GEOTECHNICAL INVESTIGATION

MACTEC Project No. 4975-10-8043.01

DURANGO REGIONAL CONVEYANCE CHANNEL

ELWOOD STREET ALIGNMENT BETWEEN 75TH AVENUE AND 107TH AVENUE

PHOENIX, ARIZONA

Prepared for:

J2 ENGINEERING & ENVIRONMENTAL DESIGN, LLC
PHOENIX, ARIZONA

Prepared by:

MACTEC ENGINEERING AND CONSULTING, INC.
PHOENIX, ARIZONA

NOVEMBER 5, 2010

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engineering and constructing a better tomorrow

November 5, 2010

Mr. Jeff Holzmeister
J2 Engineering & Environmental Design, LLC
4649 East Cotton Gin Loop, B2
Phoenix, Arizona 85040

Subject: **Geotechnical Investigation**
Durango Regional Conveyance Channel
Elwood Street Alignment Between 75th Avenue and 107th Avenue
Phoenix, Arizona
MACTEC Project No. 4975-10-8043.01

Dear Mr. Holzmeister:

MACTEC Engineering and Consulting, Inc. (MACTEC) has completed the Geotechnical Investigation for the Durango Channel Regional Conveyance Channel located in Phoenix, Arizona. The results of our evaluation, along with the boring location plan, laboratory test results, and recommendations are attached.

We at MACTEC are committed to providing quality engineering services combined with client satisfaction in order to achieve a continuing relationship with our clients. We appreciate the opportunity to provide these services for you. If you have any questions regarding any of the other engineering and testing services MACTEC provides, please do not hesitate to contact us.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Registered Professional Engineer (Civil) CERTIFICATE NO 41937 MARK HARTIG Date Signed 11.5.10 ARIZONA U.S.A.
EXPIRES 3-31-2011

Dave Klann, E.I.T.
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1.0 PURPOSE

MACTEC has performed an investigation of geotechnical conditions for the proposed Durango Regional Conveyance Channel located at the Elwood Street alignment between 75th Avenue and 107th Avenue in Phoenix, Arizona through field subsurface exploration, laboratory testing, and engineering analyses in order to develop pertinent information and recommendations for design and construction of the proposed project. Our investigation was performed in general accordance with the Flood Control District of Maricopa County (FCD) Consultant Guidelines, and the FCD Scope of Work for Contract FCD 2009C008. This report will provide discussions and recommendations for the following items specific to the proposed design and construction:

- Subsurface conditions
- Land subsidence and possible earth fissuring
- Suitability of on-site soils as fill
- Engineered fill and compaction recommendations
- Foundation types and recommendations, including bearing depth and capacities
- Slabs-on-grade
- Lateral earth pressures and friction
- Slope stability and excavations
- Seismic issues, IBC seismic zones and factors
- Settlement issues
- Corrosivity
- Asphalt pavements

This report does not address any environmental issues related to the site or the project. It is MACTEC's understanding that environmental investigations have been undertaken by others.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared exclusively for J2 Engineering & Environmental Design, LLC (J2) and the Flood Control District of Maricopa County for the design of the proposed Durango Regional Conveyance Channel described herein. This report has not been prepared for any other parties and may not contain sufficient information for purposes of other parties. If any of the project information described in Section 2.0 of this report has changed, we should be notified so that we may amend our recommendations and discussions as necessary.

2.0 PROJECT INFORMATION

In accordance with the Draft Pre-Design Report provided to MACTEC by J2, this proposed project consists of a four mile long drainage corridor, from 75th Avenue to 107th Avenue along the Elwood Street alignment. Box culverts at the existing roadway crossings will be improved and/or replaced. Three multipurpose detention/retention basins will be added; 1 near 107th Avenue, and 2 between 89th Drive and 85th Avenue. The preliminary estimated depth of the 107th Avenue basin is approximately 12 feet, and the preliminary estimated depths of the remaining 2 basins are approximately 8 feet. Maintenance roads adjacent to the drainage corridor will also be added along with trails and other associated features.

Drainage facilities within the corridor were partially constructed by the adjacent developments. The intent of this project is to enhance the existing facilities to provide a continuous segment of the regional drainage facility.

If any of this project information is incorrect, please notify us immediately so we may modify and/or amend our discussions and recommendations as necessary.

3.0 FIELD EXPLORATION AND SITE CONDITIONS

3.1 FIELD EXPLORATION AND LABORATORY TESTING

For this Geotechnical Investigation, a total of 20 test borings were drilled to depths ranging from approximately 17 to 20.5 feet. The borings were located as shown on the attached Boring Location Plans, and in general are spaced about every 1000 feet. Due to restricted access in some locations, boring spacing was adjusted as necessary. Additionally, 7 surficial samples were collected near the existing culvert locations for gradation testing. These locations are also shown on the attached Boring Location Plans and are delineated with an 'A' after the boring number.

As part of our investigation, we also performed 6 double-ring infiltration tests at the locations noted on the attached Boring Location Plans. Due to the large excavations required to perform the infiltration tests at the design depths of the retention basins, we were instructed to perform the

tests in the existing adjacent retention basins (as shown on the attached Boring Location Plans) instead.

After results of the infiltration testing were presented to J2, MACTEC was requested to perform percolation testing between 89th Drive and 85th Avenue, within the proposed retention/detention areas. Three percolation tests (28, 20, and 25 feet in depth) were performed in this area in 12-inch diameter unlined bore holes.

The test borings and percolation tests were advanced using 8-inch and 12-inch O.D. hollow stem auger (HSA) advanced by truck-mounted Diedrich D-50 and D-125 drill rigs owned and operated by D & S Drilling, Inc. A City of Phoenix Right-of-Way Permit (No. CMC 10017187) was obtained prior to accessing the site, and the appropriate land owners and/or farmers were contacted for entry permission prior to accessing the site. The locations of the test borings, surficial samples collected, infiltration tests, and percolation tests are shown on the Boring Location Plans, included as Figures 2 through 8 in this report. The logs of the test borings are presented in Appendix A.

The soils encountered during drilling at each test boring location were visually classified by our staff engineer and recorded on a field log along with notes regarding the general subsurface conditions pertinent to geotechnical design. The borings were generally located on the existing channel access roads or in the existing farm fields (new channel area). Penetration testing and sampling of soils to obtain relatively undisturbed samples was performed within the test borings at typical intervals of one sample in the upper 5 feet, and every 5 feet thereafter until boring termination. The Standard Penetration Tests (SPT's) were performed in general accordance with ASTM D 1586. Blow counts of the penetration were not modified for energy delivery or overburden. The relatively undisturbed "Ring" samples (2.42-inch inside diameter, 1-inch deep brass rings), soils recovered in the split-spoon type SPT samplers, and/or bulk samples of drill cuttings from the auger borings were obtained and transported to our laboratory for possible laboratory testing. After completion of the laboratory tests on the retrieved samples, the soil classifications and descriptions recorded on the field logs were reviewed and modified where necessary to produce the final boring logs presented in Appendix A. Our field and final soil classifications were based on the Unified Soil Classification System (USCS), a summary of which is presented in Appendix A.

For the purpose of evaluating the pertinent engineering properties of the site soils, laboratory tests were performed on the representative bulk and undisturbed samples obtained during our field exploration. The following tests were performed in general accordance with the applicable ASTM, Arizona, and EPA test methods:

- Soil Classification (Gradation/Atterberg Limits) (ASTM C136, C117, and D4318)
- In-Situ Density and Moisture Content Determination (ASTM D2435 and D7263)
- Expansion Potential (ASTM D4546 Method B)
- Collapse Potential (ASTM D5333)
- Soluble Chlorides and Sulfates (EPA 300.0)
- pH and Minimum Resistivity (ARIZONA Method 236a)
- Agronomy

The Expansion Potential tests were performed in general accordance with ASTM D4546 Method B. The applied load to the sample specimens was approximately 100 pounds per square foot. The specimens were remolded to approximately 95 percent compaction and 3 percent below optimum of a standard Proctor (ASTM D698).

A full series of agronomy testing was performed on 5 selected samples and is included as Table 6 of Appendix B. The agronomy testing was performed by IAS Laboratories.

The results of the laboratory tests performed are presented in Tables 1 through 6, Summary of Laboratory Testing, presented in Appendix B.

3.2 SITE DESCRIPTION

The project site is situated along the Elwood Street Alignment (between Broadway Road and Lower Buckeye Road) and between 75th Avenue and 107th Avenue. The project site is approximately 4 miles long, and falls within Sections 20, 21, 22, and 23 of Township 1N, Range 1E.

The project site consists of an existing drainage corridor that is generally bordered to the north and south by housing developments and farm fields. Some existing drainage facilities consisting of channels, culverts, and retention basins are present throughout most of the project corridor. The existing drainage facilities appear to mostly have been constructed by the individual developments

along this 4 mile corridor. The site crosses several existing north/south roadways, and also contains existing walking/running trails along certain portions.

3.3 SITE GEOLOGIC PROFILE

Based on the information reviewed by MACTEC, the project site lies within the southwestern United States' Basin and Range Physiographic Province. Regionally, the Site is within the locally designated Salt River Valley. The Salt River Valley is a westerly sloping alluvial valley bounded by relatively low, rugged, block-faulted mountains. The mountains are comprised primarily of granitic, metamorphic, and volcanic rocks. The Salt River Valley includes a series of structural basins filled with thick sedimentary deposits. The basin fill sediments are interpreted to be mostly unconsolidated, alluvium with gravel-, sand-, silt-, and clay-sized particles.

3.4 SITE GEOTECHNICAL PROFILE

The native subsurface materials present at the subject site include recent alluvial/fluvial deposits of sandy clays, clayey sands, silty sands, and combinations thereof. Shallow fill was encountered in a few of our soil borings as noted on the boring logs in Appendix A, and should be expected occasionally along the corridor. In a few of the borings, cleaner sands were encountered between the 10 and 20 foot depths. The consistency of the native soils is typically medium dense to very dense and firm to hard to the depths explored. The native soils tested for collapse exhibited a low potential for collapse, with low additional collapse when subjected to increases in moisture while under load. The native soils tested for expansion exhibited a low to high expansion potential when subjected to light loads and saturated.

Ground water was not encountered in our test borings. Information available on the Arizona Department of Water Resources (ADWR) website (http://www.azwater.gov/dwr/) indicates that the depth to ground water recorded in several wells located in the vicinity of the project site ranges from approximately 43 to 75 feet below existing ground surface. The moisture content of the soils encountered were typically described as being moist to wet, varying throughout the depths of investigation; the moisture contents of tested samples ranged from 10.2 to 32.6 percent.

Information available through the Arizona Geological Survey indicates the closest mapped earth fissure to the project site is approximately 7 miles to the northwest at Luke Air Force Base (http://www.azmap.org/fissures).

Land subsidence maps for various regions in Arizona have been prepared by the Arizona Department of Water Resources (http://www.azwater.gov). Based on our review of these maps, significant subsidence has not been reported within the project boundaries.

Continued groundwater withdrawal in the area could potentially cause new earth fissures near the site, could cause existing fissures to extend to the site, and may result in land subsidence at the project site. Land subsidence and fissures cannot be accurately predicted at this time; however they are not expected to be a constraint to the construction of this project.

3.5 INFILTRATION TESTING

On September 29, 30 and October 5, 2010, MACTEC performed double-ring infiltration testing in the existing retention basins adjacent to the proposed retention basins associated with the Durango Regional Conveyance Channel project. Due to the large excavations required to perform the infiltration tests at the design depths of the proposed retention basins, we were instead instructed to perform the tests in the existing retention basins (as shown on the attached Boring Location Plans). Two of the tests were performed near the 107th Avenue proposed basin, and 4 of the tests were performed between 85th Avenue and 89th Drive near the 2 proposed basins. As discussed previously, the basin near 107th Avenue is currently proposed to be 12 feet in depth from the existing farm land grade. The two infiltration tests were performed approximately 9 and 6 feet below the farm land grade. The two basins near 85th Avenue are proposed to be 8 feet in depth from the existing farm land grade. The four infiltration tests were performed approximately 6, 8, 3, and 4 feet below the existing farm land grade. The approximate test locations can be found on the attached Boring Location Plans. The tests were performed utilizing the double-ring infiltrometer method as outlined in ASTM Standard D 3385, and as required by Standard 6.10.12 of the current Maricopa County Drainage Policies and Standards. The double-ring infiltrometer tests were performed in the native soils at depths ranging from 6 to 10 inches below the existing retention basin grades. The results of the infiltration tests are provided in the following table:

Test No.	Approximate Location (1)	Measured Stabilized Infiltration Rate (cm/hour) (2)	Measured Stabilized Infiltration Rate (cubic feet per hour/ square foot) (3)
I1	400' E of 107th Ave, 130' S of Power Lines, Approx. 9 ft. Below Adjacent Farm Land Grade	7.3	0.24
I2	1,010' E of 107th Ave, 160' S of Power Lines, Approx. 6 ft. Below Adjacent Farm Land Grade	0.8	0.027
I3	340' E of 89th Dr, 80' N of Power Lines, Approx. 6 ft. Below Adjacent Farm Land Grade	1.0	0.033
I4	1,240' E of 89th Dr, 60' N of Power Lines, Approx. 8 ft. Below Adjacent Farm Land Grade	1.7	0.057
I5	70' E of W. Riley Rd, under the Power Lines, Approx. 3 ft. Below Adjacent Farm Land Grade	0.5	0.017
I6	650' E of W. Riley Rd, 15' N of Power Lines, Approx. 4 ft. Below Adjacent Farm Land Grade	0.3	0.010

(1) Test locations may be found on the Boring Location Plans.
(2) Field measurements and calculated results reported in metric units, including infiltration velocity rate in centimeters per hour in accordance with ASTM D 3385.
(3) Calculated infiltration rates converted from metric infiltration velocity rates in cm/hour to standard English volumetric infiltration rates.

3.6 PERCOLATION TESTING

After review of the above provided infiltration results by J2, MACTEC was requested to perform some additional percolation testing in general accordance with Title 18 - Environmental Quality of the Arizona Administrative Code. Twelve-inch diameter soil borings were drilled to depths in which sandy or clayey sand layers were encountered in the proposed retention areas between 85th Avenue and 89th Drive. Two percolation tests were planned; however one test hole had minor sidewall collapse during the test, so a third percolation test hole was drilled. The bottom of the test holes were filled with approximately 3 inches of gravel, and the percolation tests were performed in the unlined bore hole with approximately 1 foot of water head. The locations of the percolation tests are presented on the attached Boring Location Plans. After appropriate pre-soaking of the test holes, the following stabilized percolation rates were measured:

Percolation Number	Bore Hole Diameter	Depth Below Existing Grade	Stabilized Percolation Rate (minutes per inch)
*P1	12-inches	28 feet	30
P2	12-inches	20 feet	15
P3	12-inches	25 feet	30

*Bore hole had minor sidewall collapse during test.

3.7 EXISTING STREET CROSSINGS

During vacuum excavation services being performed at street crossings (for utility location) by Aztec for this project, MACTEC observed existing pavement section thicknesses. In some instances, due to scheduling difficulties, MACTEC was not on site during excavation by Aztec and instead relied on Aztec's measurements for the pavement section thickness. It should be noted that Aztec did not measure the Aggregate Base thickness as part of their operations. The following table presents the existing section thicknesses as measured. Thicknesses provided by Aztec are highlighted in grey.

Street Name	Street Designation[1]	Approximate Location of Pothole	AC Thickness	Aggregate Base Thickness
76th Avenue	*Minor Collector*	*None Performed – Unpaved Roadway*	*N/A*	*N/A*
79th Avenue	Collector	300' N. of Elwood St. -NB	4 inches[2]	Not Reported
79th Avenue	Collector	250' N. of Elwood St. - NB	3 inches[2]	Not Reported
83rd Avenue	Arterial	SB - Shoulder	3.5 inches[2]	Not Reported
83th Avenue	Arterial	SB - Shoulder	4 inches[2]	Not Reported
89th Drive	Minor Collector	NB - West of Centerline	4 inches	4.5 inches
91st Avenue	Arterial	NB - Right Shoulder	12 inches	None Present
91st Avenue	Arterial	SB - Right Lane	7 inches	None Present (4' of slurry encountered)
91st Avenue	Arterial	NB - Left Lane	14.5 inches	12 inches
92nd Drive	Minor Collector	NB - 7' W. of East Curb	3.75 inches	7 inches
95th Avenue	Minor Collector	NB - 8' W. of East Curb	3.25 inches	8 inches
99th Avenue	Arterial	NB - 650 ' N. of Illini St.	6 inches[2]	Not Reported
99th Avenue	Arterial	NB - 700' N. of Illini St.	6 inches[2]	Not Reported
103rd Avenue	Minor Collector	NB	2.75 inches	11 inches

(1) Street Designations as provided in the City of Phoenix Street Classification Map
(2) Thickness measurements provided by Aztec

It's our understanding that the intent of the FCD is to replace asphalt concrete (AC) pavement sections at roadway crossings to match the existing pavement sections. It appears that the thicknesses of the asphalt concrete layers encountered are generally adequate for the respective types of streets. However, actual thickness encountered during construction may vary with location and, in some cases, may not meet current standards for structural pavement design.

4.0 RECOMMENDATIONS

4.1 GENERAL

The recommendations contained in this report were based on the soils and conditions encountered in the test borings performed for the field investigation of the proposed Durango Regional Conveyance Channel. We have assumed that the soils and conditions encountered within the test borings advanced at the project site are also representative of the characteristics of the portions of the site between borings. If soil conditions different than those presented herein are encountered during construction operations, we should be notified so that we may amend or revise our recommendations as necessary.

As discussed previously, the existing near-surface soils at the site are typically in a medium dense to dense, or firm to hard state. These soils exhibit a low potential for settlement and a low to high potential for expansion. Given the variation in soil conditions, existing native soils should not be used to provide direct support for typical shallow foundations without proper treatment.

4.2 WING WALLS AND RETAINING WALLS

Provided the recommendations presented in the Earthwork section (Section 5.0) of this report are followed, walls associated with this project may be supported by typical shallow spread foundations (footings) bearing on engineered fill materials as recommended herein. Spread and continuous footings for the proposed structures should not bear directly upon existing near-surface soils without treatment to provide firm, consistent, level bearing surfaces.

Spread footings supporting proposed structures may be designed using a recommended maximum allowable uniform bearing pressure of 2,500 pounds per square foot (psf) provided that the footings are supported by and bearing directly upon a minimum of 1 foot of properly prepared engineered fill materials. A one-third increase in bearing pressure may be used for temporary wind or seismic loads. The recommended minimum width for spread footings is 1.5 feet. The bottom of footings should bear at a depth of at least 1.5 feet below the lowest adjacent grade.

The recommended maximum allowable bearing pressure presented herein considers both dead and live loads. A one-third increase in bearing pressure may be used for temporary wind or seismic loads. The location of the resultant pressure on the base of each footing should be maintained within the middle third of the footing at its base.

Assuming that the footings bear upon properly prepared engineered fill materials as recommended herein, the total settlement of footings designed using the maximum allowable bearing pressure is estimated to be less than one inch, with differential settlement estimated to be less than ½ inch.

Foundation excavations should be observed by a geotechnical engineer or his/her representative to verify that the foundations will be established in properly compacted engineered fill. Any loose soils in the excavations should be removed prior to placing steel or concrete.

Wall footings should be protected down- and up-stream of the box culverts with rip rap or other similar erosion control methods to prevent scour and undermining of the footings.

4.3 BOX CULVERTS

Native clayey site soils have a high potential for expansion. Slabs for the proposed culverts should be supported on a minimum of 24 inches of properly prepared and compacted engineered fill materials constructed from approved overexcavated on-site soils and/or non-expansive imported materials. The overexcavation, processing, moisture conditioning, and controlled compaction of the existing near-surface subgrade soils as recommended in the Earthwork section (Section 5.0) of this report should serve to help moderate the potential movement of the culverts. Testing should be performed during earthwork operations to verify that materials present, and/or proposed to be placed within 24 inches of the base of the slabs possess expansion potentials less than the

maximum allowable in accordance with the recommendations provided in Section 5.5 of this report. Materials present within 24 inches of the base of the slabs exceeding the maximum allowable expansion potential should be removed and replaced with non-expansive materials.

An allowable soil bearing pressure of 2,500 psf may be used for the culvert base slab founded on engineered fill as described above. A coefficient of friction of 0.35 may be used against sliding between the culvert slab and engineered fill soils. We estimate that the culvert slab, if prepared as described herein, will experience movements of less than 1 inch.

The box culvert base slabs should be protected down- and up-stream with rip rap or other similar erosion control methods to prevent scour and undermining of the slabs.

4.4 LATERAL EARTH PRESSURES

Lateral loads applied to spread footings may be resisted by soil friction at the base of the footing and by passive resistance of soils in contact with the face of the toe or heel of the footing, depending on the direction of the applied lateral load(s). For spread footings bearing on and within properly prepared engineered fill materials, an allowable base coefficient of friction value of 0.35 may be used in conjunction with an allowable passive lateral soil resistance equivalent to a fluid pressure of 250 psf per foot beneath the lowest adjacent finished grade. A one-third increase in the passive resistance may be used in design for temporary wind or seismic loads.

For design of unrestrained below-grade vertical structural elements that retain earth including stem walls, bearing walls, and retaining walls, the effects of active lateral earth pressures may be designed using an equivalent fluid pressure of 35 psf per foot of depth. If walls are restrained from moving at the top (such that horizontal deflection is less than 0.001 times the wall height), then the resulting at-rest earth pressure may be designed using an equivalent fluid pressure of 55 psf per foot. These earth pressures are based on the construction of level backfill and do not include consideration of forces associated with hydrostatic conditions behind the walls or footings, seismic, or other dynamic conditions. High plasticity clayey soils should not be placed as backfill within 2 feet behind or adjacent to walls. Wall drain systems consisting of geocomposite or similar materials should be placed at the back of retaining walls to promote drainage. Compaction of fill within 2 feet behind retaining walls should be accomplished by hand tampers or other small

equipment in lifts not exceeding 6 inches. Compaction behind walls with heavier equipment may cause overcompaction resulting in excessive lateral pressures and unacceptable wall movements.

4.5 PAVEMENT SECTION DESIGN

It is MACTEC's understanding that AC pavement areas disturbed and/or removed during the installation or upgrade of the box culverts will be replaced by generally matching pavement sections. The existing pavement sections as measured varied, and may not be representative of the overall section of pavement to be removed. Therefore, the cross-sections as provided in Section 3.7 may be used for preliminary data. However once the street is opened up during construction, the existing pavement section thickness should be verified prior to replacement with a matching section. It is possible that some of the pavement sections encountered may not meet current City of Phoenix standards.

To provide indicators to field personnel of which sections might require verification of structural adequacy, MACTEC performed a preliminary analysis of minimum thickness requirements for AC pavement and aggregate base course for various levels of traffic for collector and arterial streets, based on a minimum R-value of 30 as recommended for engineered fill. The analysis was performed according to the procedures in Chapter 10 Pavement Design Guide in the 2004 Maricopa County Department of Transportation (MCDOT) *Roadway Design Manual*, using the AASHTO DARWin 3.1 Pavement Design software. The following tables present the parameters used in the designs and the corresponding pavement cross-sections.

Collector Street Crossings - Anticipated Ranges of Thickness for Asphalt Concrete Pavement Layers for Various Traffic Levels			
2-Way ADT, vehicles per day	500	5,000	7,000
# Lanes in design direction	1	1	1
% Trucks in Design Lane	100	100	100
% Trucks in design direction	50	50	50
% Trucks ≥FHWA Class 5	100	100	100
ESALs per Truck	1.2	1.2	1.2
Annual Truck Volume Growth Rate, %	3	3	3
20 year ESALs	140,804	1,408,039	3,154,007
Initial Serviceability	4.4	4.4	4.4
Terminal Serviceability	2.3	2.3	2.3
Reliability Level, %	90	90	90
Overall Standard Deviation	0.45	0.45	0.45
Roadbed Soil Resilient Modulus, psi	17,785	17,785	17,785
Required Structural Number (SN)	1.78	2.59	2.94
Asphalt Concrete Structural Coefficient	0.42	0.42	0.42
Asphalt Concrete Thickness, inches	**3.5**	**5.0**	**6.0**
Aggregate Base Course Structural Coefficient	0.12	0.12	0.12
Aggregate Base Course Thickness, inches	**4.0**	**4.0**	**4.0**
Section Structural Number (SN)	1.95	2.58	3.00

Arterial Street Crossings – Anticipated Ranges of Thickness for Asphalt Concrete Pavement Layers for Various Traffic Levels				
2-Way ADT, vehicles per day	6,000	18,000	22,000	45,000
# Lanes in design direction	2	2	2	2
% Trucks in Design Lane	90	90	90	90
% Trucks in design direction	50	50	50	50
% Trucks ≥FHWA Class 5	5	5	5	5
ESALs per Truck	1.2	1.2	1.2	1.2
Annual Truck Volume Growth Rate, %	3	3	3	3
20 year ESALs	1,520,682	4,562,046	5,575,833	11,405,114
Initial Serviceability	4.5	4.5	4.5	4.5
Terminal Serviceability	2.5	2.5	2.5	2.5
Reliability Level, %	95	95	95	95
Overall Standard Deviation	.45	.45	.45	.45
Roadbed Soil Resilient Modulus, psi	17,785	17,785	17,785	17,785
Required Structural Number	2.79	3.31	3.42	3.81
Asphalt Concrete Structural Coefficient	0.42	0.42	0.42	0.42
Asphalt Concrete Thickness, inches	**5.5**	**6.5**	**7.0**	**7.5**
Aggregate Base Course Structural Coefficient	0.12	0.12	0.12	.12
Aggregate Base Course Thickness (in)	**4.0**	**5.0**	**4.0**	**6.0**
Section Structural Number	2.79	3.33	3.42	3.87

The layered elastic design method was used to determine the minimum thickness of AC required based on fatigue criteria. These preliminary designs indicate the following:

- For Collector streets, AC layers less than 3.5 inches thick may not meet current structural standards
- For Arterial streets, AC layers less than 5.5 inches thick may not meet current structural standards

If layers of AC thinner than these minimum values are encountered, MACTEC recommends contacting the City of Phoenix to obtain current and projected future traffic volumes and, if available, vehicle classification information to provide site specific analysis of the minimum AC thickness required to meet current standards.

Asphaltic concrete for the proposed project should consist of dense-graded, central plant mixed asphalt concrete generally conforming to the requirements of Section 710 of the Maricopa Association of Governments (MAG) Uniform Standard Specifications for Public Works Construction for Marshall Mix Design. Aggregate base course should generally conform to the requirements of Sections 702.2 of the MAG Specifications for crushed aggregate.

4.6 SEISMIC CONSIDERATIONS

For structural design based on the International Building Code, 2006 edition, the following seismic parameters should be used:

Parameter	Value	2006 IBC Reference
Site Class Definition	D	Table 1613.5.2
Site Coefficient F_a	1.60	Table 1613.5.3(1)
Site Coefficient F_v	2.40	Table 1613.5.3(2)
Spectral Acceleration S_{D1}	0.094	Section 1613.5.4
Spectral Acceleration S_{DS}	0.179	Section 1613.5.4

4.7 PERMANENT SLOPES

Based on the information received from our soil borings and our experience with similar projects and conditions, we recommend that permanent cut and fill slopes associated with the project be constructed no steeper than 3:1 (horizontal:vertical). Protection of these slopes from water erosion should be taken into account during design.

4.8 SOIL CORROSIVITY

Four selected samples at the site were tested for sulfate and chloride contents, minimum Resistivity, and pH levels. The test results indicate that the soils encountered at the site are potentially corrosive to buried steel structures and pose a moderate potential for sulfate attack on Portland cement concrete. Special consideration should be given to the use of corrosion protected steel pipes (if planned). Type II cement may be used for construction of concrete structures at this site. However, due to the potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, pozzolan or admixtures designed to increase sulfate resistance should be considered. The results of these tests are presented in Tables 4 and 5, included in Appendix B.

5.0 EARTHWORK

5.1 GENERAL

Vegetation, debris, organic topsoil, existing fill soils, and any other deleterious materials shall be stripped from proposed structural areas. The removal of such materials should be performed in a manner that will result in exposed surfaces free of mounds and depressions.

Based on our observations of the near-surface soils, we anticipate that conventional equipment will be able to perform shallow excavations for the proposed construction. However, contractors should draw their own conclusions based on their own evaluation of the site for the purpose of estimating excavation requirements since subsurface conditions between borings may vary somewhat from those presented in this report.

Temporary excavation slopes for the proposed construction should be performed in accordance with OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, Subpart P. While some of the near surface soils would classify as Type B soils, they are intermixed throughout the site with cleaner sandy soils that would classify as Type C soils. Therefore, for excavations of less than 20 feet in depth, Subpart P, Appendix B allows maximum allowable unshored slope inclinations of 1.5H:1V and (Horizontal to Vertical) for Type C soils.

5.2 WING WALLS AND RETAINING WALLS

Footings should bear on properly compacted engineered fill material which extends to a minimum depth of 1 foot below footing bottom elevations. The lateral limits of the overexcavation should extend a minimum of 1 foot horizontally beyond the footing edges in plan. Following the overexcavation of the existing subgrade soils to the minimum depth and horizontal limits recommended, the materials exposed at the base of the excavation should be inspected and approved prior to the placement of engineered fill. The depth of overexcavation recommended herein should be considered to be the minimum amount required; additional overexcavation may be required if additional soft, loose, disturbed, or otherwise deleterious or unacceptable soils are present, as determined during inspection by the geotechnical engineer or his representative. The overexcavated site soils meeting the materials requirements provided herein may then be moisture-conditioned, placed, and compacted to backfill the overexcavation with engineered fill as recommended in the Compaction section (Section 5.5) of this report.

5.3 BOX CULVERTS

In box culvert slab areas, the upper 24 inches of native soils below the planned subgrade level should be overexcavated and replaced with properly compacted fill. The overexcavation should extend laterally beyond the slab footprint a minimum of 2 feet. Following the removal of the overexcavated soils, the soil exposed at the base of the excavation should be inspected and approved by a geotechnical engineer or his/her representative prior to the placement of engineered fill. Any soft, loose, disturbed, or otherwise deleterious or unacceptable soils present that are identified during inspection should be removed and replaced with engineered fill. The overexcavated site soils meeting the materials requirements provided herein may then be moisture-conditioned, placed, and compacted to backfill the overexcavation with engineered fill as recommended in the Compaction section (Section 5.5) of this report.

5.4 PAVEMENT AREAS

Native clayey soils encountered at the site are generally not suitable for use directly below asphaltic concrete pavements. Therefore, pavement sections shall bear on a minimum of 24 inches of non-expansive, properly compacted, native or import soils. These soils should have an R-Value

of 30 or more, and should meet the requirements of the Materials section (Section 5.6) of this report.

5.5 COMPACTION

The placement and compaction of fill in horizontal lifts should be performed using methods that will produce uniform moisture contents and densities throughout the lift. The thickness of uncompacted fill lifts should not exceed 8 inches. Materials shall be compacted to the following densities and moistures:

	ASTM D698	Moisture Specification
Approved Native Site Soils		
Structural Areas	95% Min	+/- 3% of Optimum
Pavement Areas	95% Min	+/- 3% of Optimum
Channel Areas	95% Min	+/- 3% of Optimum
Imported Fill Material		
Structural Areas	95% Min	+/- 3% of Optimum
Pavement Areas	95% Min	+/- 3% of Optimum
Channel Areas	95% Min	+/- 3% of Optimum
Aggregate Base Course		
Below Pavement	100% Min	+/- 2%
Landscape Areas	90% Min	+/- 2%

Prepared subgrade soils should not be allowed to dry out prior to placing concrete for footings and slabs or aggregate base course beneath pavements in order to minimize the potential for future expansion of compacted clayey subgrade soils.

5.6 MATERIALS

Based on the results of our laboratory testing, some site soils possess a high potential for expansion. We recommend that native soils placed as engineered fill within 24 inches of slabs, culverts, retaining walls, and pavements possess an expansion potential of 1.5 percent or less. Soils possessing expansion potentials greater than 4 should not be used as engineered fill (below

structures, including pavements) at any depth. Regular expansion potential testing during construction operations will be necessary to identify the expansive soils.

Existing site soils and imported soils to be used as engineered fill below slabs-on-grade (within 24 inches) and pavement areas (within 24 inches), and behind wing and retaining walls should conform to the following criteria:

Gradation (ASTM C 136)	
Particle Size	Percent Finer by Weight
6"	100
2"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	75 or less
Plasticity Index (ASTM D 4318)	
15 or less	
R-Value (ASTM D2844)	
30 or more within 24 inches of pavement sections	
Expansion Potential (ASTM D 4546)	
1.5 % or less (when placed within 24 inches below slabs and pavements, and within 24 inches of walls)	

The expansion potential specification is based on a low temperature oven-dried sample compacted to approximately 95 percent of the maximum dry density determined by ASTM Standard D698 at a moisture content about 3 percent below optimum, and tested under saturation with a surcharge load of 100 psf.

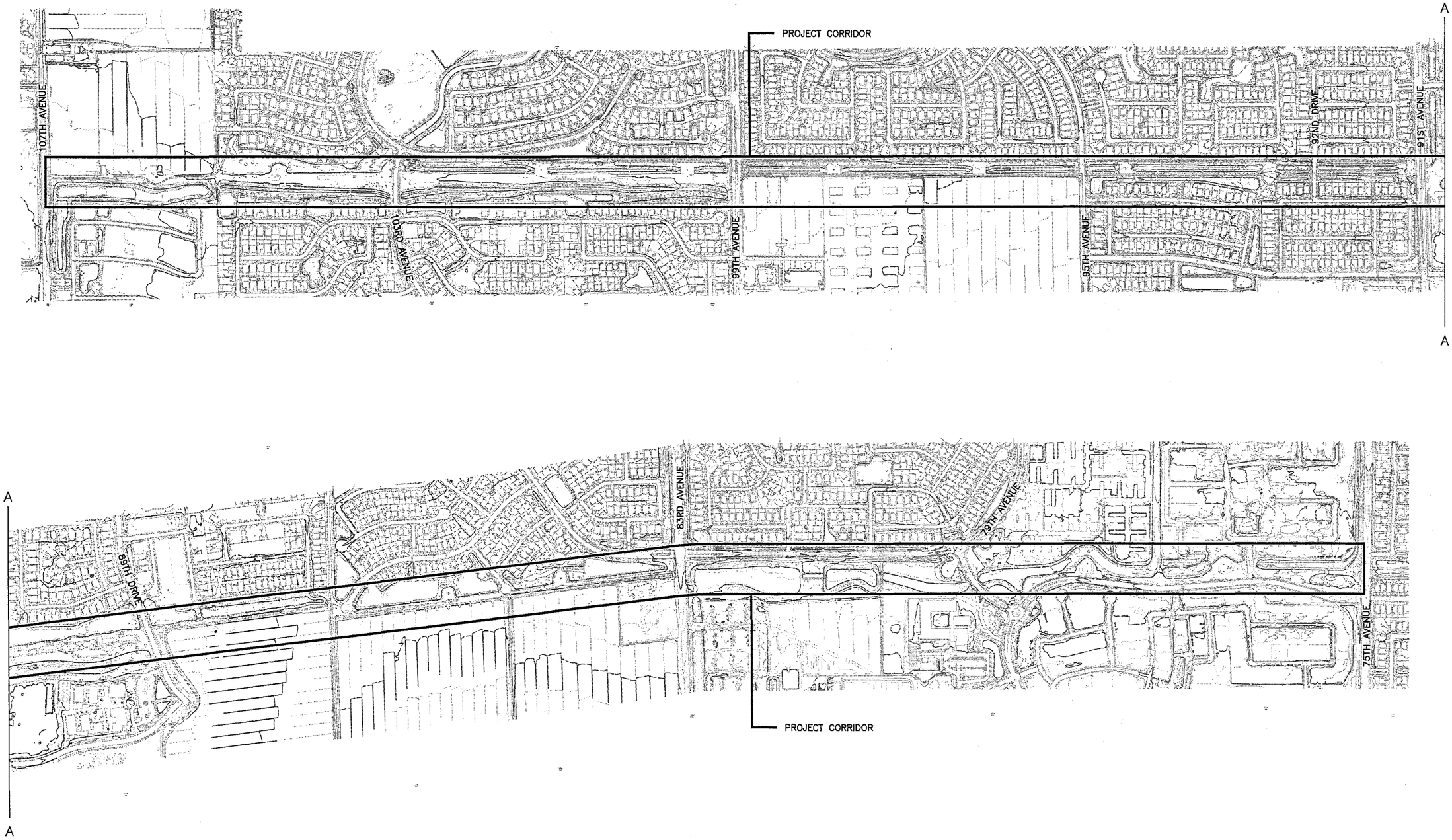
6.0 BASIS FOR RECOMMENDATIONS

The recommendations provided in this report are based on our understanding of the project described herein and on our interpretation of the data collected during the subsurface exploration. We have made our recommendations based on experience with similar subsurface conditions under similar loading conditions. These recommendations apply to the specific project discussed in this report; therefore, any changes in load conditions or site grades should be provided to us so that we may review our conclusions and recommendations and make any necessary modifications.

Regardless of the thoroughness of the geotechnical exploration, there is always a possibility that conditions between the test borings will be different than those encountered in the test borings, or that soil conditions may change subsequent to our investigation. Therefore, an experienced geotechnical engineer or qualified technical representative should monitor the earthwork and subgrade construction to confirm that the soil conditions encountered in the field conform to those described in this report.

FIGURES

MACTEC



OVERALL SITE PLAN
SCALE:
NTS

OVERALL SITE PLAN	FIGURE 1

MACTEC PROJECT NAME: DURANGO REGIONAL CONVEYANCE CHANNEL
MACTEC PROJECT NO: 4973-10-8043.01
DATE: 11-1-10 E-FILE: 108043.01BLP
DRAWN BY: DAK CHECKED BY:

MACTEC
MACTEC ENGINEERING AND CONSULTING, INC.
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX: (602) 437-3675

BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'

LEGEND:

B1 ⊕ APPROXIMATE SOIL BORING LOCATION

I1 ⊞ APPROXIMATE DOUBLE RING INFILTRATION TEST LOCATION

BORING LOCATION PLAN	FIGURE 2

MACTEC PROJECT NAME:	DURANGO REGIONAL CONVEYANCE CHANNEL		
MACTEC PROJECT NO:	4973-10-8043.01		
DATE:	11-1-10	E-FILE:	108043.01BLP
DRAWN BY:	DAK	CHECKED BY:	

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3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX: (602) 437-3675

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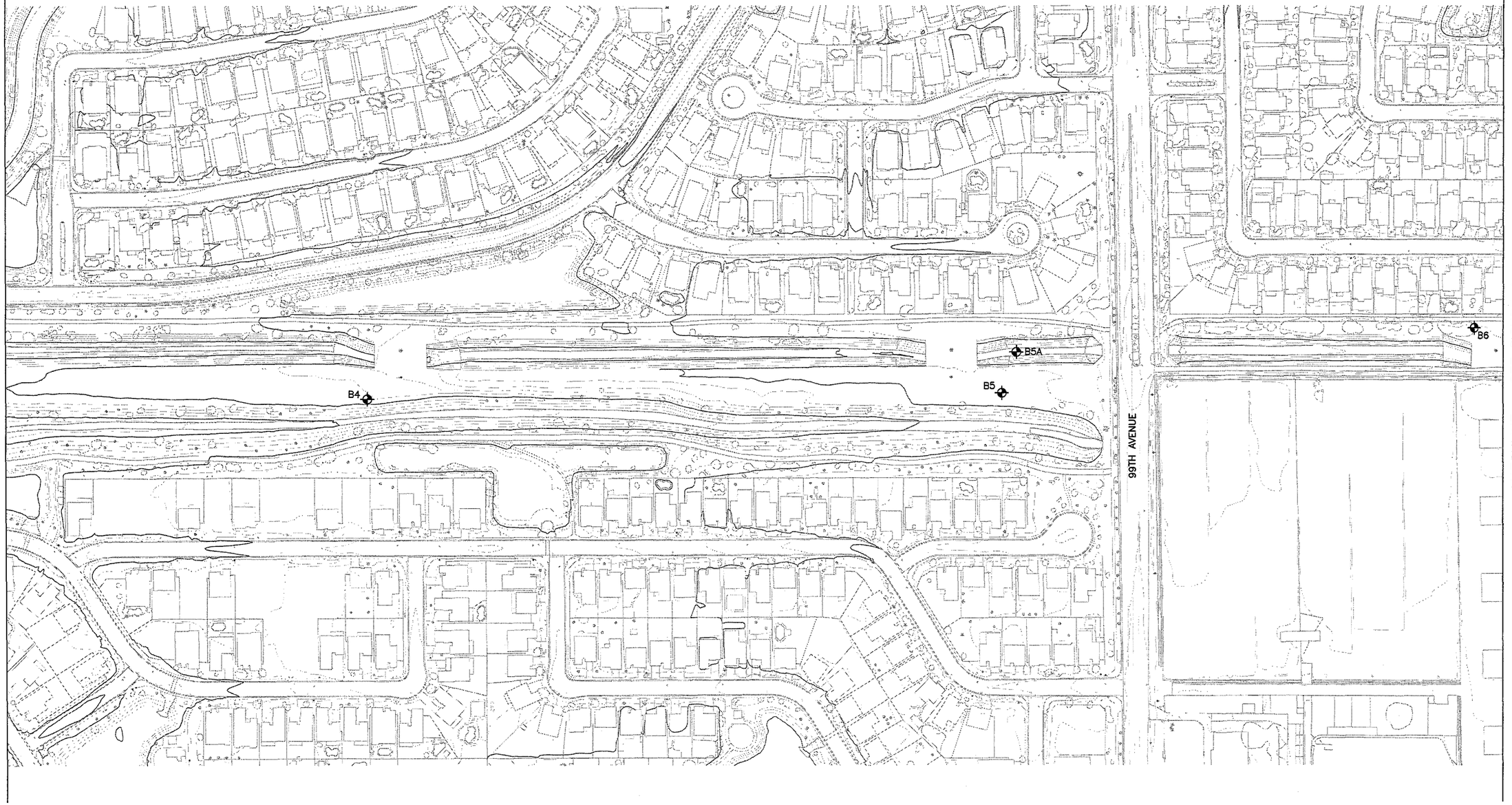
File Last Updated: Tue, 2 Nov 2010



BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'

LEGEND:

B1 ⊕ APPROXIMATE SOIL BORING LOCATION

BORING LOCATION PLAN	FIGURE 3

MACTEC PROJECT NAME:	DURANGO REGIONAL CONVEYANCE CHANNEL		
MACTEC PROJECT NO:	4973-10-8043.01		
DATE:	11-1-10	E-FILE:	108043.01BLP
DRAWN BY:	DAK	CHECKED BY:	

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File Last Updated: Tue, 2 Nov 2010

BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'
LEGEND:
B1 APPROXIMATE SOIL BORING LOCATION

BORING LOCATION PLAN

FIGURE 4

MACTEC PROJECT NAME: DURANGO REGIONAL CONVEYANCE CHANNEL
MACTEC PROJECT NO: 4973-10-8043.01
DATE: 11-1-10
E-FILE: 108043.01BLP
DRAWN BY: DAK
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File Last Updated: Tue, 2 Nov 2010

MATCHLINE – SEE FIGURE 4

MATCHLINE – SEE FIGURE 6

BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'
LEGEND:
B1 ⊕ APPROXIMATE SOIL BORING LOCATION

BORING LOCATION PLAN

FIGURE 5

MACTEC PROJECT NAME: DURANGO REGIONAL CONVEYANCE CHANNEL
MACTEC PROJECT NO: 4973-10-8043.01
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MATCHLINE – SEE FIGURE 5

MATCHLINE – SEE FIGURE 7

WEST RILEY ROAD

85TH AVENUE

I3 I4 I5 I6

P1 B12

P2 B13

P3 B14

B15

BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'

LEGEND:

B1 APPROXIMATE SOIL BORING LOCATION

I1 APPROXIMATE DOUBLE RING INFILTRATION TEST LOCATION

P1 APPROXIMATE DEEP PERCOLATION TEST LOCATION

BORING LOCATION PLAN

FIGURE 6

MACTEC PROJECT NAME: DURANGO REGIONAL CONVEYANCE CHANNEL
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MATCHLINE – SEE FIGURE 6

MATCHLINE – SEE FIGURE 8

BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'
LEGEND:
B1 ⊕ APPROXIMATE SOIL BORING LOCATION

BORING LOCATION PLAN	FIGURE 7

MACTEC PROJECT NAME: DURANGO REGIONAL CONVEYANCE CHANNEL
MACTEC PROJECT NO: 4973-10-8043.01
DATE: 11-1-10 E-FILE: 108043.01BLP
DRAWN BY: DAK CHECKED BY:

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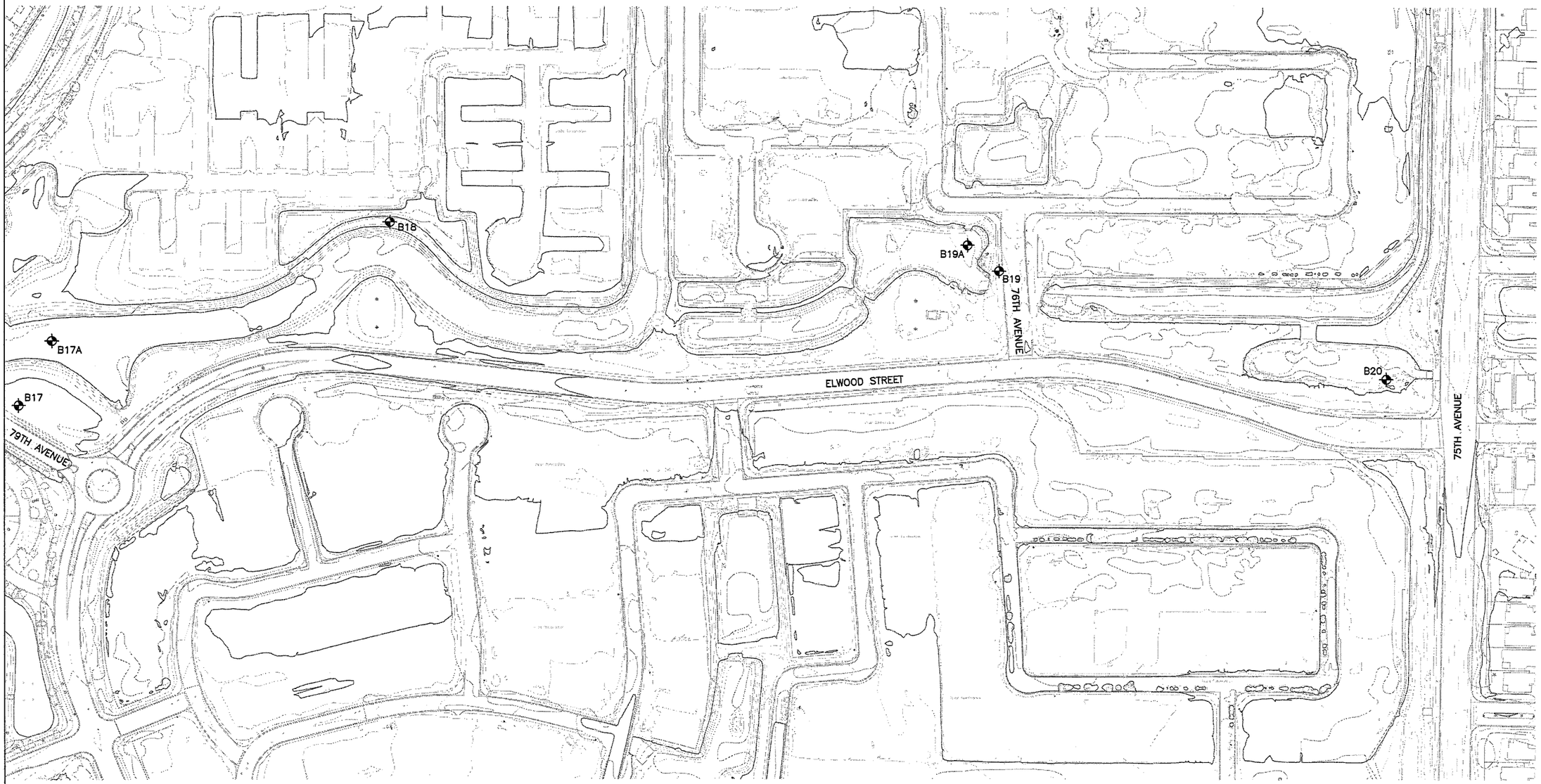
MACTEC ENGINEERING AND CONSULTING, INC.
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PHONE: (602) 437-0250 FAX: (602) 437-3675

MATCHLINE – SEE FIGURE 8



BORING LOCATION PLAN
APPROXIMATE SCALE:
1" = 200'
LEGEND:
B1 ⊕ APPROXIMATE SOIL BORING LOCATION

BORING LOCATION PLAN	FIGURE 8

MACTEC PROJECT NAME:	DURANGO REGIONAL CONVEYANCE CHANNEL		
MACTEC PROJECT NO:	4973-10-8043.01		
DATE:	11-1-10	E-FILE:	108043.01BLP
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APPENDIX A

FIELD INVESTIGATION METHODS & TEST BORING LOGS

The general field procedures employed by MACTEC Engineering and Consulting, Inc. for this project are summarized in AASHTO Standard Recommended Practice R-13 (ASTM Specification D-420). This recommended practice lists recognized methods for determining characterizing subsurface soil, rock, and ground water distribution and conditions.

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SOILS SAMPLING AND TESTING IN BOREHOLES

Several techniques may be used to obtain samples and data in soils, however the methods typically employed in the Southwest United States are:

a) Standard Penetration Testing
b) Undisturbed Sampling
c) Disturbed Bulk Sampling
d) Water Level Readings

These procedures are discussed below. Any additional testing techniques employed during this study are discussed in other sections of this Appendix.

Standard Penetration Testing
At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2-inch outside diameter (O.D.) split barrel sampler connected to an AW-rod. The sampler is first seated 6-inches to penetrate any loose cuttings, then is driven an additional 12-inches with blows of a 140-pound safety hammer falling a vertical distance of 30 inches. The number of hammer blows are counted for each 6-inch of advance of the sampler. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the "penetration resistance" or "N" value, in blows per 12 inches. The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for examination. Representative portions of the soil samples obtained from each split barrel sample are placed in jars or bags, sealed and transported to our laboratory.

The Standard Penetration Test (SPT), when properly evaluated, provides an indication of the soil density, strength, and compressibility. The tests are conducted in general accordance with ASTM Specification D-1586. The depths and N-values of Standard Penetration tests are shown on the Test Boring Record. Split barrel samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory testing.

Undisturbed Sampling
Relatively undisturbed samples of firmer soils typically present in the Southwest are obtained by driving 3-inch O.D. samplers lined with 2.42-inch I.D. brass rings in a manner similar to the Standard Penetration Test utilizing the same hammer and driving criteria.

Water Level Readings
When water is encountered in Test Borings, measurements of the level of free ground water are taken in the borings and are recorded on the Test Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water table at the time of our field investigation. In clayey soils, the rate of water seepage into the boring is low and it is generally not possible to establish the location of the hydrostatic water table through short-term water level readings. Also, fluctuation in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors. For long-term monitoring of water levels, it is necessary to install standpipes or piezometers.

The water level reported on the Test Boring Records is determined by field crews immediately after the drilling tools are removed, and several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the groundwater table, which may have been disrupted by the drilling operation. Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is measured and recorded on the Test Boring Records, under these circumstances.

TEST BORING RECORDS:
Soils Terminology

The subsurface conditions encountered during drilling of test borings were reported on a field test boring record by our Field Geologist or Engineer. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and any observations of encountered ground water. It also contains the Geologist/Engineer's interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the field exploration is completed, the field and project engineers classify the soil materials based on laboratory analyses and further inspection, and prepare the final Test Boring Records which are the basis for all evaluations and recommendations. The soils are classified according to the Unified Soil Classification System (USCS), presented on the following page. Additional descriptive terminology and criteria used for this project shown below are based on those presented in the FHWA-NHI Soils and Foundations Reference Manual, Vol. I (2006) and ASTM D2487, and are slightly modified for local practice, where appropriate.

RELATIVE DENSITY OF COHESIONLESS GRANULAR SOILS FROM THE STANDARD PENETRATION TEST

Relative Density	Blows per foot (bpf)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	>50

RELATIVE FIRMNESS OF PARTIALLY SATURATED, COHESIVE SOILS AND CEMENTED SOILS FROM THE STANDARD PENETRATION TEST

Relative Firmness	Blows per foot (bpf)
Very Soft	0 – 4
Soft	5 – 8
Moderately Firm	9 – 15
Firm	16 – 30
Very Firm	31 – 50
Hard	>50

RELATIVE CONSISTENCY OF SATURATED COHESIVE FROM THE STANDARD PENETRATION TEST

Relative Consistency	Blows per foot (bpf)
Very Soft	0 – 2
Soft	2 – 4
Medium Stiff	4 – 8
Stiff	8 – 15
Very Stiff	15 – 30
Hard	>30

ESTIMATED RELATIVE MOISTURE CONDITION

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

RELATIVE PROPORTIONS OF MINOR SOIL CONSTITUENTS

Trace	0 - 12%
Some	12 - 30%
Considerable	30 - 50%
Mostly	50 - 100%

PARTICLE SIZE IDENTIFICATION

Boulders	Larger than 12 inches
Cobbles	3 to 12 inches
Gravel:	
Coarse	¾ to 3 inches
Fine	No. 4 Sieve (4.75 mm) to ¾ inches
Sand:	
Coarse	2 to 4.75 mm
Medium	0.425 to 2 mm
Fine	0.075 to 0.425 mm
Fines	
(Silt or Clay)	Smaller than 0.075 mm

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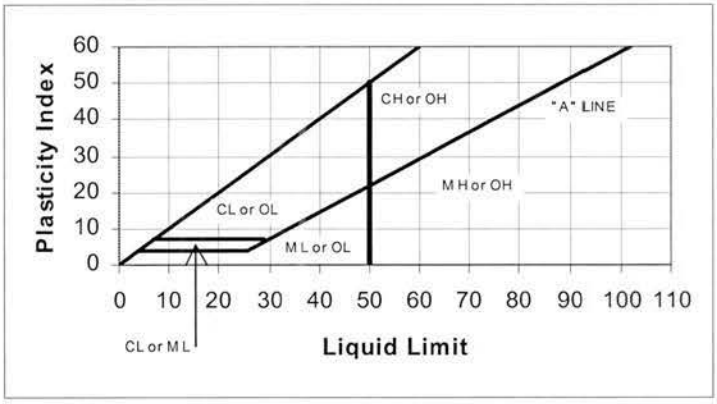
UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

Soils are classified by the Unified Soil Classification system on the boring logs presented in this report. Grain-size analysis and Atterberg Limits Tests are often performed on selected samples to aid in refining the classifications made in the field during exploration. The classification system is briefly outlined on this chart. For a more detailed description of the system, please refer to ASTM Designation D-2487, the FHWA Soils and Foundations Reference Manual (2006), or US Army Technical Memorandum No. 3-357.

MAJOR DIVISIONS				GROUP SYMBOL	TYPICAL NAMES
COARSE GRAINED SOILS (Less than 50% passes No. 200 sieve)	GRAVELS (Less than 50% of coarse fraction passes No. 4 sieve)	CLEAN GRAVELS (Less than 5% passes No. 200 Sieve)		GW	Well-graded gravels, gravel-sand mixtures.
				GP	Poorly graded gravel, gravel-sand mixtures.
		GRAVELS WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	GM	Silty gravels, gravel-sand-silt mixtures.
			Limits plot below "A" line & hatched zone on plasticity chart	GC	Clayey gravel, gravel-sand-clay mixtures.
	SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Less than 5% passes No. 200 Sieve)		SW	Well-graded sand, gravelly sands.
				SP	Poorly graded sand, gravelly sands.
		SAND WITH FINES (More than 12% passes No. 200 sieve)	Limits plot below "A" line & hatched zone on plasticity chart	SM	Silty sand, sand-silt mixtures.
			Limits plot below "A" line & hatched zone on plasticity chart	SC	Clayey sand, clayey sand with gravel.
FINE GRAINED SOILS (50% or more passes No. 200 sieve)	SILTS Limits Plot below "A" line & hatched zone on Plasticity Chart	SILTS OF LOW PLASTICTY (Liquid Limit Less than 50)		ML	Inorganic silts, clayey silts with slight plasticity.
		SILTS OF HIGH PLASTICITY (Liquid Limit More Than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.
	CLAYS Limits Plot above "A" line & hatched zone on Plasticity chart.	CLAYS OF LOW PLASTICITY (Liquid Limit Less than 50)		CL	Inorganic clays at low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		CLAYS OF HIGH PLASTICITY (Liquid Limit More than 50)		CH	Inorganic clays with high plasticity, fat clays.
NOTE: Coarse soils with between 5% and 12% passing the No. 200 sieve and fine grained soils with plasticity values plotting in the hatched zone of the Plasticity Chart are to have dual symbols.					

PLASTICITY CHART



DEGREE OF PLASTICITY OF COHESIVE SOILS (FHWA, 2006)

Degree of Plasticity	Plasticity Index
Non-Plastic	0
Low	1 - 10
Medium	10 - 20
High	20 - 40
Very High	over 40

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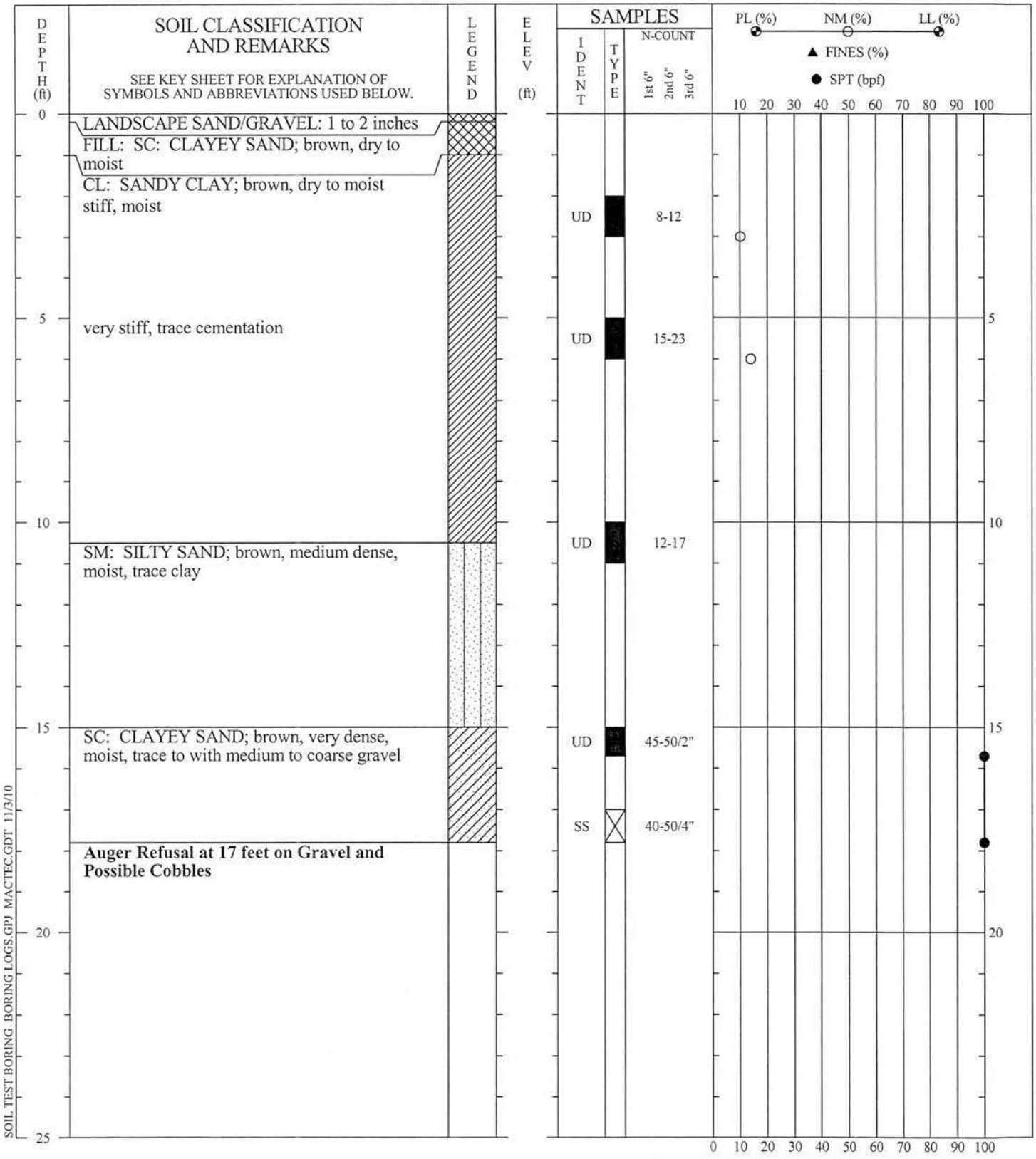

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 1
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

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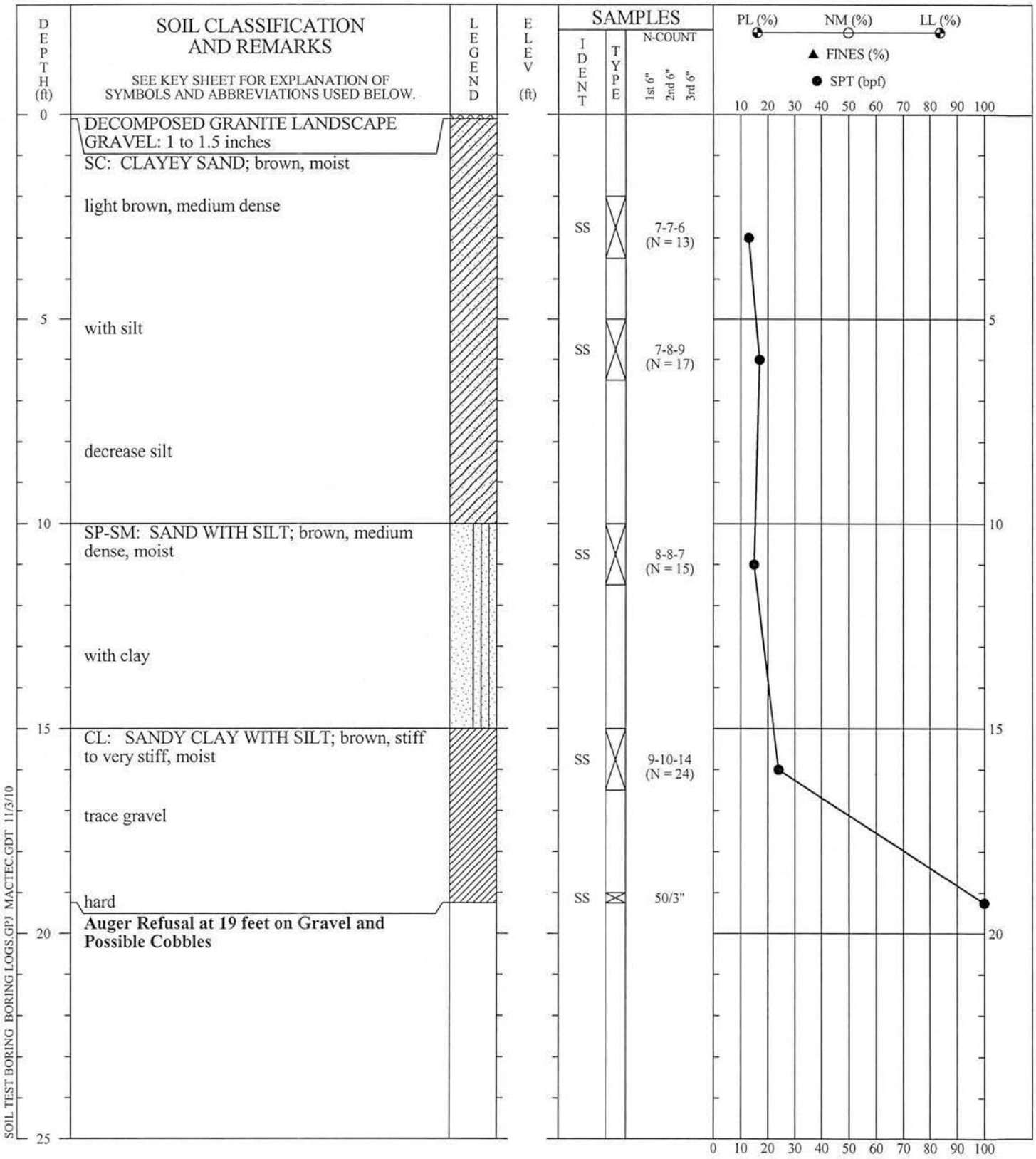

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 2
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

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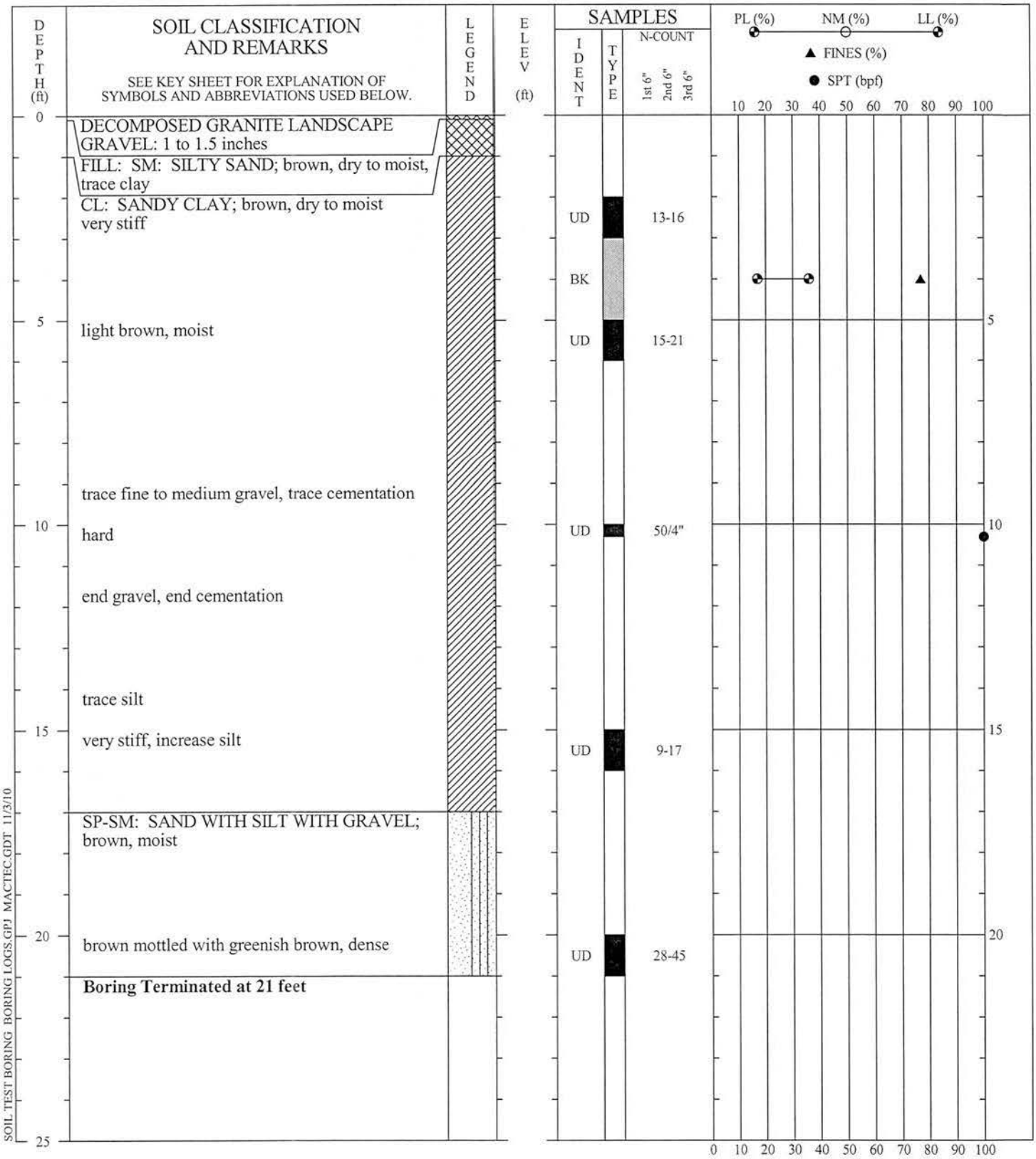

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 3
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

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DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT 1st 6" / 2nd 6" / 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	SC: CLAYEY SAND WITH GRAVEL; brown, dry to moist						
	CL: SANDY CLAY; brown, dry to moist			BK			
	Test Pit Terminated at 13 inches						▲ at 70
							0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

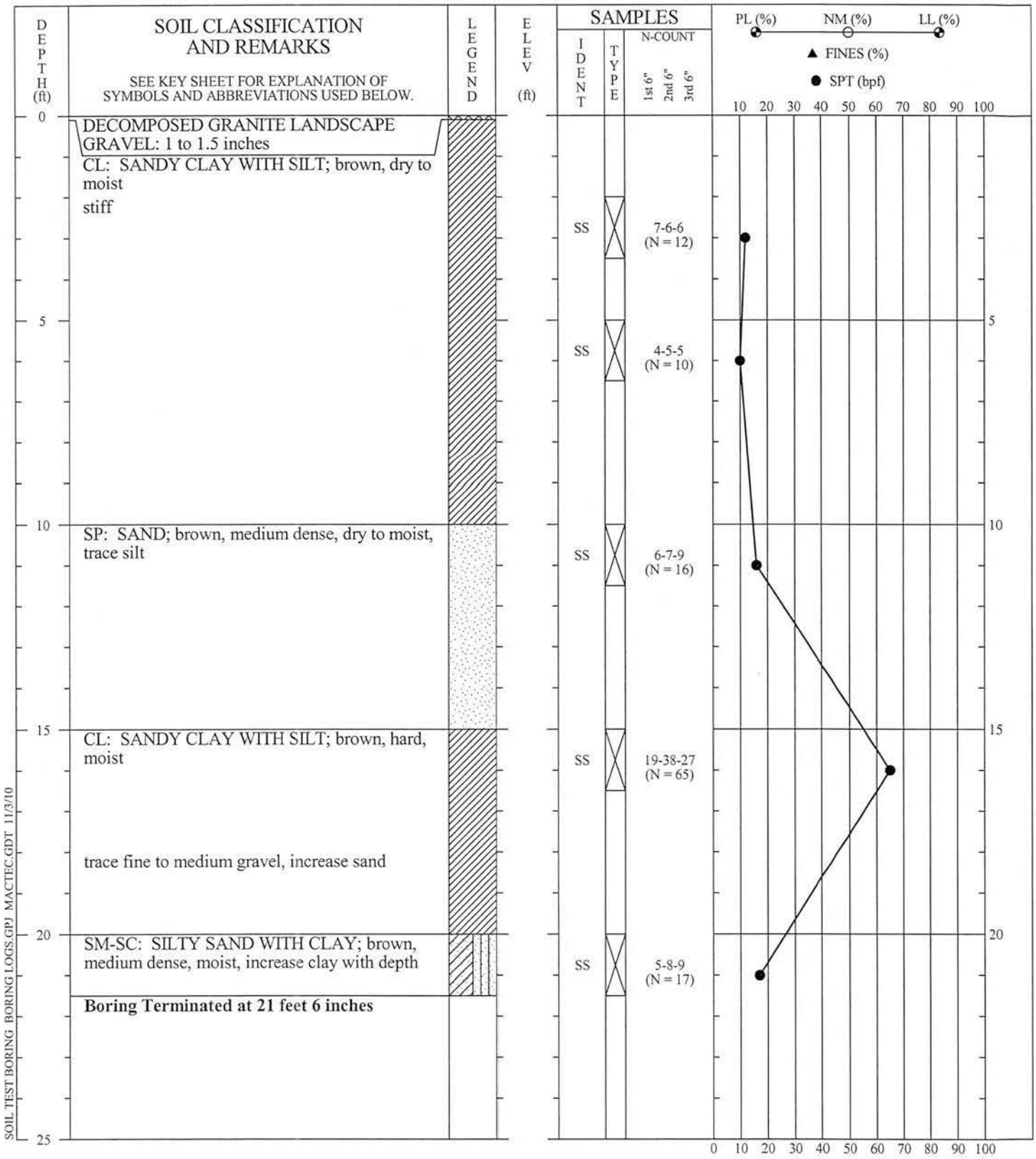
DRILLER: Dave Klann (MACTEC)
EQUIPMENT: Hand Sampling
METHOD:
HOLE DIA.:
REMARKS: No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 3A
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

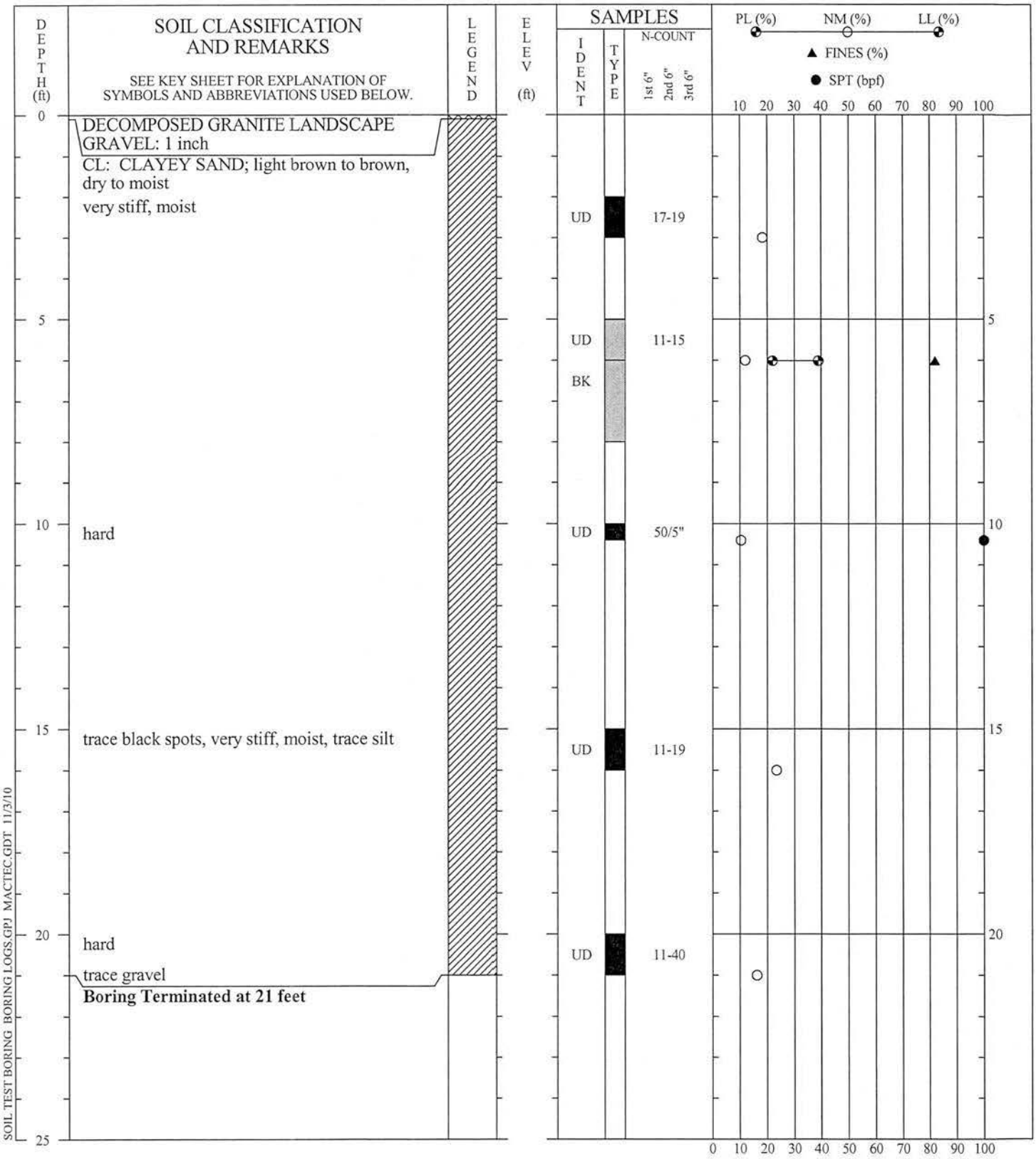
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 4
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 5
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"
0	DECOMPOSED GRANITE LANDSCAPE GRAVEL: 0.5 inches					
	FILL: SC: CLAYEY SAND; brown, dry to moist, trace gravel, trace construction debris					
	CL: SANDY CLAY; brown, dry to moist			BK		
	Test Pit Terminated at 14 inches					

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

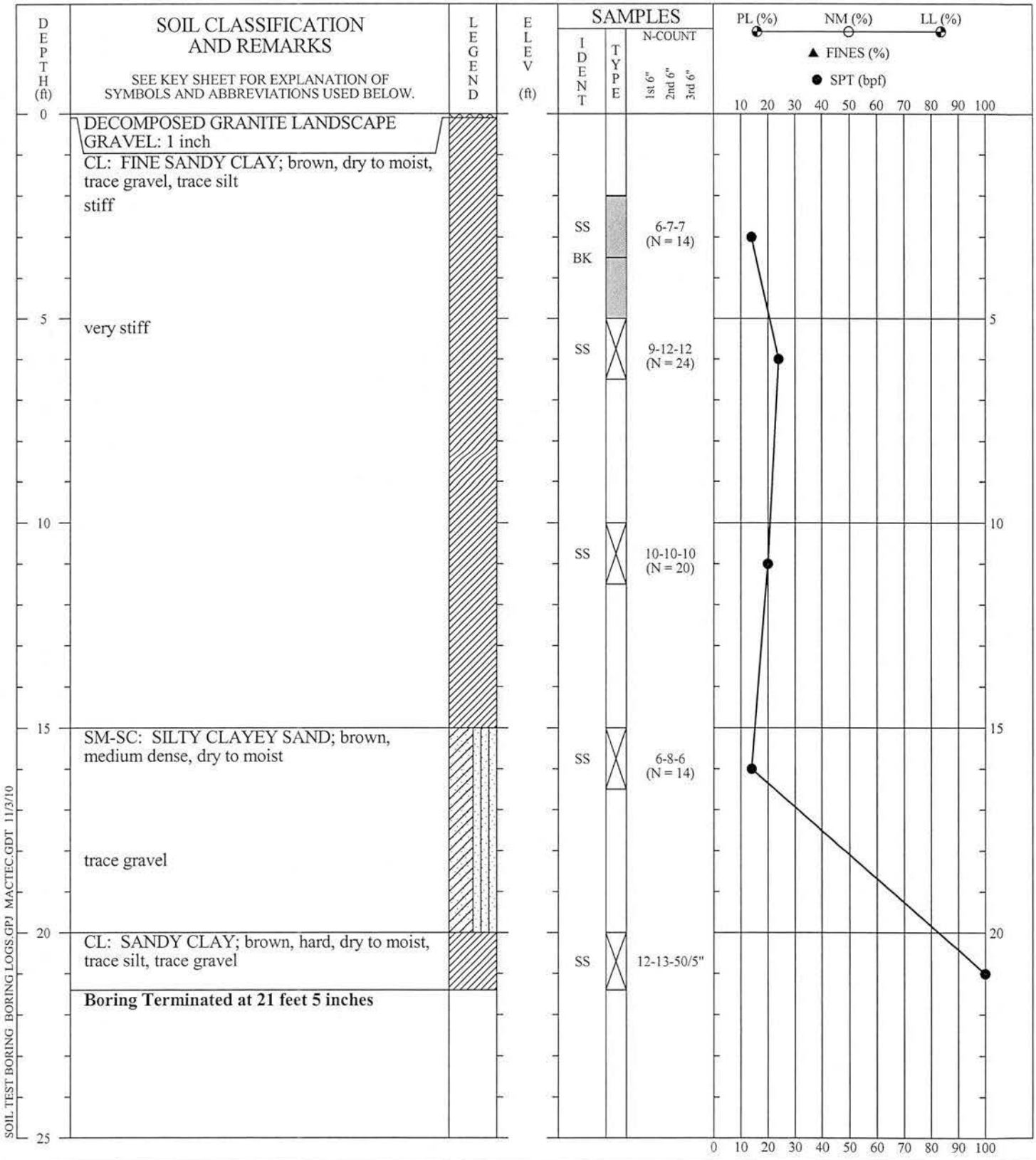
DRILLER: Dave Klann (MACTEC)
EQUIPMENT: Hand Sampling
METHOD:
HOLE DIA.:
REMARKS: No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 5A
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

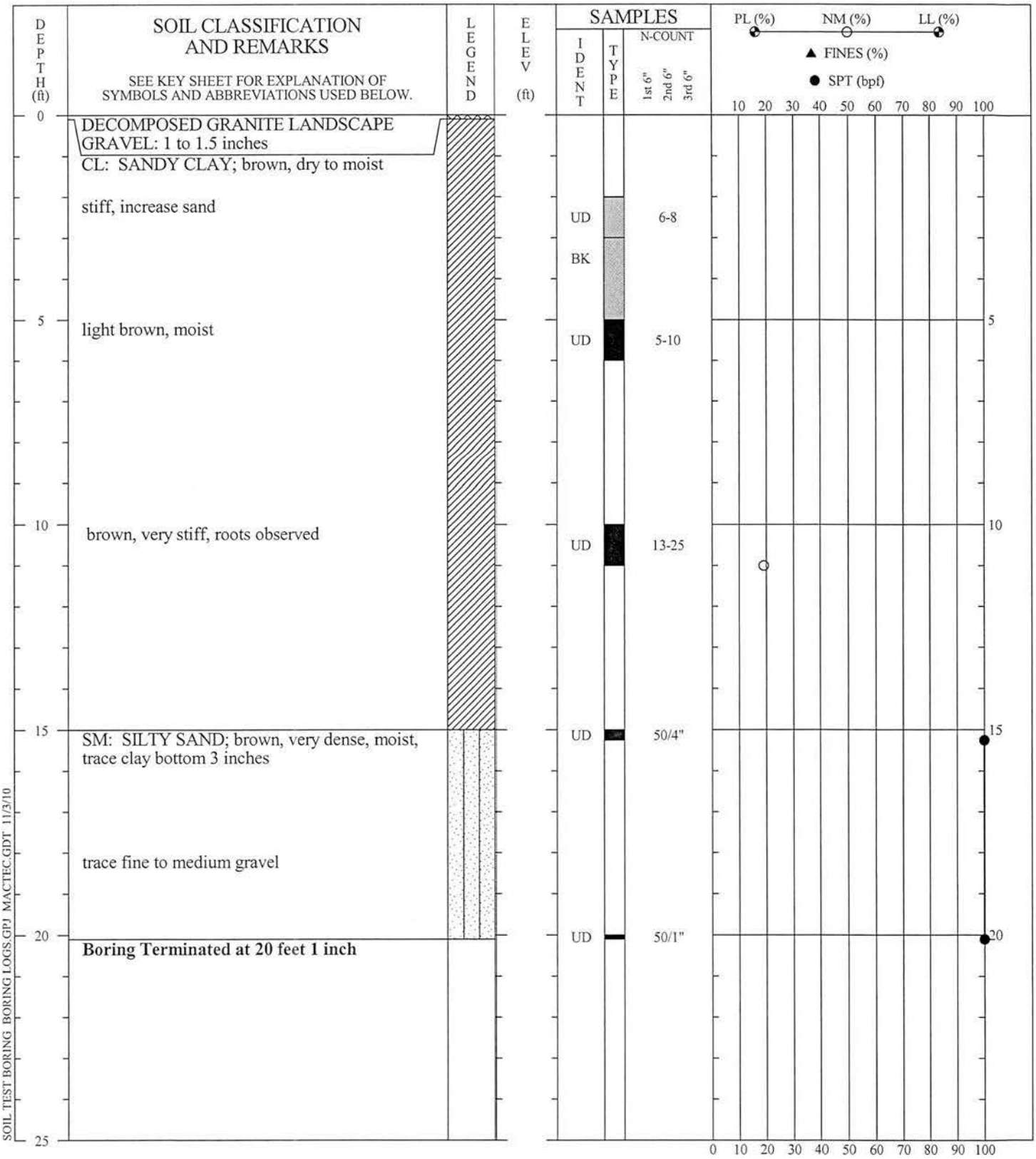
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.:	6
PROJECT:	Durango Regional Conveyance Channel
LOCATION:	Elwood Alignment Between 75th & 107th Ave
DRILLED:	September 23, 2010
PROJECT NO.:	4975-10-8043.01

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

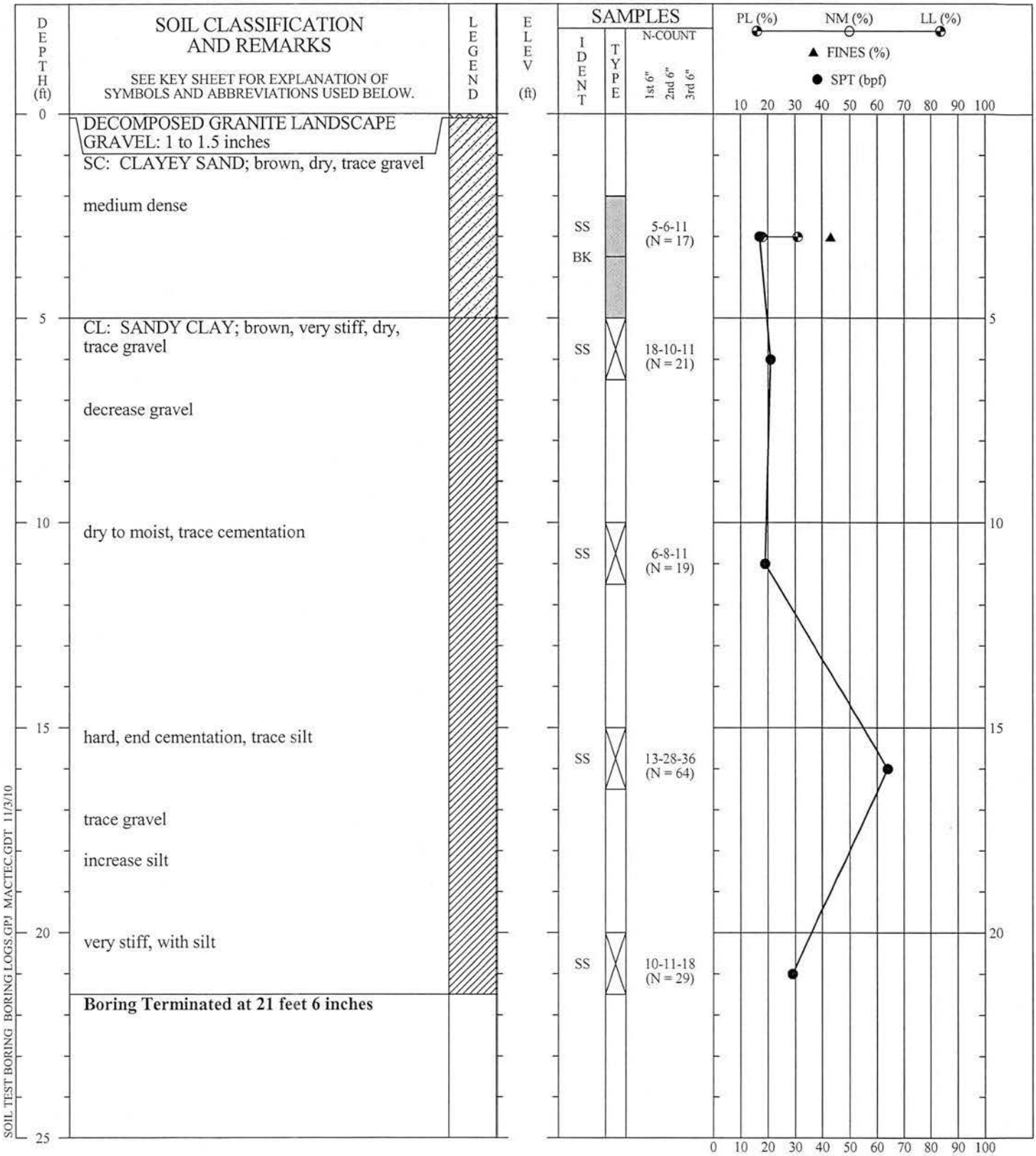
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 7
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 8
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"
0	SC: CLAYEY SAND WITH GRAVEL, brown, dry					
	CL: SANDY CLAY; brown, dry, trace gravel			BK		
	Test Pit Terminated at 11 inches					

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

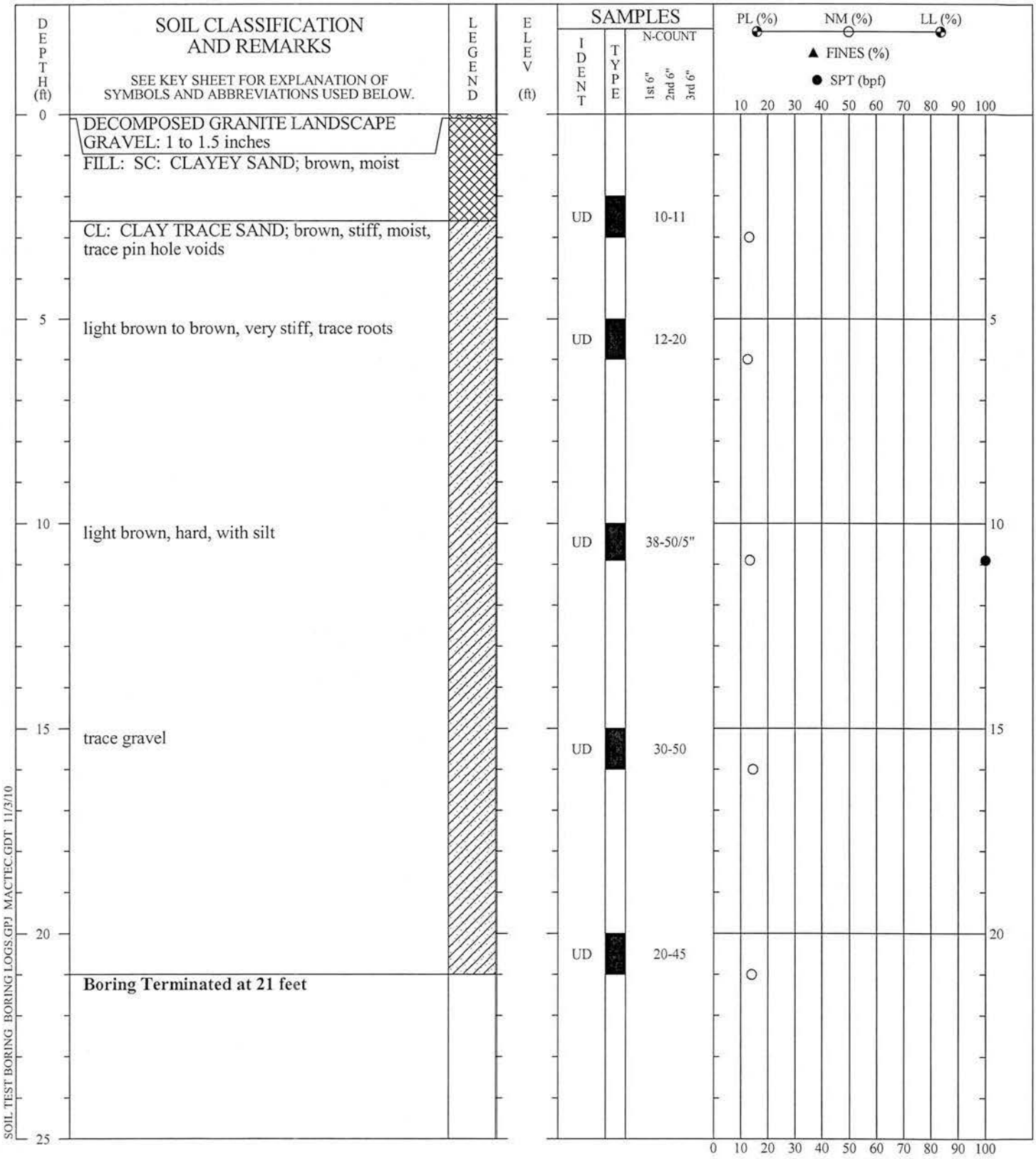
DRILLER: Dave Klann (MACTEC)
EQUIPMENT: Hand Sampling
METHOD:
HOLE DIA.:
REMARKS: No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 8A
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



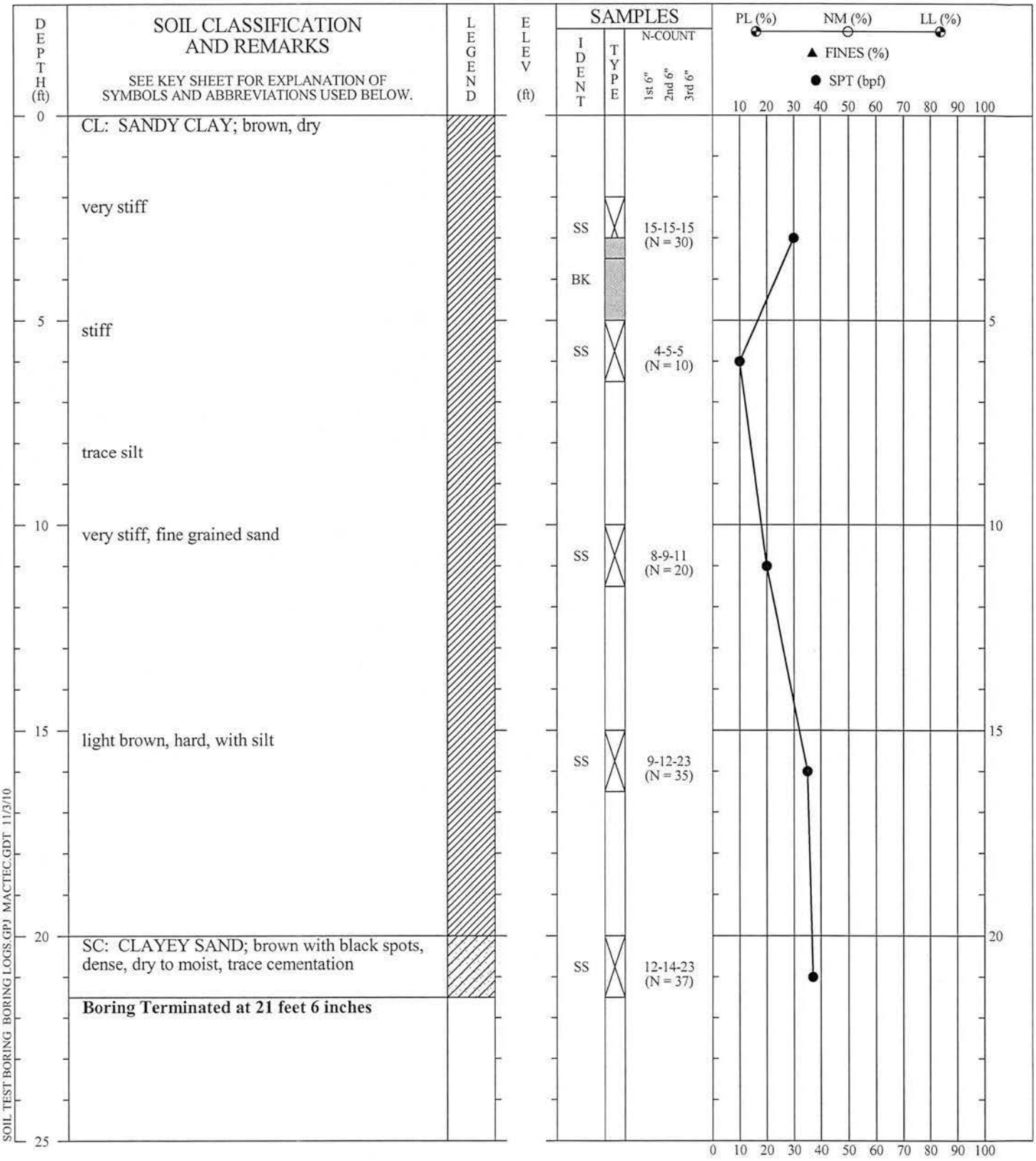
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 9
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 10
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	SAMPLES N-COUNT 1st 6" 2nd 6" 3rd 6"
0	DECOMPOSED GRANITE LANDSCAPE GRAVEL: 1.5 inches					
	SC: CLAYEY SAND; brown, dry, trace gravel					
	CL: SANDY CLAY; brown, dry, trace fine gravel			BK		
	Test Pit Terminated at 12 inches					

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

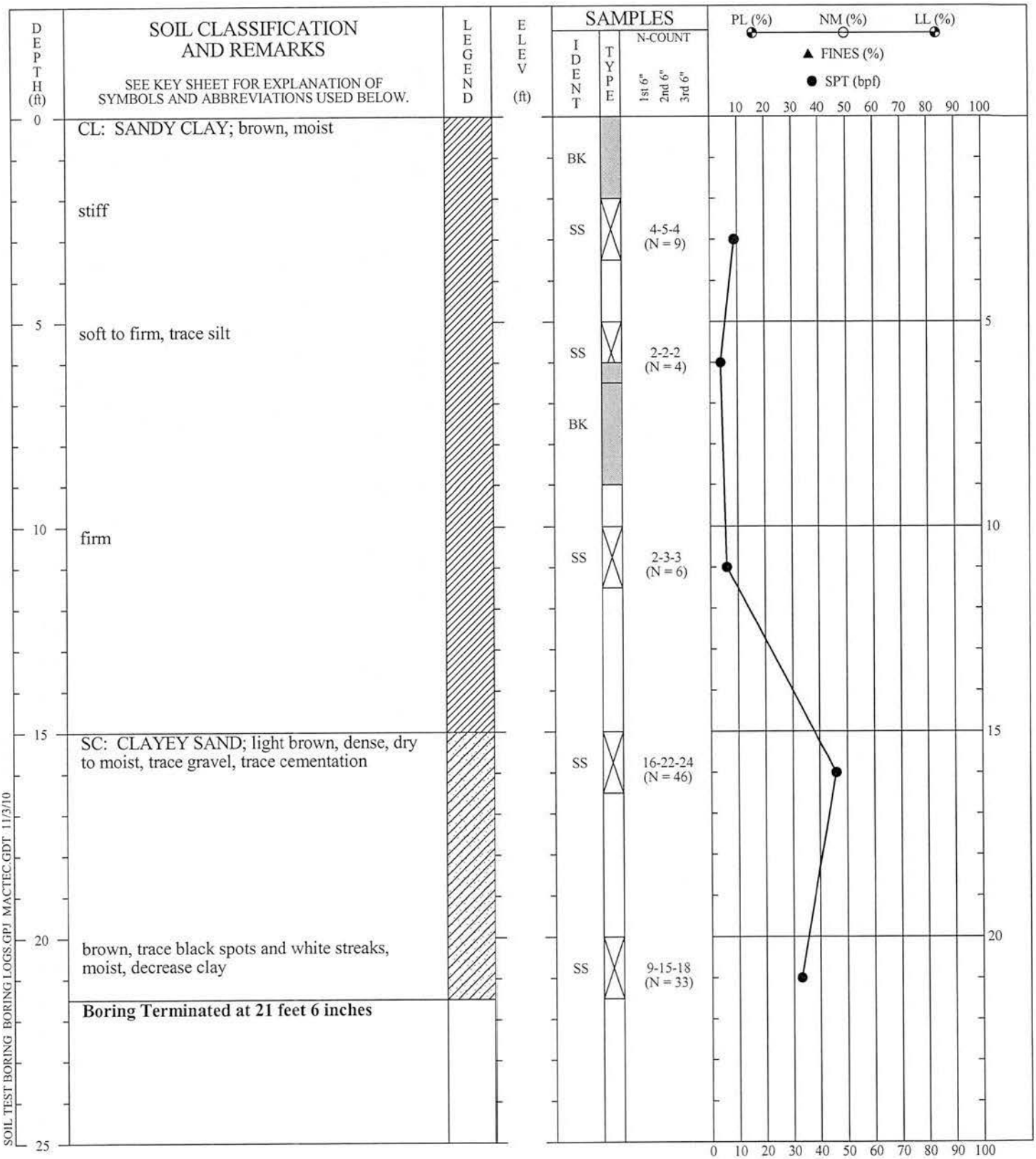
DRILLER:	Dave Klann (MACTEC)
EQUIPMENT:	Hand Sampling
METHOD:	
HOLE DIA.:	
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.:	10A
PROJECT:	Durango Regional Conveyance Channel
LOCATION:	Elwood Alignment Between 75th & 107th Ave
DRILLED:	September 23, 2010
PROJECT NO.:	4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

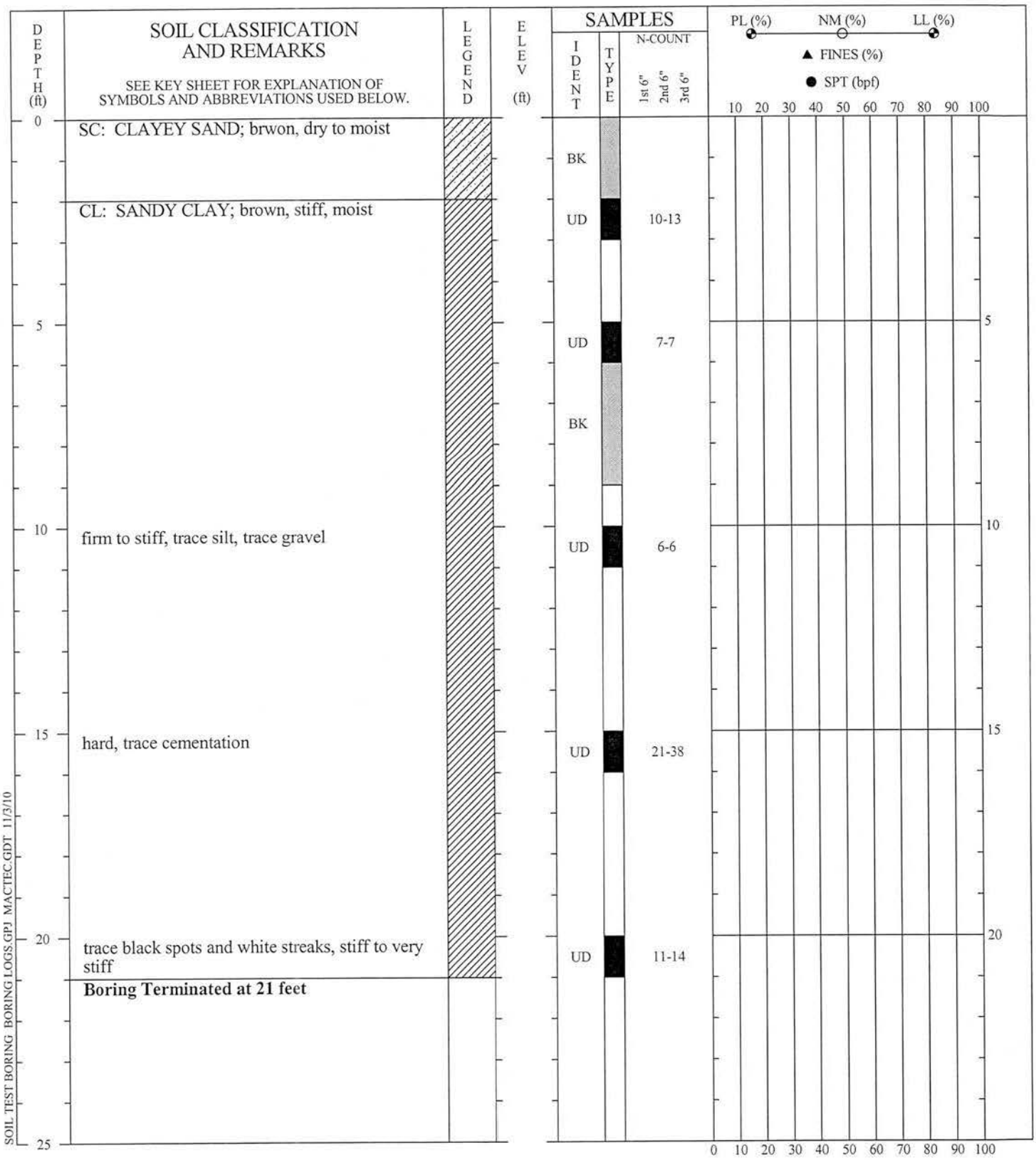
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.:	11
PROJECT:	Durango Regional Conveyance Channel
LOCATION:	Elwood Alignment Between 75th & 107th Ave
DRILLED:	October 14, 2010
PROJECT NO.:	4975-10-8043.01

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

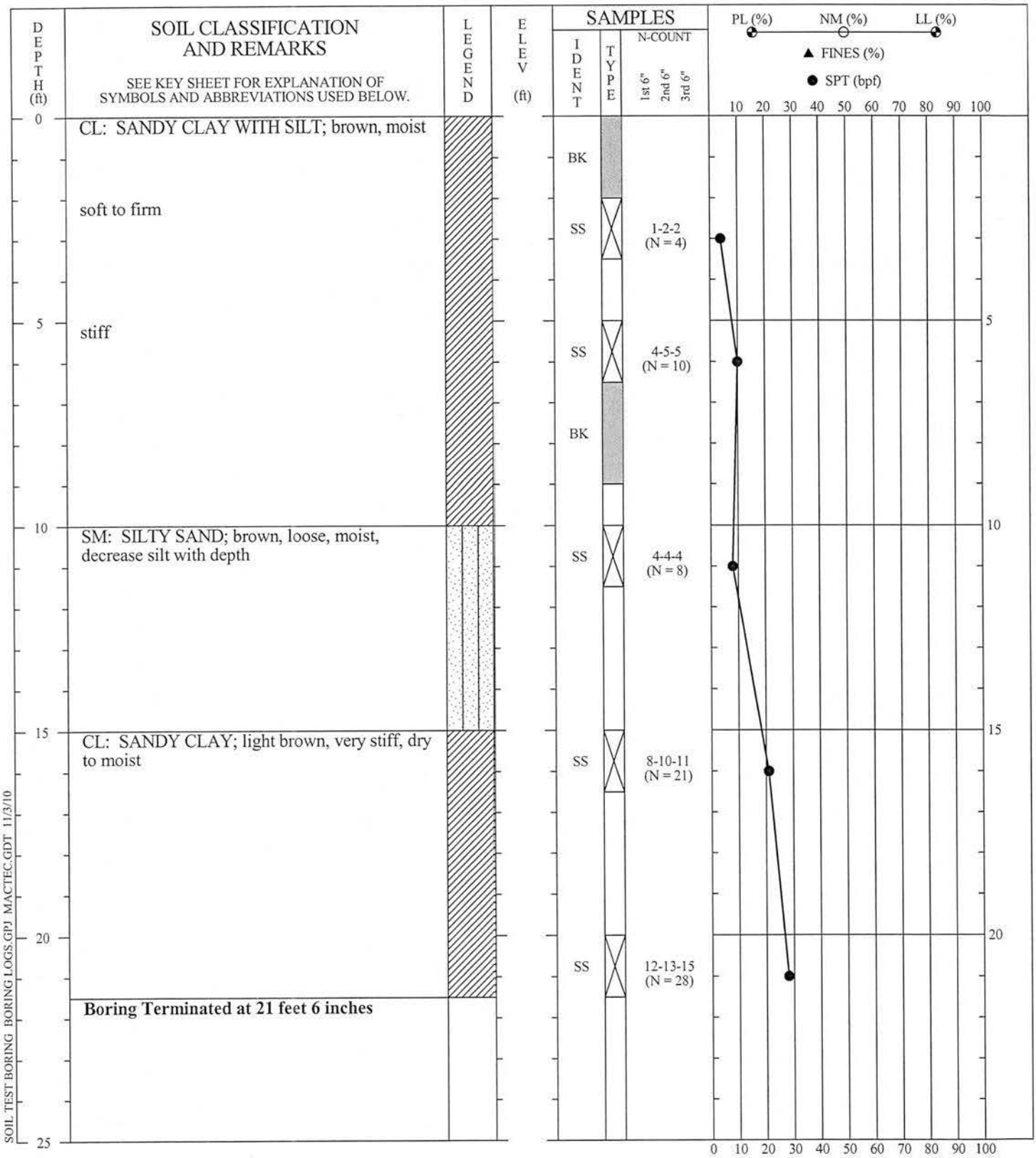
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 12
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 14, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



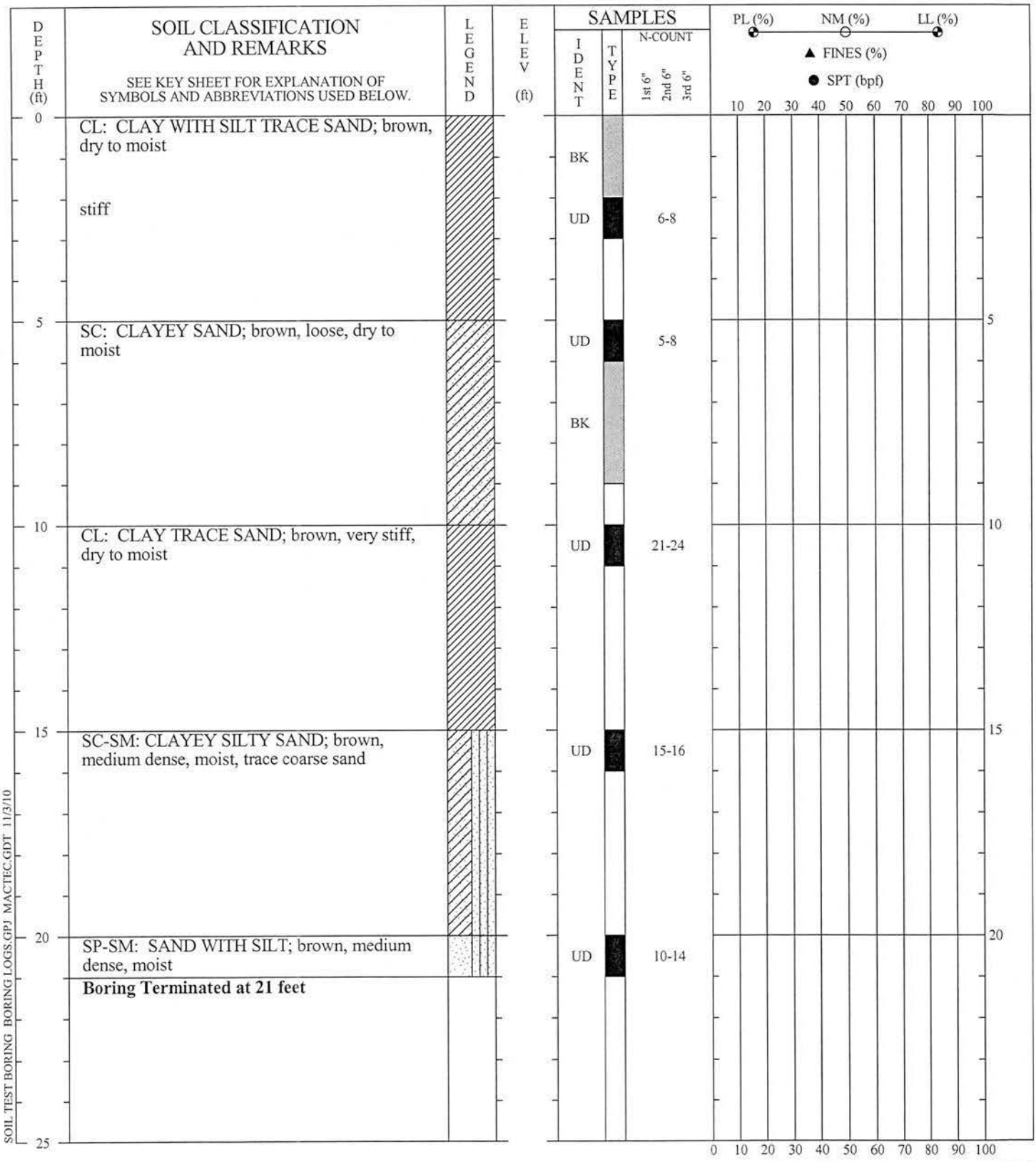
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 13
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 14, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

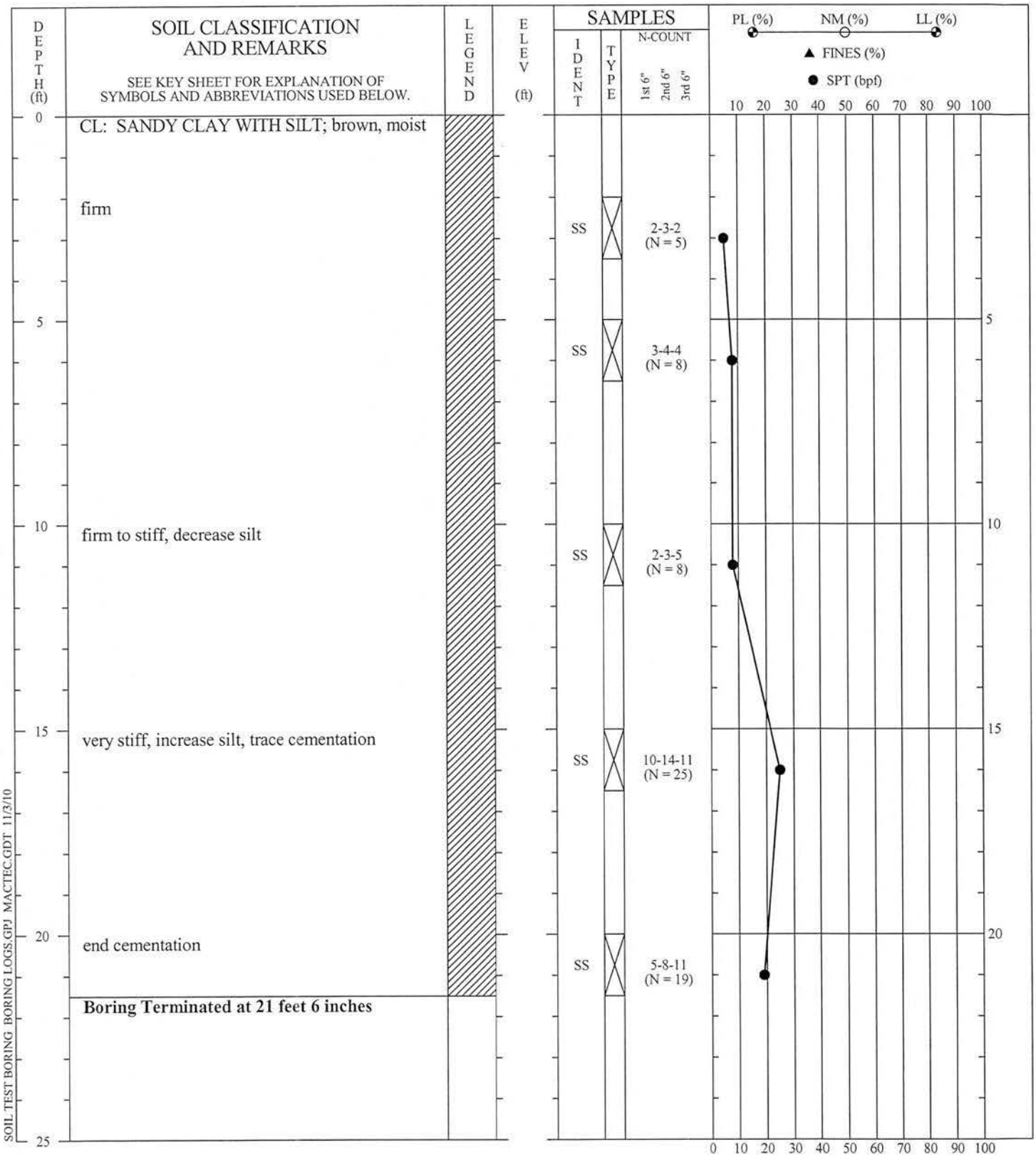
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 14
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 14, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

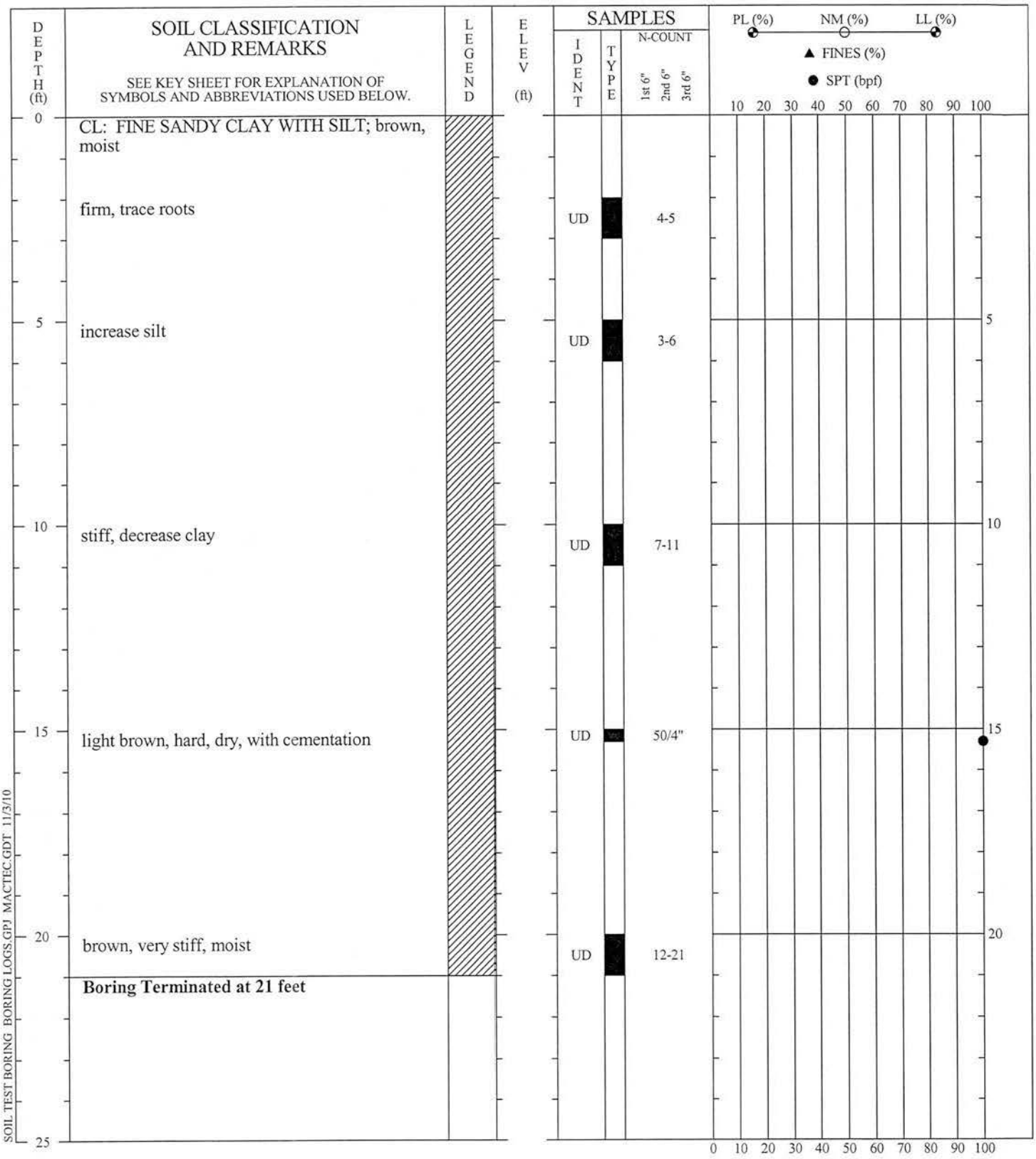
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 15
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 27, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 16
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 27, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT (1st 6" / 2nd 6" / 3rd 6")	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	CL: SANDY CLAY; brown, dry			BK			
	Test pit terminated at 12 inches						

0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

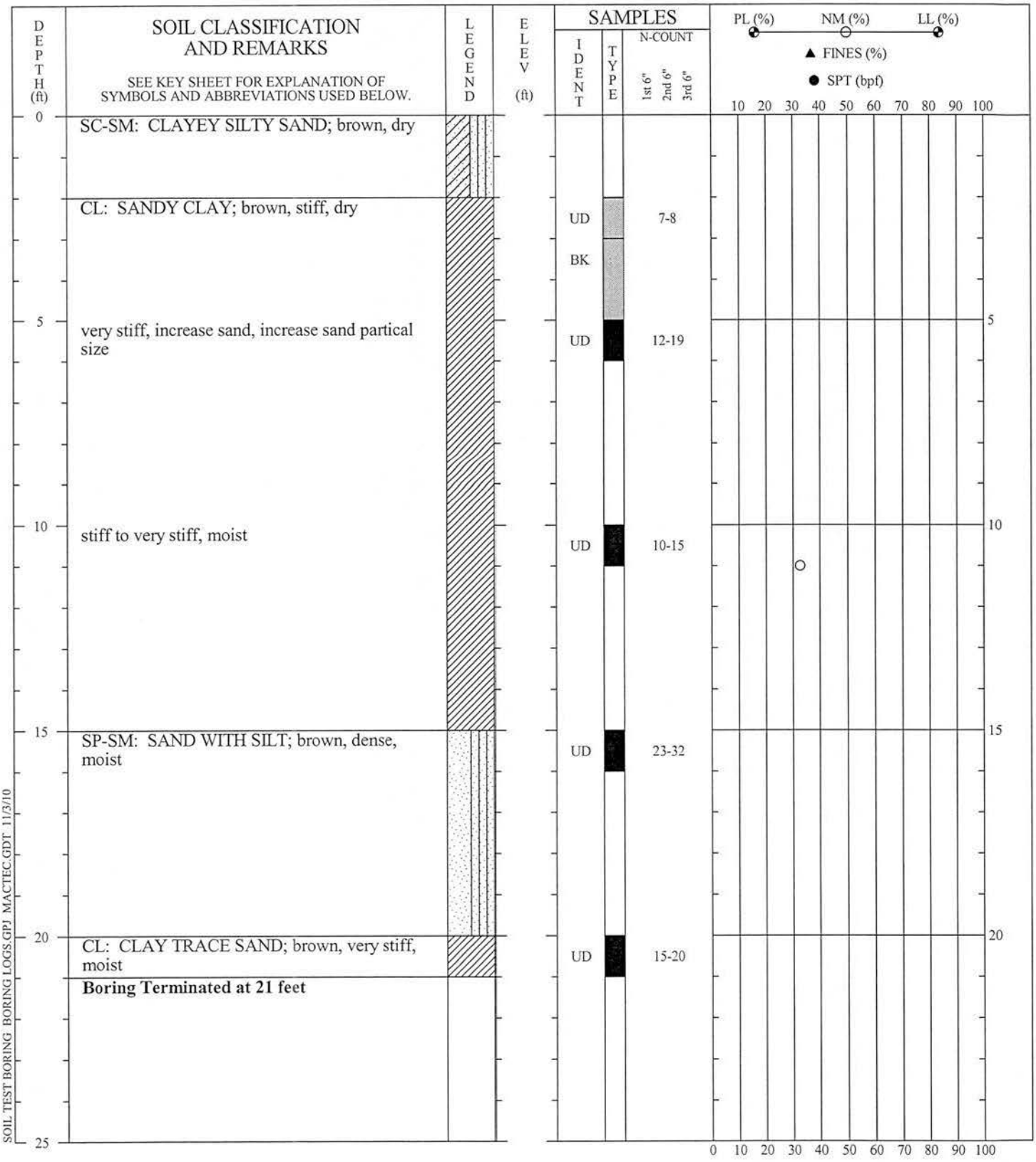
DRILLER: Dave Klann (MACTEC)
EQUIPMENT: Hand Sampling
METHOD:
HOLE DIA.:
REMARKS: No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 16A
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 15, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 17
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 22, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT 1st 6" / 2nd 6" / 3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf)
0	CL: SANDY CLAY; brown, dry			BK			
	Test pit terminated at 13 inches						

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER: Dave Klann (MACTEC)
EQUIPMENT: Hand Sampling
METHOD:
HOLE DIA.:
REMARKS: No Groundwater Encountered

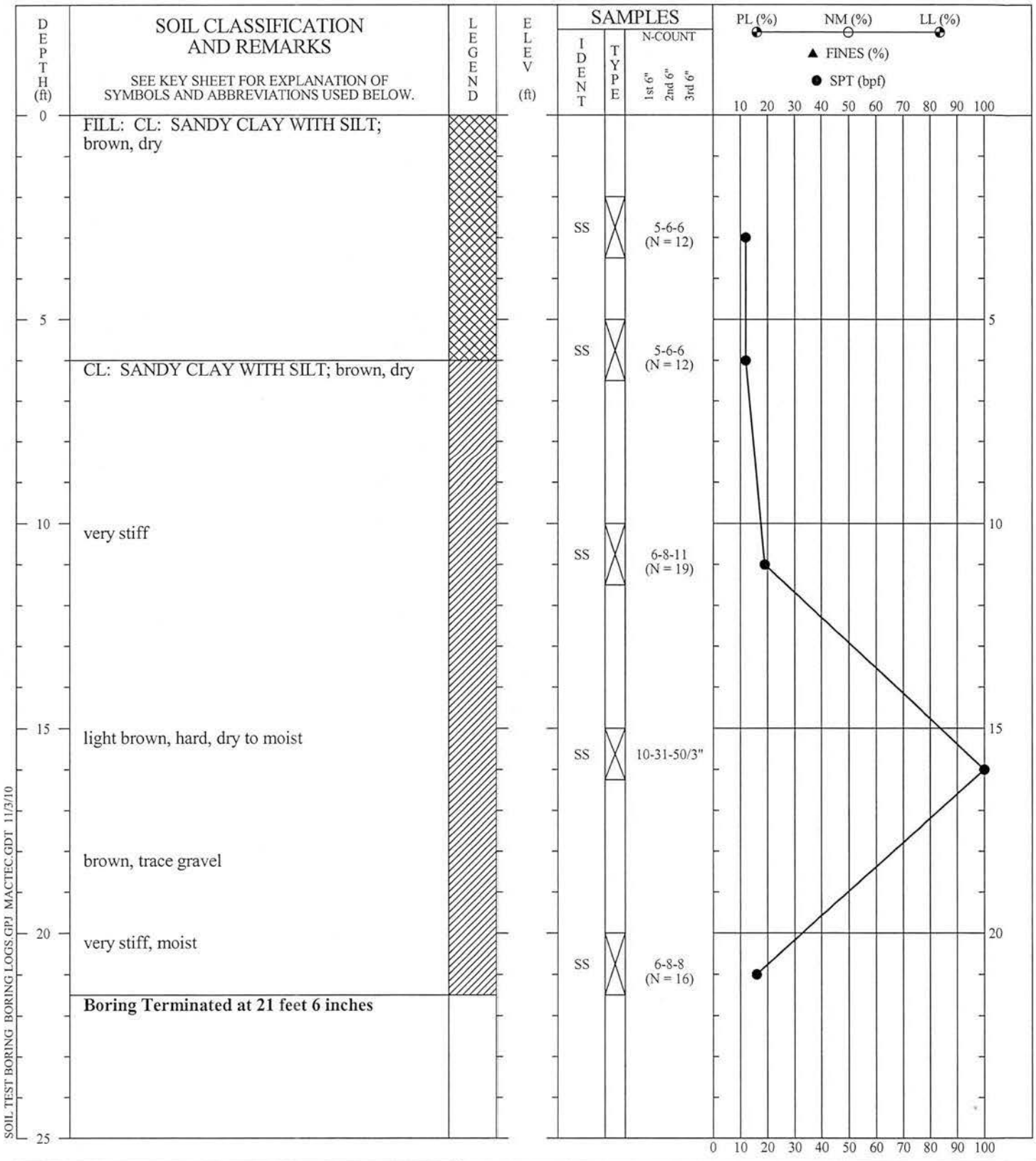
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 17A
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 15, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC

N



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

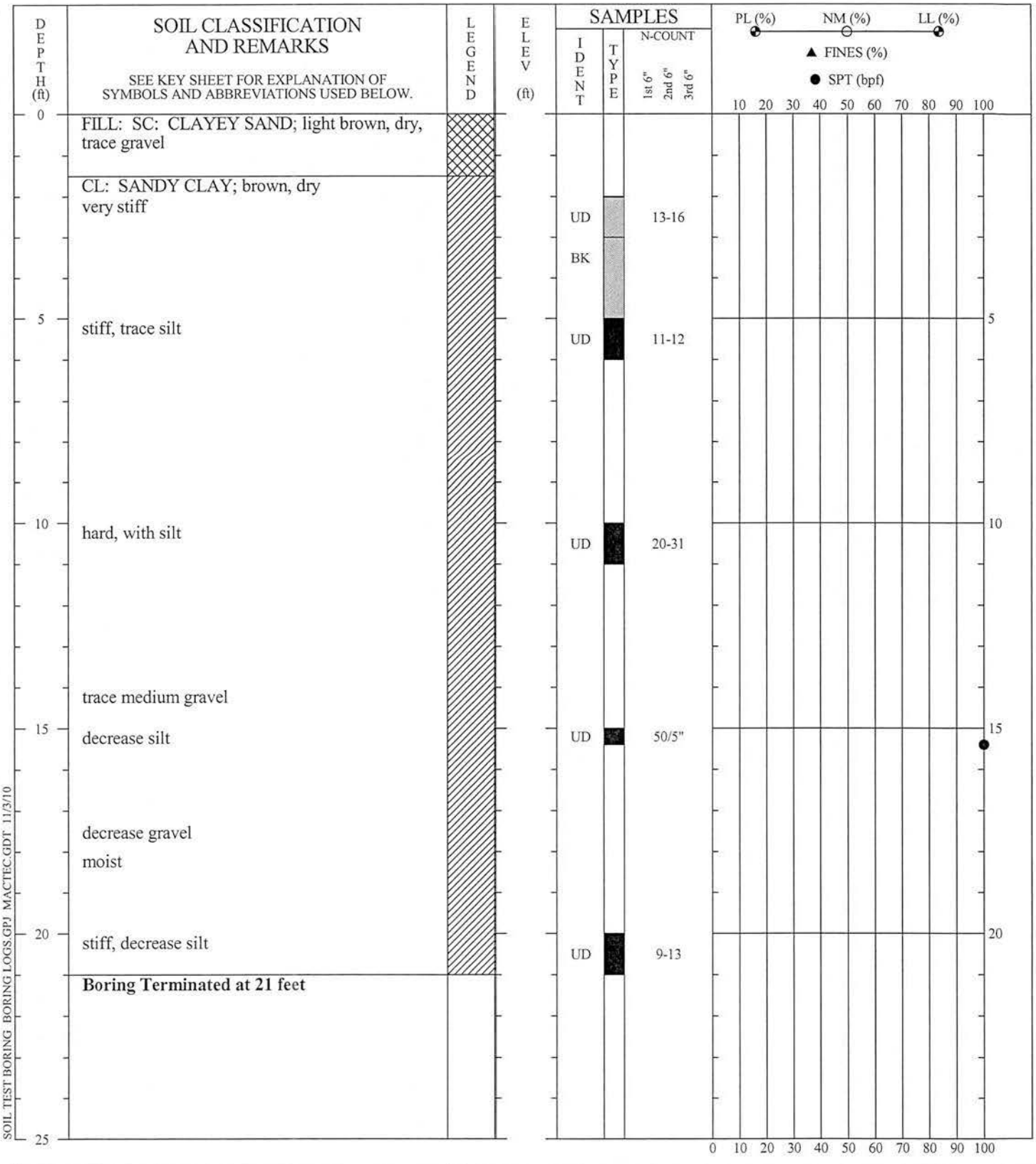
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.:	18
PROJECT:	Durango Regional Conveyance Channel
LOCATION:	Elwood Alignment Between 75th & 107th Ave
DRILLED:	September 22, 2010
PROJECT NO.:	4975-10-8043.01

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 19
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS USED BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	SAMPLES: TYPE	SAMPLES: N-COUNT 1st 6" / 2nd 6" / 3rd 6"
0	CL: SANDY CLAY; brown, dry			BK		
	Test Pit Terminated at 9 inches					

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100
0 10 20 30 40 50 60 70 80 90 100

SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

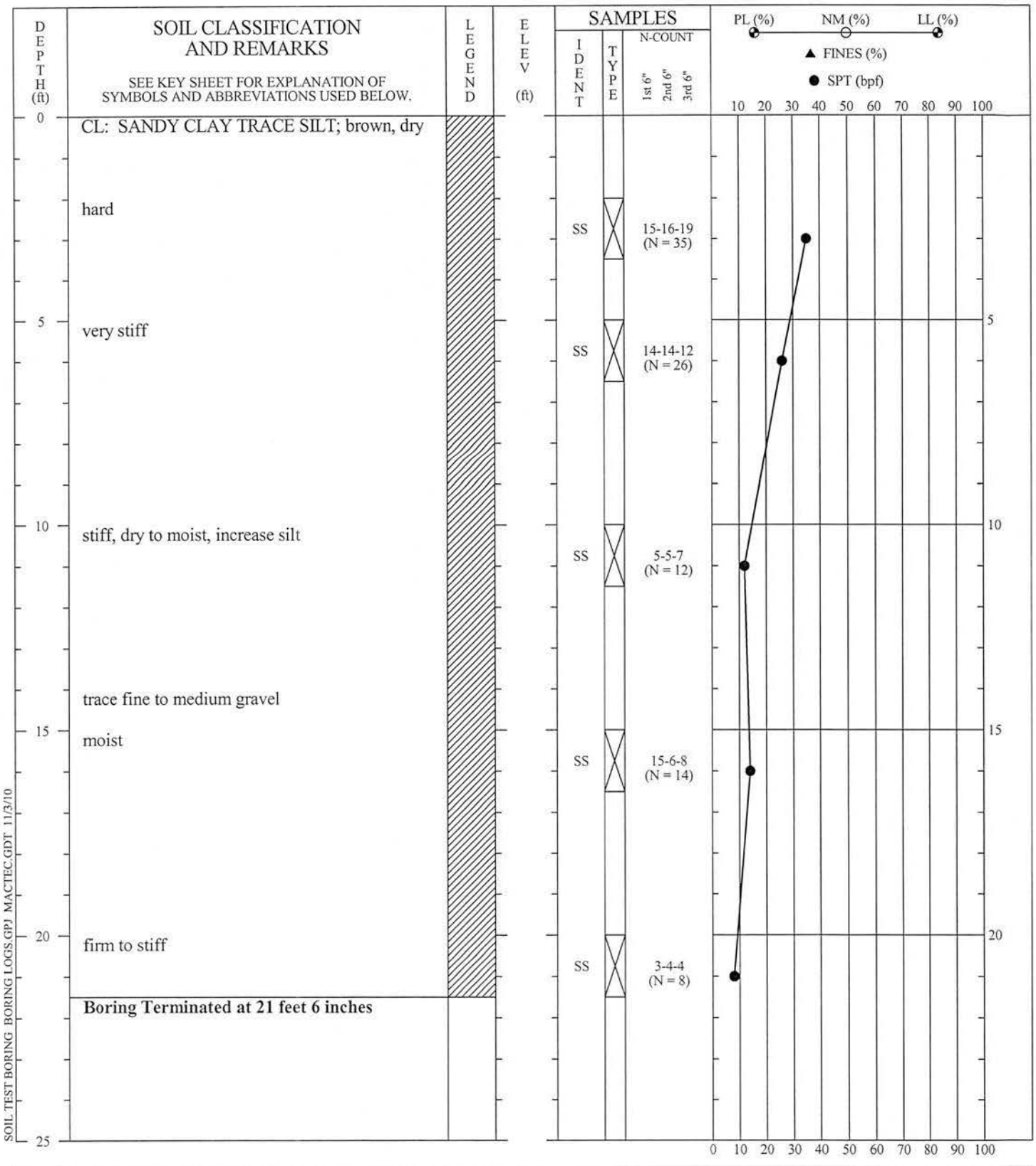
DRILLER: Dave Klann (MACTEC)
EQUIPMENT: Hand Sampling
METHOD:
HOLE DIA.:
REMARKS: No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 19A
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

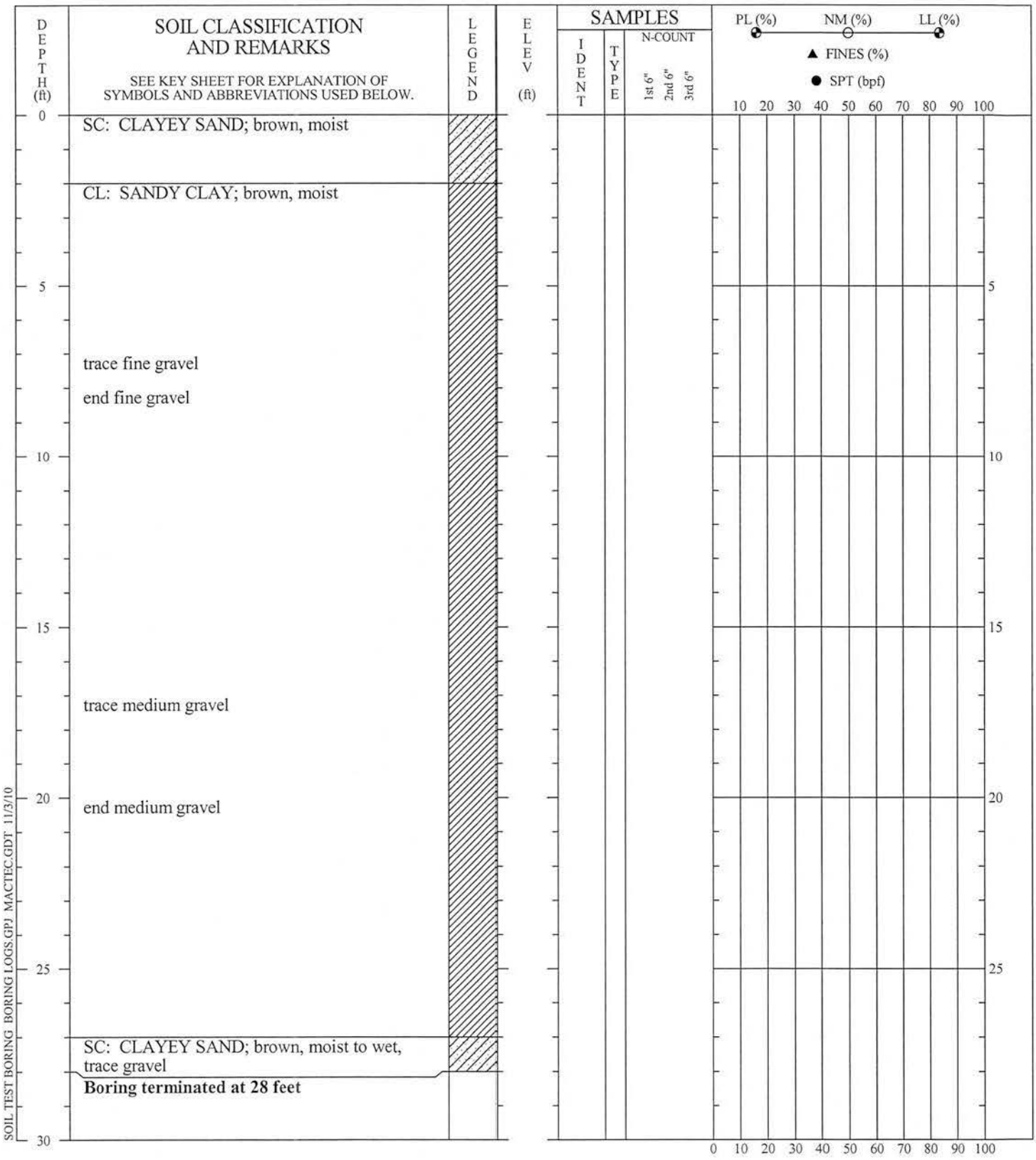
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-50 (Auto-Hammer)
METHOD:	8" HSA
HOLE DIA.:	8 inches
REMARKS:	No Groundwater Encountered

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: 20
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: September 23, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

MACTEC



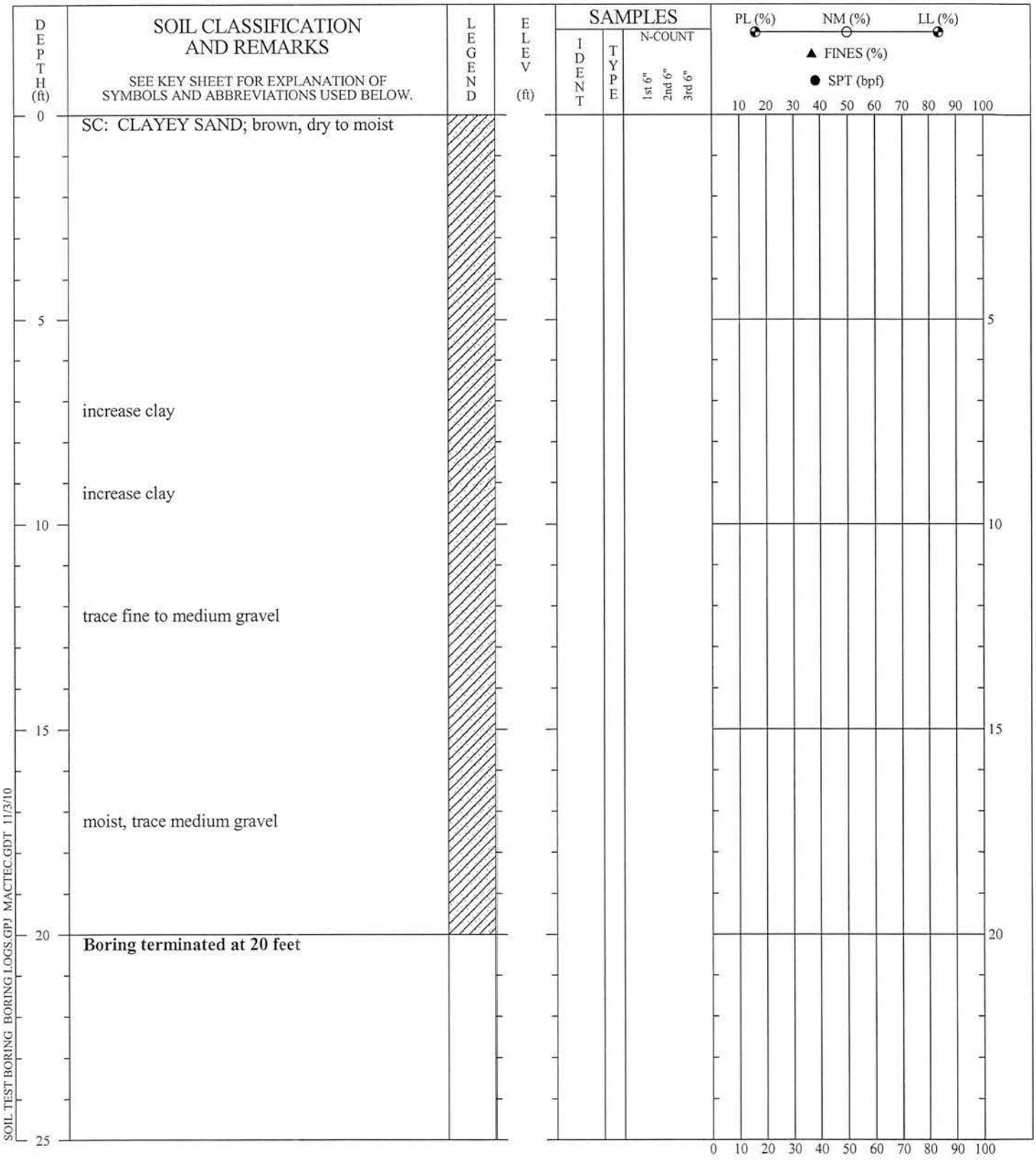
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	12" HSA
HOLE DIA.:	12 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: P1
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 14, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE 1 OF 1**

MACTEC



SOIL TEST BORING BORING LOGS.GPJ MACTEC.GDT 11/3/10

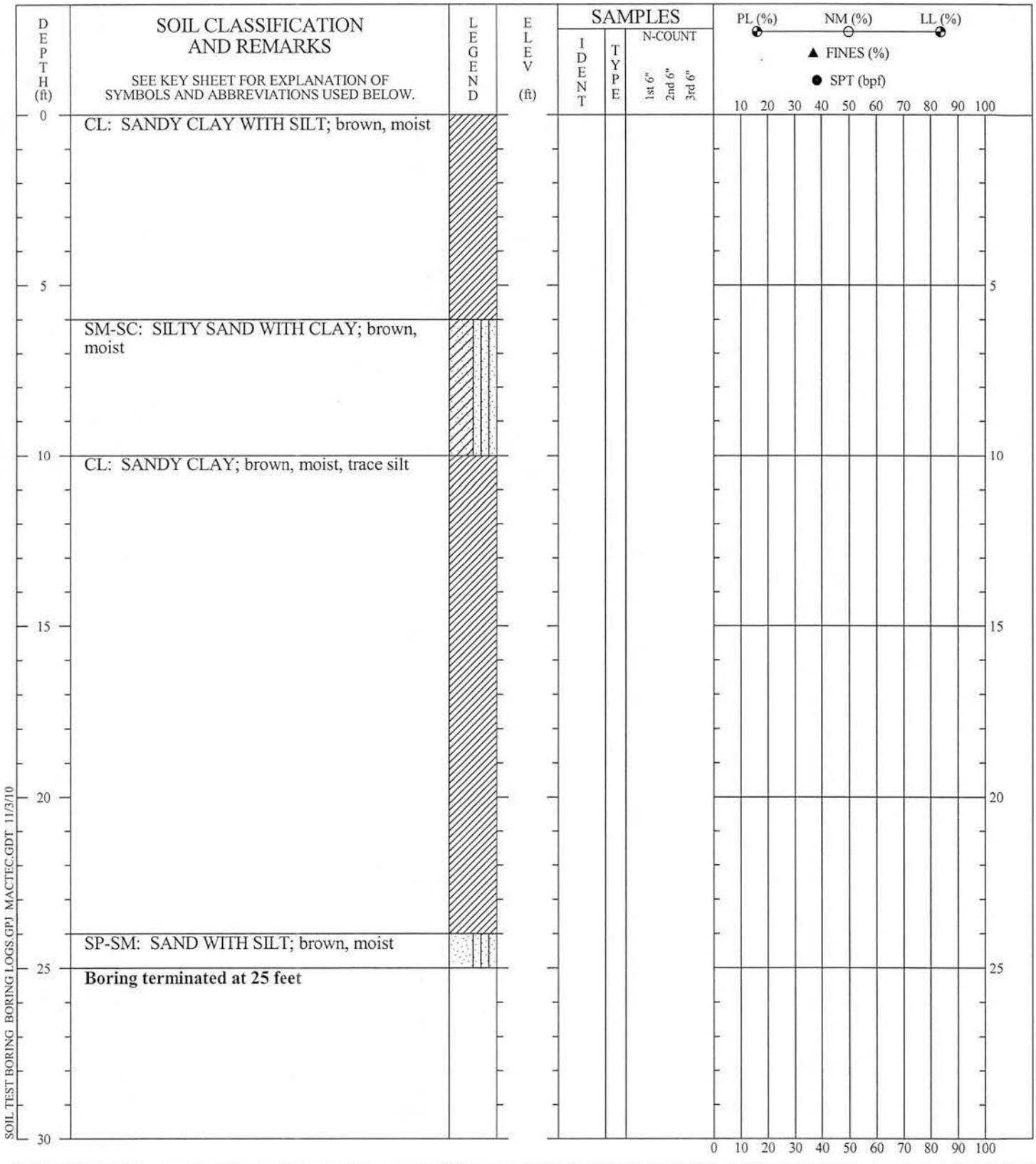
DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	12" HSA
HOLE DIA.:	12 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.:	P2
PROJECT:	Durango Regional Conveyance Channel
LOCATION:	Elwood Alignment Between 75th & 107th Ave
DRILLED:	October 14, 2010
PROJECT NO.:	4975-10-8043.01

MACTEC



DRILLER:	D&S Drilling
EQUIPMENT:	Diedrich D-125 (Auto-Hammer)
METHOD:	12" HSA
HOLE DIA.:	12 inches
REMARKS:	No Groundwater Encountered. Boring Located in Alfalfa Field

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

BORING NO.: P3
PROJECT: Durango Regional Conveyance Channel
LOCATION: Elwood Alignment Between 75th & 107th Ave
DRILLED: October 14, 2010
PROJECT NO.: 4975-10-8043.01 **PAGE** 1 **OF** 1

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APPENDIX B

LABORATORY TESTING

The laboratory testing procedures employed by MACTEC Engineering and Consulting, Inc. are in general accordance with AASHTO, ASTM, EPA, and/or Arizona standard methods and other applicable specifications.

MACTEC

SUMMARY OF LABORATORY TESTING

TABLE 1

Durango Regional Conveyance Channel
Elwood Street Alignment Between 75th Avenue and 107th Avenue
Phoenix, Arizona
MACTEC Project 4975-10-8043.01

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS	In-situ		Sieve Analysis (% Passing)					Liquid Limit	Plasticity Index	Remolded Moisture Content (%)	Remolded Dry Density (pcf)	Expansion (%)	Notes
				Moisture Content (%)	Dry Density (pcf)	3/4"	3/8"	No. 4	No. 40	No. 200						
1	2 - 3	1016454	CL	10.2	96											1, 2
1	5 - 6	1016455	CL	14.0	100											1, 2
3	3 - 5	1016441	CL			100	99	97	89	77	36	19				
3A	0.4 - 1.1	1016442	CL			100	99	99	90	68						
5	2 - 3	1016460	CL	18.3	107											1, 2
5	5 - 6	1016461	CL	12.0	92											1, 2
5	5 - 8	1016443	CL			100	95	93	87	82	39	17				
5	10 - 11	1016462	CL	10.4	94											1, 2
5	15 - 16	1016463	CL	23.4	116								10.2	112	10.7	1, 2, 3
5	20 - 21	1016464	CL	16.2	108											1, 2
5A	0.6 - 1.2	1016444	CL			100	97	95	90	80						

Notes:
1. Soil classification by field methods only.
2. Average In-situ Moisture Content and Dry Density for entire sample.
3. Remolded at approximately 95% of ASTM D698A at 3% below optimum and loaded with a 100 psf normal load.

SUMMARY OF LABORATORY TESTING

TABLE 2

Durango Regional Conveyance Channel
Elwood Street Alignment Between 75th Avenue and 107th Avenue
Phoenix, Arizona
MACTEC Project 4975-10-8043.01

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS	In-situ Moisture Content (%)	In-situ Dry Density (pcf)	Sieve Analysis (% Passing) 3/4"	3/8"	No. 4	No. 40	No. 200	Liquid Limit	Plasticity Index	Remolded Moisture Content (%)	Remolded Dry Density (pcf)	Expansion (%)	Notes
7	10 - 11	1016467	CL	19.1	102								14.4	103	13.3	1, 2, 3
8	2 - 5	1016447	SC			93	78	69	57	43	31	13				
8	10 - 11.5	1016502	CL										20.0	92	10.2	1, 3
8A	0.5 - 0.9	1016448	CL			99	97	96	91	76						
9	2 - 3	1016469	CL	13.2	84											1, 2
9	5 - 6	1016470	CL	12.6	86											1, 2
9	10 - 11	1016471	CL	13.4	90											1, 2
9	15 - 16	1016472	CL	14.6	108											1, 2
9	20 - 21	1016473	CL	14.1	112											1, 2
10A	0.7 - 1	1016450	CL			100	98	97	89	83						

Notes:
1. Soil classification by field methods only.
2. Average In-situ Moisture Content and Dry Density for entire sample.
3. Remolded at approximately 95% of ASTM D698A at 3% below optimum and loaded with a 100 psf normal load.

SUMMARY OF LABORATORY TESTING

TABLE 3

Durango Regional Conveyance Channel
Elwood Street Alignment Between 75th Avenue and 107th Avenue
Phoenix, Arizona
MACTEC Project 4975-10-8043.01

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS	In-situ Moisture Content (%)	In-situ Dry Density (pcf)	Sieve Analysis (% Passing) 3/4"	3/8"	No. 4	No. 40	No. 200	Liquid Limit	Plasticity Index	Remolded Moisture Content (%)	Remolded Dry Density (pcf)	Expansion (%)	Notes
12	6 - 9	1016618	CL										10.9	110	7.1	1, 3
16A	0 - 1	1016623	CL			100	98	97	92	81						
17	5 - 6	1016477	CL										28.3	81	1.1	1, 3
17A	0.5 - 1.1	1016624	CL			100	100	99	96	87						
19A	0.25 - 0.75	1016453	CL			100	98	97	94	84						

Notes:
1. Soil classification by field methods only.
2. Average In-situ Moisture Content and Dry Density for entire sample.
3. Remolded at approximately 95% of ASTM D698A at 3% below optimum and loaded with a 100 psf normal load.

SUMMARY OF LABORATORY TESTING

TABLE 4

Durango Regional Conveyance Channel
Elwood Street Alignment Between 75th Avenue and 107th Avenue
Phoenix, Arizona
MACTEC Project 4975-10-8043.01

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS	In-situ		Direct Shear		Collapse Potential		pH	Minimum Resistivity (ohms-cm)	Sulfate Content (ppm)	Chloride Content (ppm)	Expansion (%)	Notes
				Moisture Content (%)	Dry Density (pcf)	Angle of Friction (degrees)	Cohesion (psf)	Surcharge (psf)	Compression (%)						
3	3 - 5	1016441	CL							8.4	800	220	120		1, 2
5	5 - 8	1016443	CL							8.5	800	170	160		1, 2
5	15 - 16	1016463	CL	23.4	116			500	1.1						3, 4
								1000	1.7						
								1000 SAT	1.7						
								2000 SAT	2.5						
7	10 - 11	1016467	CL	19.1	102			500	0.5						3, 4
								500 SAT	-0.6						
								1000 SAT	-0.6						
								2000 SAT	0.2						
8	2 - 5	1016447	SC							8.2	734	300	230		1, 2
12	5 - 6	1016626	CL	28.3	97			500	0.4						3, 4
								1000	1.0						
								1000 SAT	1.0						
								2000 SAT	1.7						

Notes:
1. Sulfates and Chlorides tests in accordance with EPA Method 300.0.
2. pH and Minimum Resistivity tests in accordance with ARIZ 236a method.
3. Average In-situ Moisture Content and Dry Density for entire sample.
4. Soil classification by field methods only.

SUMMARY OF LABORATORY TESTING

TABLE 5

Durango Regional Conveyance Channel
Elwood Street Alignment Between 75th Avenue and 107th Avenue
Phoenix, Arizona
MACTEC Project 4975-10-8043.01

Boring No.	Sample Depth (ft)	MACTEC Lab No.	USCS	In-situ		Direct Shear		Collapse Potential		pH	Minimum Resistivity (ohms-cm)	Sulfate Content (ppm)	Chloride Content (ppm)	Expansion (%)	Notes
				Moisture Content (%)	Dry Density (pcf)	Angle of Friction (degrees)	Cohesion (psf)	Surcharge (psf)	Compression (%)						
17	2 - 5	1016451	CL							8.2	400	350	710		1, 2
17	10 - 11	1016476	CL	32.6	89			500	0.4						3, 4
								1000	0.8						
								1000 SAT	0.4						
								2000 SAT	0.9						

Notes:
1. Sulfates and Chlorides tests in accordance with EPA Method 300.0.
2. pH and Minimum Resistivity tests in accordance with ARIZ 236a method.
3. Average In-situ Moisture Content and Dry Density for entire sample.
4. Soil classification by field methods only.

TABLE 6

DURANGO REGIONAL CONVEYANCE CHANNEL

4975-10-8043.01

IAS Laboratories

2515 East University Drive
Phoenix, Arizona 85034
(602) 273-7248

SOIL ANALYSIS REPORT

Today's Date: 10/27/2010
Grower: DCRC
Submitted By: Mark Noorani
Send Report To: Orange Coast Analytical, Inc
Report Number: 6639050
Crop: Turf
Date Received: 10/22/2010

VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

BORING NO.	Sender Sample Id	Depth	Lab #	pH	Calcium (Ca) PPM	Magnesium (Mg) PPM	Sodium (Na) PPM	Potash (K) PPM	Iron (Fe) PPM	Zinc (Zn) PPM	Manganese (Mn) PPM	Copper (Cu) PPM	Salinity (EC x K) dS/m	Nitrate Nitrogen (NO3-N) PPM	Phosphorus (Bicarb - Soluble P) PPM	Computed % Sodium (ESP)	Sulfur (SO4-S) PPM	Boron (B) PPM	Free Lime Level
B11	1016615	0-2	678	8.3	7500 VH	960 VH	310 VH	320 VH	7.2 H	1.5 H	3.3 H	1.5 VH	1.0 L	7.3 L	3.3 VL	2.8	9.1 L	.40 L	High
B11	1016616	6-9	679	8.5	7400 VH	490 VH	140 M	250 H	6.8 H	.46 L	1.8 H	1.1 VH	.8 L	5.5 VL	4.1 VL	1.4	12 M	.30 VL	High
B13	1016619	0-2	680	8.2	7300 VH	590 VH	190 M	320 VH	12.0 VH	.23 L	3.2 H	1.2 VH	1.2 L	12.0 M	24.0 H	1.9	9.5 L	.41 L	High
B13	1016620	6-9	681	8.6	7200 VH	1000 VH	640 VH	270 VH	14.0 VH	1.1 M	7.5 VH	2.5 VH	1.8 L	4.7 VL	1.6 VL	5.8	29 VH	.58 L	High
B1	1016456	10-11	682	8.6	6600 VH	790 VH	230 H	270 VH	5.2 H	.50 L	1.5 M	.88 H	.8 L	3.0 VL	1.0 VL	2.4	7.9 L	.27 VL	High

MK 10-27-10