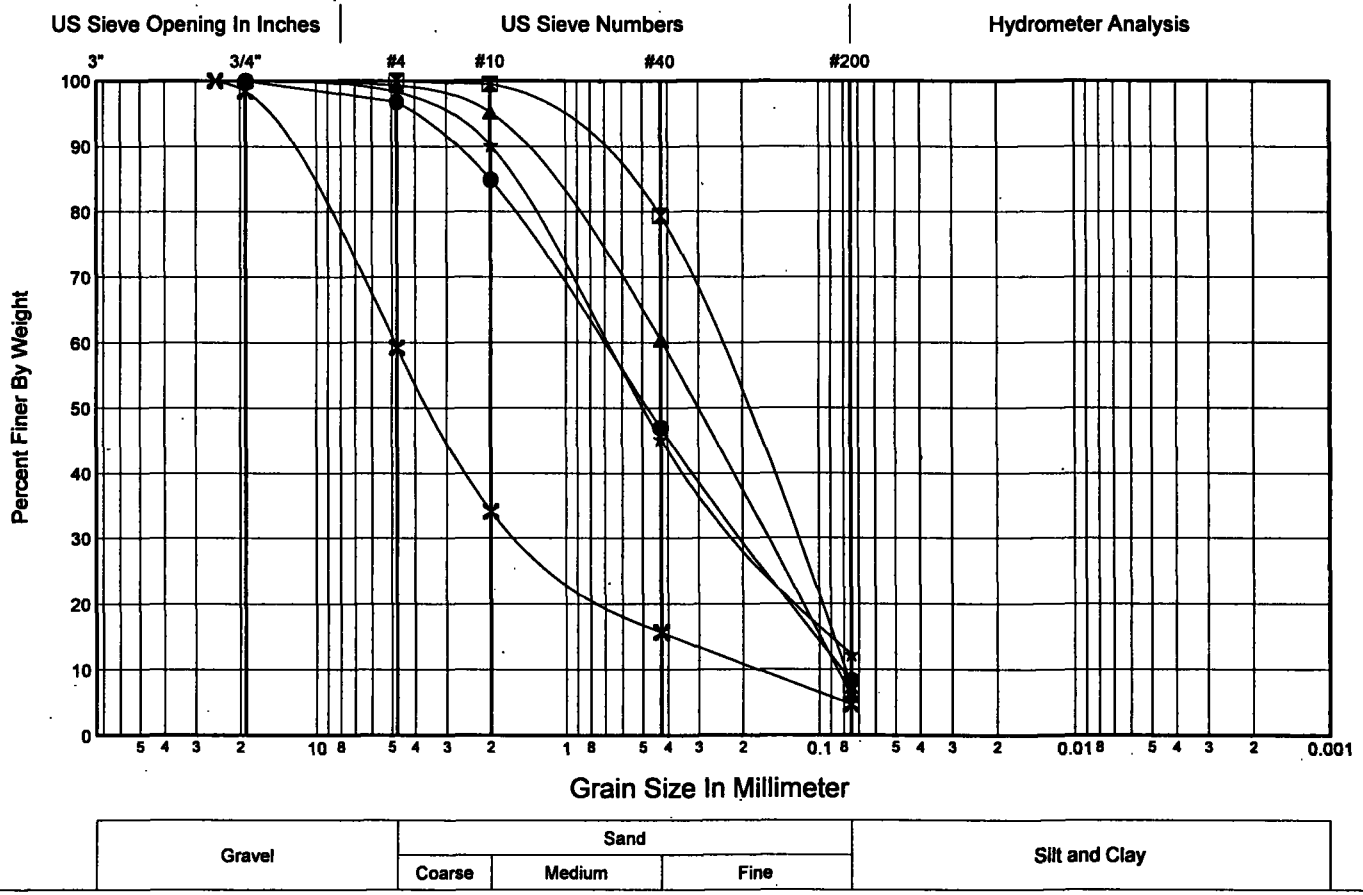
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	6.0	1.83	D-3	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	18	NP	NP	NP
⊠	8.0	2.44	D-4	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	12	NP	NP	NP
▲	16.0	4.88	D-7	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	11	NP	NP	NP
★	23.0	7.01	D-10	SM	See Boring Log	SILTY SAND	16	NP	NP	NP
✕	26.0	7.92	D-11	SW	See Boring Log	WELL-GRADED SAND with GRAVEL	16	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	3.2	88.5	8.3	0.8	10.7
⊠	0.0	92.5	7.5	1.2	3.8
▲	0.7	93.3	6.0	1.2	4.2
★	1.7	86.0	12.3	1.5	18.6
✕	40.8	54.5	4.7	2.2	20.7

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.97	0.55	0.27	0.18	0.09
⊠	0.33	0.28	0.18	0.14	0.09
▲	0.42	0.36	0.23	0.17	0.10
★	0.94	0.59	0.26	0.16	
✕	5.03	3.74	1.65	0.79	0.24



Job No. OL2530 | Date September 9, 1999

Hole No. H-8-99 | Sheet 2 of 2

Project SE 192nd Avenue Interchange

Laboratory Summary

Washington State Department of Transportation

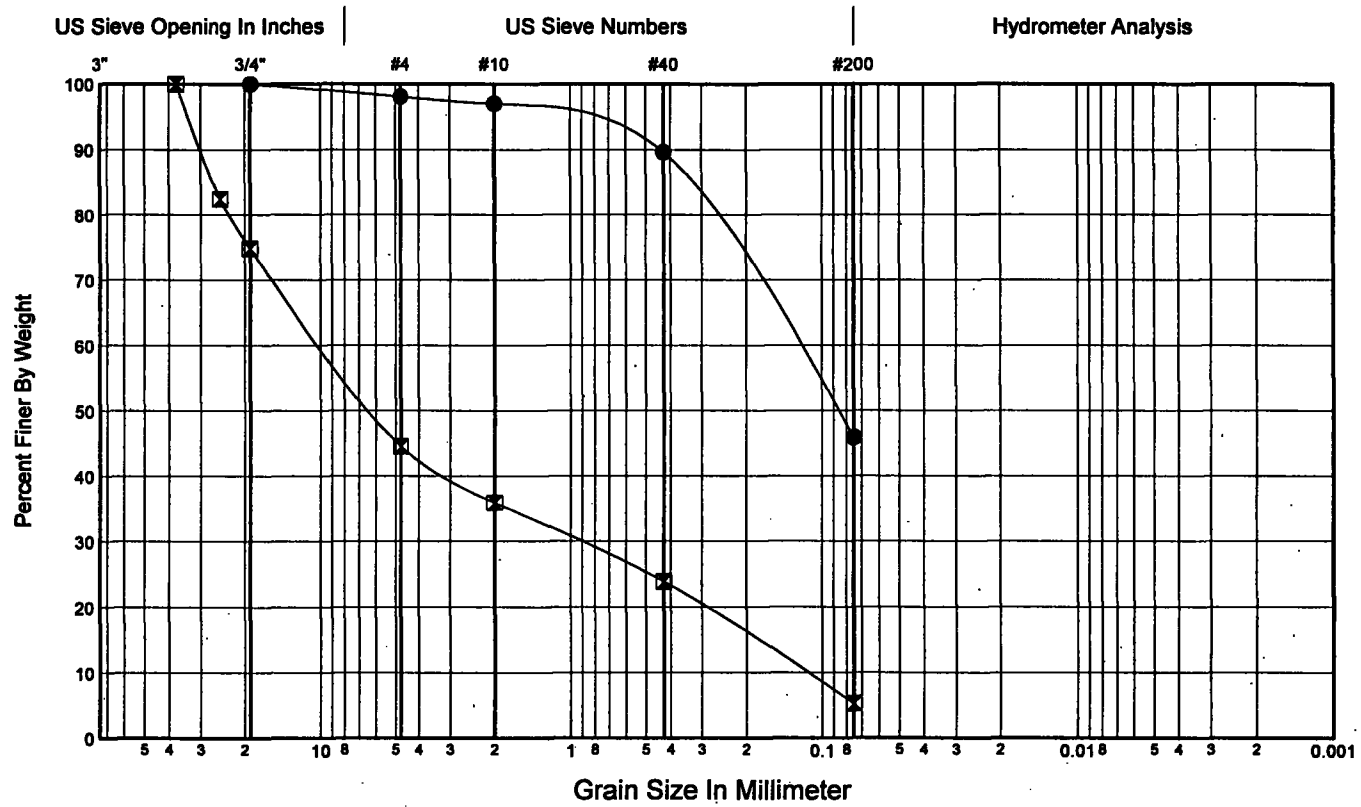
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	28.0	8.53	D-12	SC	See Boring Log	CLAYEY SAND	34	38	23	15
⊠	41.0	12.50	D-17	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	15	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	1.9	52.1	45.9		
⊠	55.4	39.3	5.3	0.8	73.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.19	0.11			
⊠	12.01	7.30	1.22	0.35	0.16



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL2530** Date **September 14, 1999**

Hole No. **H-9-99** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

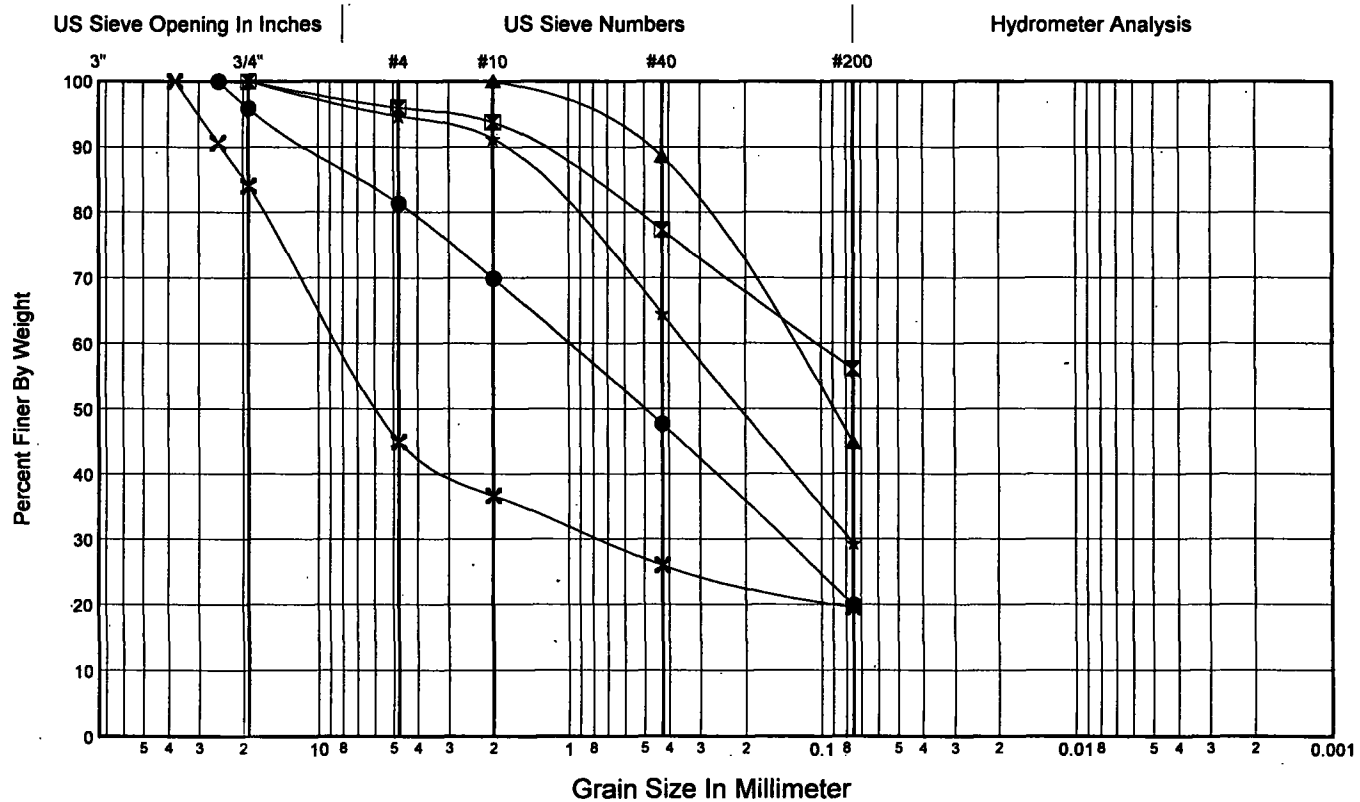
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-2	SM	See Boring Log	SILTY SAND with GRAVEL	19	NP	NP	NP
⊠	4.0	1.22	D-3	ML	See Boring Log	SANDY SILT	25	28	23	5
▲	9.0	2.74	D-5	SM	See Boring Log	SILTY SAND	29	NP	NP	NP
★	14.0	4.27	D-7	SM	See Boring Log	SILTY SAND	36	NP	NP	NP
✕	20.0	6.10	D-9	GC	See Boring Log	CLAYEY GRAVEL with SAND	27	37	24	13

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	18.6	61.5	19.9		
⊠	4.0	40.0	56.0		
▲	0.0	55.2	44.8		
★	5.3	65.4	29.3		
✕	55.1	25.4	19.5		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.30	0.59	0.20	0.08	
⊠	0.14				
▲	0.20	0.12			
★	0.38	0.28	0.08		
✕	10.24	6.59	1.02	0.10	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL2530** Date **September 14, 1999**

Hole No. **H-9-99** Sheet **2** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

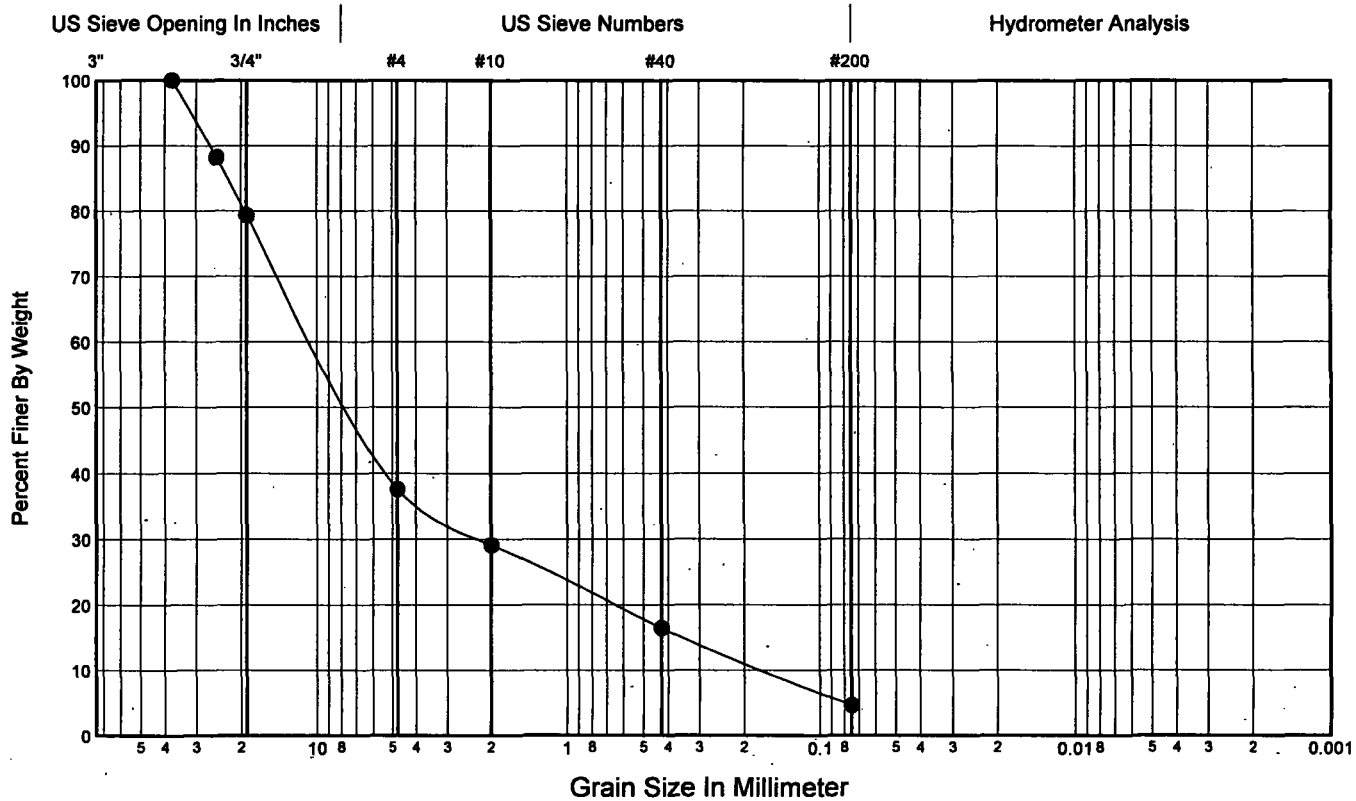
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	25.0	7.62	D-11	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	17	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	62.4	33.0	4.7	1.8	53.3

GRADATION VALUES

	D60	D50	D30	D20	D10
●	12.39	8.98	2.29	0.86	0.23



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-2530** Date **October 25, 1999**

Hole No. **H-10-99** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

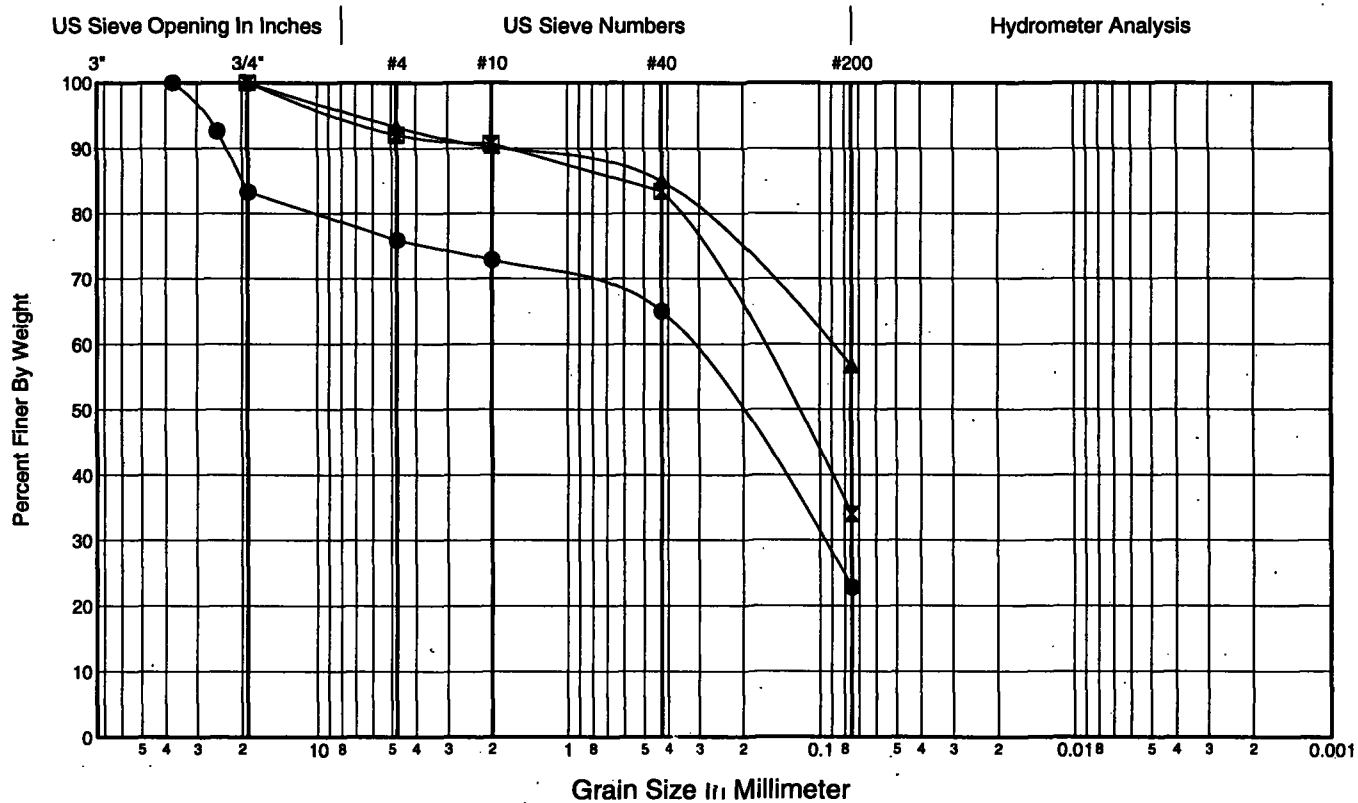
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.0	2.74	D-2	SM	See Boring Log	SILTY SAND with GRAVEL	33	NP	NP	NP
⊠	14.0	4.27	D-3	SM	See Boring Log	SILTY SAND	3	NP	NP	NP
▲	24.0	7.32	D-5	ML	See Boring Log	SANDY SILT	36	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	24.1	53.1	22.8		
⊠	7.9	58.1	34.0		
▲	6.8	36.5	56.7		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.38	0.30	0.13		
⊠	0.26	0.19			
▲	0.12				



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-2530** Date **October 26, 1999**

Hole No. **H-11-99** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

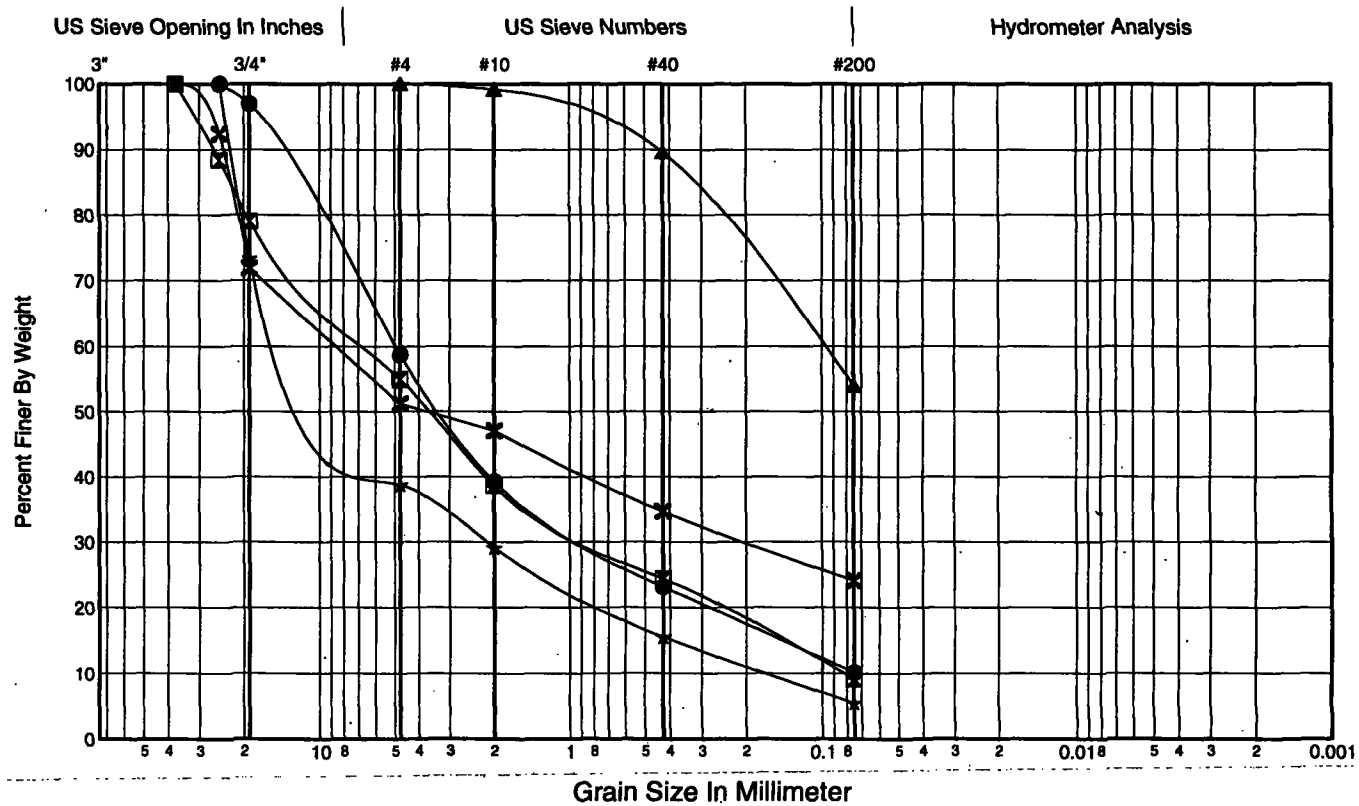
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SW-SM	See Boring Log	WELL-GRADED SAND with SILT and GRAVEL	12	NP	NP	NP
⊠	10.0	3.05	D-2	SW-SM	See Boring Log	WELL-GRADED SAND with SILT and GRAVEL	15	NP	NP	NP
▲	45.0	13.72	D-11	ML	See Boring Log	SANDY SILT	34	NP	NP	NP
★	60.0	18.29	D-14	GW-GM	See Boring Log	WELL-GRADED GRAVEL with SILT and SAND	16	NP	NP	NP
✕	70.0	21.34	D-16	GC	See Boring Log	CLAYEY GRAVEL with SAND	43	48	22	26

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	41.2	48.6	10.1	1.8	67.5
⊠	45.1	45.8	9.2	1.2	77.1
▲	0.0	46.0	54.0		
★	61.2	33.3	5.5	2.6	68.4
✕	48.8	27.1	24.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	4.97	3.22	0.82	0.28	
⊠	6.35	3.66	0.78	0.26	0.08
▲	0.10				
★	11.11	7.45	2.15	0.70	0.16
✕	8.57	3.70	0.20		



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-2530** Date **March 31, 2000**

Hole No. **H-12-00** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

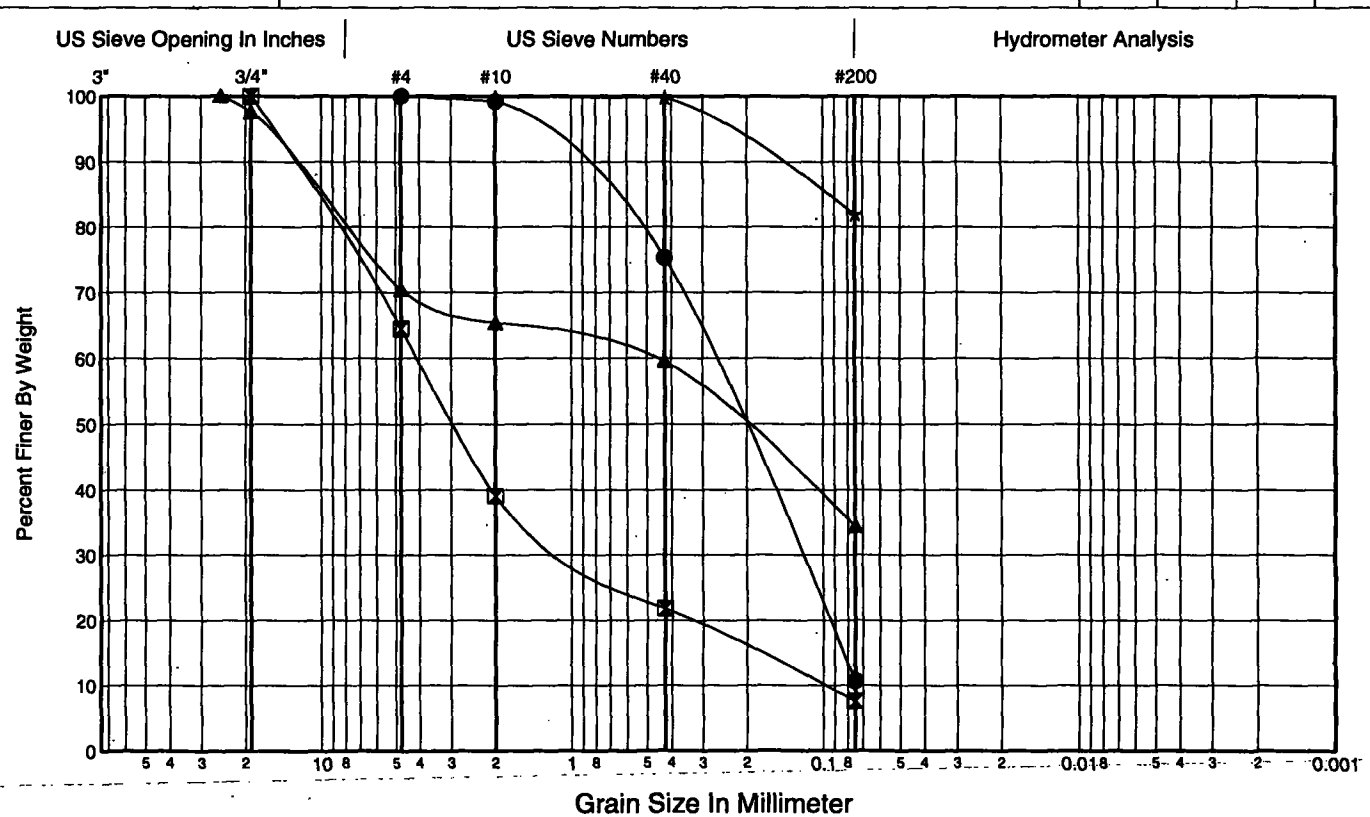
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.0	2.13	D-2	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	15	NP	NP	NP
⊠	22.0	6.71	D-8	SW-SM	See Boring Log	WELL-GRADED SAND with SILT and GRAVEL	12	NP	NP	NP
▲	30.5	9.30	D-10	SM	See Boring Log	SILTY SAND with GRAVEL	31	NP	NP	NP
★	35.5	10.82	D-11	ML	See Boring Log	SILT with SAND	29	30	23	7

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	89.3	10.7	0.8	3.8
⊠	35.5	56.8	7.6	1.9	40.7
▲	29.6	36.1	34.4		
★	0.0	18.0	82.0		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.28	0.22	0.13	0.10	
⊠	4.08	2.90	0.89	0.34	0.10
▲	0.48	0.22			
★					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No.	OL-2530	Date	March 31, 2000
Hole No.	H-13-00	Sheet	1 of 1
Project	SE 192nd Avenue Interchange		

Laboratory Summary

Washington State Department of Transportation

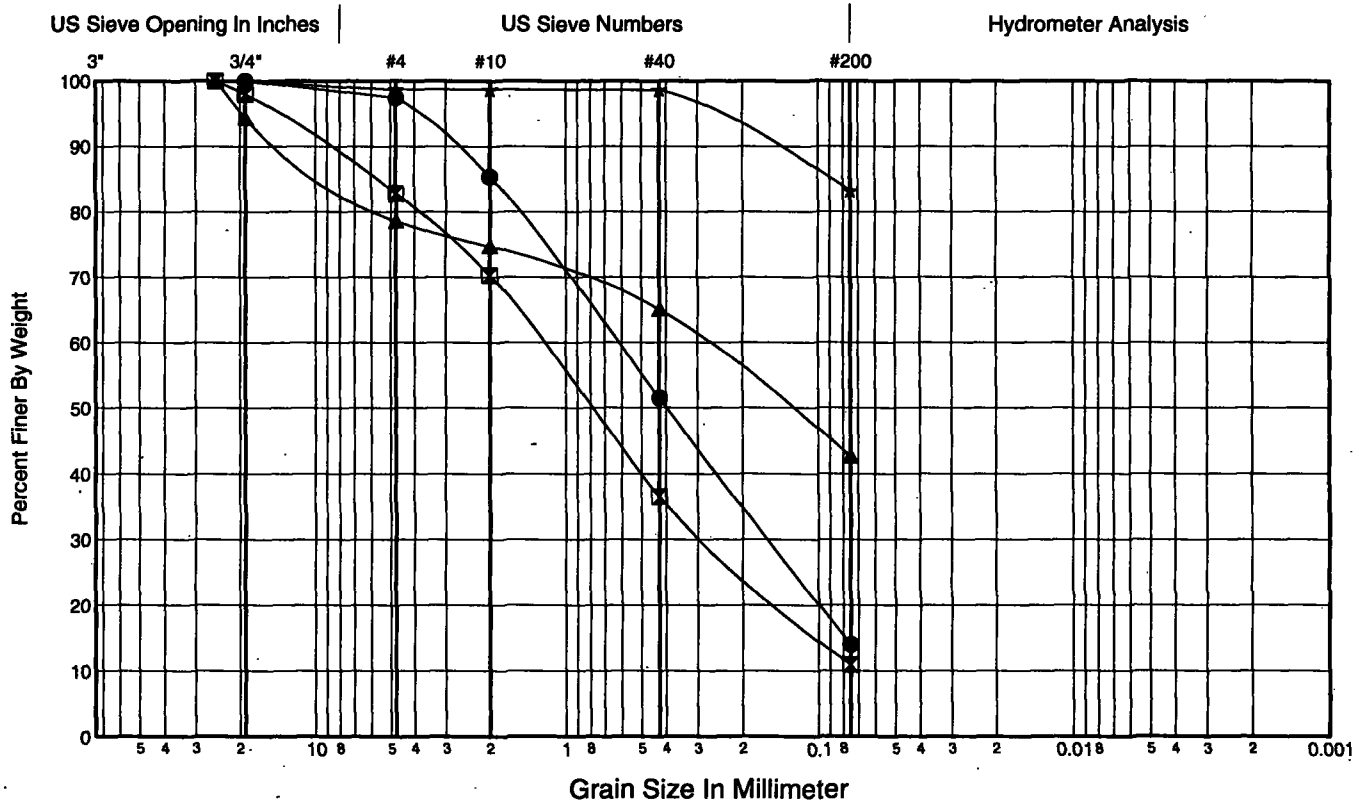
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.0	2.13	D-2	SM	See Boring Log	SILTY SAND	21	NP	NP	NP
⊠	30.5	9.30	D-10	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	17	NP	NP	NP
▲	35.5	10.82	D-11	SC	See Boring Log	CLAYEY SAND with GRAVEL	17	40	25	15
★	40.5	12.34	D-12	CL	See Boring Log	LEAN CLAY with SAND	32	47	22	25

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	2.6	83.4	14.0		
⊠	17.2	71.9	10.9	0.8	17.7
▲	21.4	35.9	42.7		
★	1.3	15.4	83.2		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.63	0.40	0.16	0.10	
⊠	1.25	0.79	0.27	0.14	
▲	0.29	0.13			
★					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-2530** Date **March 31, 2000**

Hole No. **H-14-00** Sheet **1** of **1**

Project **SE 192nd Avenue Interchange**

Laboratory Summary

Washington State Department of Transportation

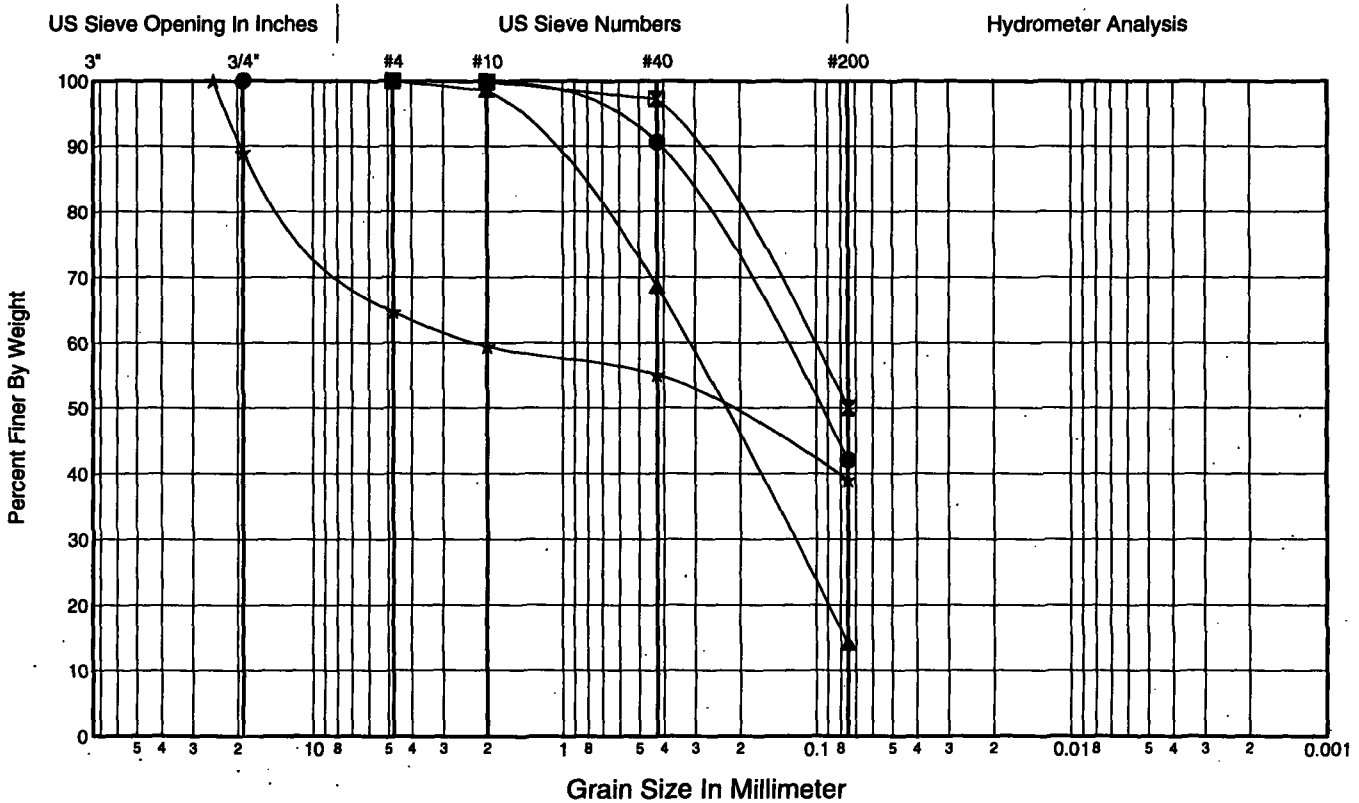
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	6.0	1.83	D-2	SM	See Boring Log	SILTY SAND	27	NP	NP	NP
⊠	9.5	2.90	D-3	ML	See Boring Log	SANDY SILT	27	NP	NP	NP
▲	16.0	4.88	D-6	SM	See Boring Log	SILTY SAND	27	NP	NP	NP
★	24.5	7.47	D-8	GM	See Boring Log	SILTY GRAVEL with SAND	36	37	25	12

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.1	57.8	42.1		
⊠	0.0	50.0	50.0		
▲	0.0	85.8	14.2		
★	35.3	25.6	39.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.14	0.10			
⊠	0.11				
▲	0.32	0.24	0.12	0.09	
★	2.18	0.24			



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	