GEOTECHNICAL REPORT
CHEYENNE AVENUE DISTRESS
INVESTIGATION and MITIGATION
CLARK COUNTY
April 2003

NEVADA DOT
GEOTECHNICAL ENGINEERING

MATERIALS DIVISION

STATE OF NEVADA
DEPARTMENT OF TRANSPORTATION
MATERIALS DIVISION
GEOTECHNICAL SECTION

GEOTECHNICAL REPORT
CHEYENNE AVENUE DISTRESS

April 2003

CLARK COUNTY, NEVADA

Prepared by: ________________________________

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TABLE OF CONTENTS

APPENDICES

INTRODUCTION

General

This report has been prepared to address the pavement distress occurring on Cheyenne Avenue in Clark County, Nevada. An area of eastbound Cheyenne between Trade Drive and Revere Street in North Las Vegas has been exhibiting subsidence and heaving for at least four years. There is some evidence that this area of distress is enlarging to the north and east to include the median and westbound lanes. At present, the road is two lanes wide (12-13 feet each) in each direction, with 12-foot wide shoulder lanes and median. A site plan for the project is presented in Appendix A.

Purpose and Scope

The purpose of this report is to provide information regarding the subsurface soil conditions at the affected site on Cheyenne Avenue between Trade Drive and Revere Street. This report also provides geotechnical design recommendations for reparation of the roadway. The scope of this report consists primarily of geotechnical investigation and analysis. The investigation included gathering data from past field explorations and reports, in addition to information obtained from recent field reconnaissance, subsurface explorations, soil sampling, and analysis of field and laboratory testing data. This report includes the boring logs and summaries of test results from field investigations and the laboratory testing regimen. These may be found in appendices B and C, respectively.

PROJECT DESCRIPTION

Cheyenne Avenue (State Route 574) between Trade Drive and Revere Street is in North Las Vegas in Clark County, Nevada. It lies approximately 1.6 miles west of I-15, and 3.0 miles north of US 95, and runs generally east-west. Cheyenne Avenue is approximately 84 feet wide at this location, and is currently two lanes wide in each direction, with 12-foot wide shoulder lanes, and median. A site plan is presented in Appendix A.

Eastbound Cheyenne Avenue has been exhibiting large amounts of subsidence, along with some minor heaving, for about four years. The most recent repair was performed in 2001, with a four-foot deep excavation and reconstruction beginning approximately 250 feet east of Trade Drive, in the south shoulder and first adjacent eastbound lane, extending about 225 feet. At this point, the repair widens to include the shoulder and both eastbound lanes and proceeds approximately 420 feet east, extending beyond Revere Street.

Currently, there are one major and two lesser areas of subsidence. The largest is at the west end of the most recent repair section (See Photo 1), while the two minor areas lie just west of Revere Street. All of these zones are in the eastbound lanes, directly adjacent to the gutter pan.

Photo 1. Cheyenne Avenue Looking West.

GEOLOGIC CONDITIONS

The site is founded primarily in consolidated sediments (QTs). These sediments are generally fine sand and may contain silt, clay, pebbly sand, and pebble to small cobble gravel. The deposits commonly have areas that are moderately to well consolidated, and may exhibit some cementation due to layers of petrocalcic carbonate (caliche)[1].

This area lies at an elevation of approximately 2100 feet and slopes downward (˜4%) to the east[2]. Groundwater was not found at the time of exploration in any of the boreholes, the deepest of which was 23.3 feet. Areas exist less than 1000 feet away, both east and west of the site, which are identified as containing subsidence-induced fissures[1,3]. In addition, the area in general has experienced subsidence of one foot documented in a large-scale study of the central Las Vegas Valley as a whole[4].

FIELD INVESTIGATION

The Geotechnical Section performed an investigation between Trade Drive and Revere Street, in December 2002. This investigation consisted of three boreholes placed just north of the south concrete gutter pan, and advanced to depths ranging from 11.0 to 23.3 feet. Borehole CHD-1 was placed in an undistressed area to the west of boreholes CHD-2 and CHD-3, which were placed in an area of subsidence.

The soils are primarily loose silts, silty sands, and stiff to hard clays. The loose silts can be subject to piping (transportation of the fine particles via water flow), while loose silts and silty sands can be more prone to collapse. The clays exhibit expansive properties when they are exposed to water. These are possible causative factors of distress in this instance, since it appears that both heaving and subsidence are occurring.

The approximate location of each borehole is shown on the Borehole Location sheet in Appendix A. The surface elevations were approximated for the borehole locations by extrapolation from contract plans. Drilling was accomplished utilizing a Mobile B-57 drill rig equipped with six-inch hollow stem auger. Soil samples and standard penetration resistance values (N-Values) were obtained utilizing the Standard Penetration Test (SPT) procedure as set forth in ASTM test number T206. The uncorrected blow counts are shown on the boring logs in Appendix B. Soil conditions were also suitable for using both a California Modified Split Spoon Sampler (CMS) and thin-walled Shelby tubes (SH), allowing for both disturbed and relatively undisturbed samples to be obtained. All soil samples were classified, both visually and using laboratory data, using the Unified Soil Classification System (USCS).

LABORATORY ANALYSIS

Laboratory tests were performed on the samples collected from the boreholes. The testing program consisted of particle size analyses, Atterberg limits, consolidation tests (hydrocollapse and swell index), moisture content, and unit weights. The results of this testing program show that the soils consist primarily of loose silts and silty sands, transitioning into stiff to hard clays. Further information is presented in the summaries of test results in Appendix C.

DISCUSSION

Subsequent evaluation of both boring log data and lab results from testing indicate the soils have the potential to both collapse and expand. Any change in volume of the underlying soil results in movement at the surface. Substantial differential movement will cause deformation of the pavement, which usually expresses itself by cracking in asphalt pavements. The resulting cracks then provide an avenue for further infiltration of moisture, perpetuating the cycle. The 1999 investigation identified a leaking water pipe located in a planter area of the adjacent structure to the south of Cheyenne Avenue as one of the initial sources of water to the subgrade. It is possible this was the start of such a cycle. The adjacent structure and parking lot appear to be suffering from problems similar to the roadway. The structure, a large concrete tilt-up approximately 600 feet in length, is showing what appears to be diagonal shear cracks in several panels indicating differential settlement in its foundation. In addition, there are obvious gaps along most of the window mullions at the foundation line. The parking lot has two large areas of depression identified by concentric circular cracking, as well as several linear cracks in other areas. Runoff from the building roof collects in these depressions, the largest of which is adjacent to the location of the boreholes (See Diagram 1).

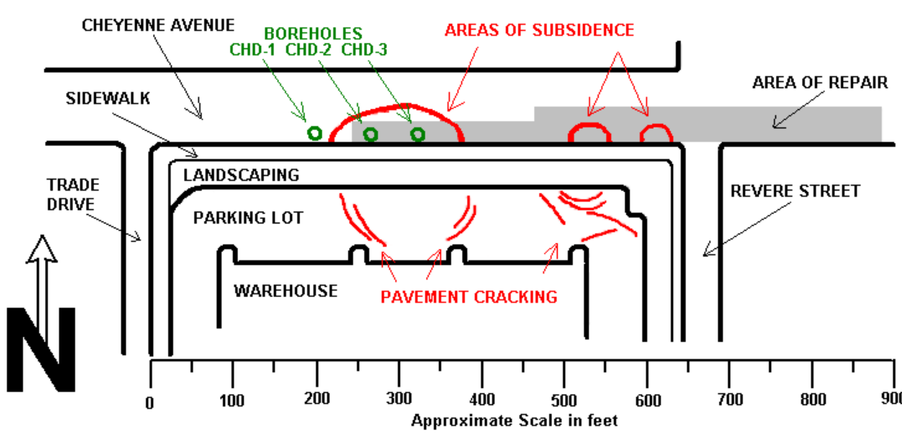


Diagram 1

In all three boreholes, loose pea gravel (See Photo 2), was encountered from approximately 2.5 feet to 5.0 feet below the surface. It is unclear when and why this pea gravel was introduced. Possibilities include using the gravel for utility trench backfill, roadway edge drain, or other drain applications. In any case, this gravel could be a conduit for water to reach the native soils, increasing the problems in the area. In addition, this gravel could provide an excellent avenue to promote the piping away of any fine silty soils, creating voids, which can then collapse.

A previous investigation in September 1999 provided information indicating the presence of silty sands and silty clays, with some interspersed gravel layers.

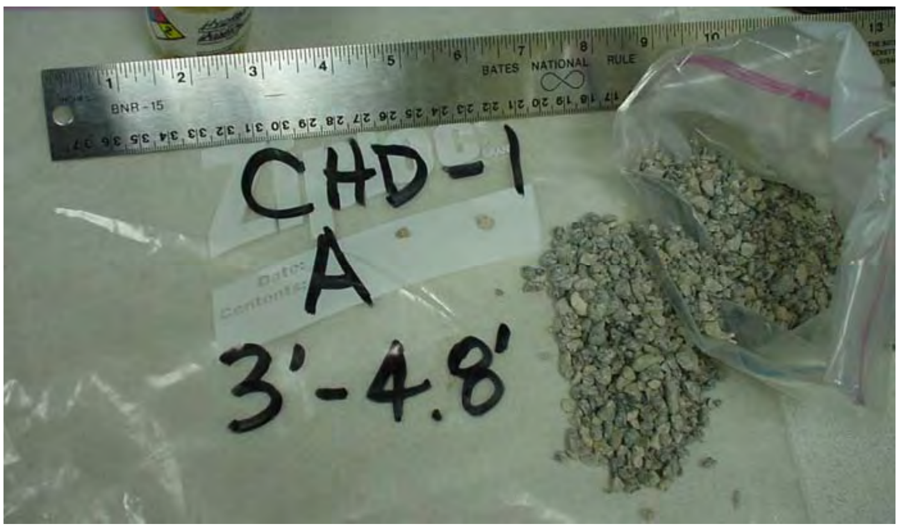


Photo 2. <u>Sample of Pea Gravel</u>

The previous repair consisted of placement of an impermeable layer of geomembrane at the bottom of the excavation, 30 inches of borrow material placed on top of the geomembrane, then one foot of Type 1 Class B aggregate base, 6 inches of plantmix bituminous surface with a ¾ inch plantmix open-graded surface. Currently, there are one major and two minor areas of subsidence. The largest is at the west end of the most recent repair section. There is some evidence that the distress in this area is expanding to the north and east to include the median and westbound lanes.

RECOMMENDATIONS

The cause of the pavement distress is most probably due to the introduction of water into the poorly compacted, moisture sensitive soils. This may occur from infiltration through cracks in the pavement; excess irrigation flow; runoff from the adjacent building roof; or other undiscovered means. The distressed area currently runs for approximately 500 feet along Cheyenne Avenue. Any mitigation effort should extend a minimum of 50 feet beyond the distressed area at each end, and run the full width of the roadway.

All construction shall be performed in accordance with the NDOT 2001 Standard Specifications for Road and Bridge Construction. Although not anticipated, variable site conditions include the possibility of encountering caliche, large cobbles, or other adverse soil conditions. Soft soils should be expected to be encountered.

Repair Options

Option 1. Excavation. Excavate the roadbed to a depth of approximately five feet from the roadbed surface, and stockpile the excavated material. Replace the excavated material from the stockpile, and compact to 90% of the maximum density as determined by Test Method No. Nev. T101. This method of repair has been attempted once in this area, in combination with features from Option 2, with poor results. The previous repair did not extend full-width across Cheyenne Avenue, and it appears that the material used during the repair construction was not compacted properly, resulting in excessive settlement. Special care should be taken during construction to ensure that all subgrade work receives adequate attention towards achieving the proper compaction, 90% of the maximum density.

Option 2. Encapsulation. Excavate the roadbed to a depth of approximately five feet from the roadbed surface and place a geomembrane (impervious geosynthetic layer) full width on the subgrade, extending down beyond the silty sand layer (approximately four to five feet), in vertical trenches on all four sides of the roadway excavation (See Diagram 2). This will prevent surface moisture from entering the moisture-sensitive layers below it. Replace the excavated material below the base with Selected Borrow. The geomembrane should be cushioned before or during construction[7]. This may be accomplished by using either a material with geomembrane sandwiched between layers of geotextile, or layering geotextile-geomembrane-geotextile during construction. This is done to prevent puncturing the geomembrane, which compromises the capacity to waterproof. Employed with proper compaction of both subgrade and all subsequent fill, this should reduce future moisture-related movement.

Geomembrane was used previously in the last repair effort, but only partial width across Cheyenne Avenue, as mentioned in Option 1. Geomembrane specifications are located in Appendix D.

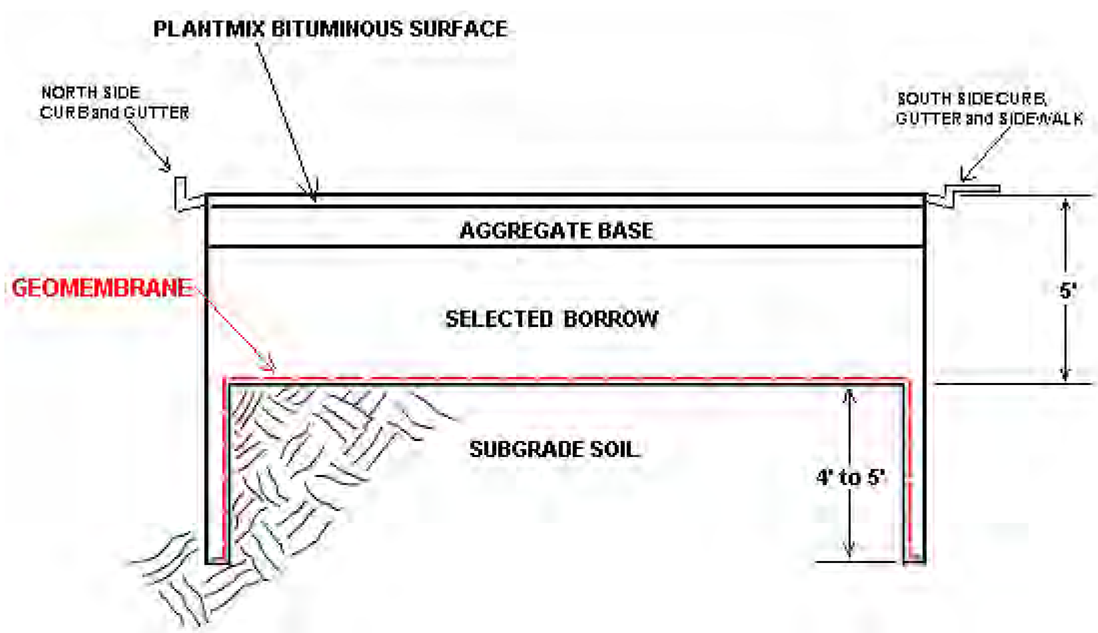
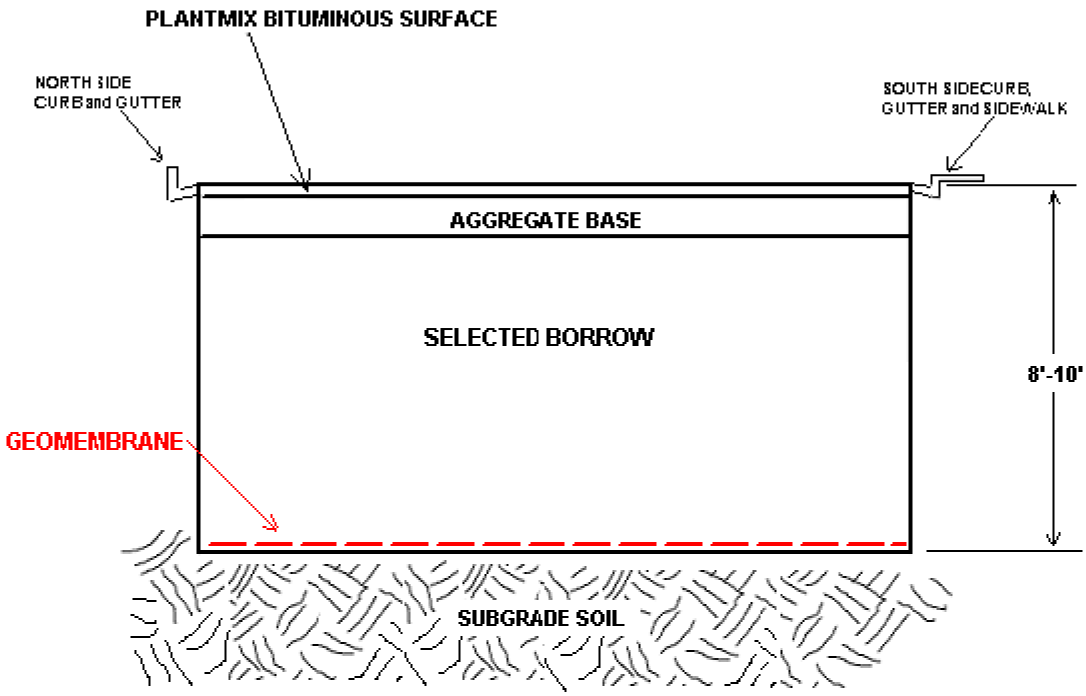


Diagram 2

Option 3. Remove and replace. Excavate the roadway to an approximate depth of eight to ten feet. Replace the material below the aggregate base with Selected Borrow.



<u>Diagram 3</u>

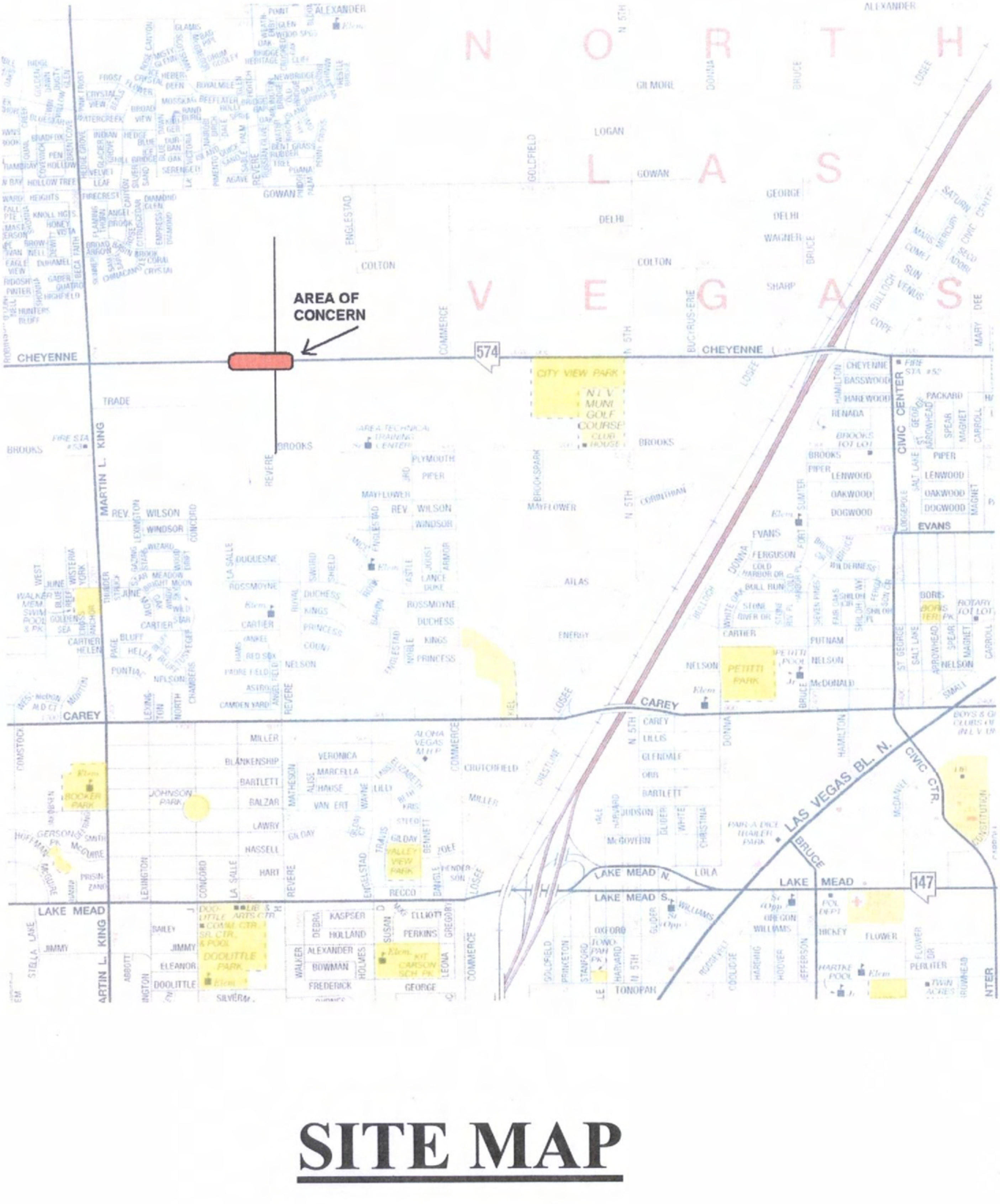
Other options, such as installing stone columns or chemically treating the soil were discussed and excluded as not being feasible.

Based on cost and constructability, the Materials Division recommends Option 2. This repair was utilized in a clay heave area and no apparent heave or settlement has occurred since the repair.

REFERENCES

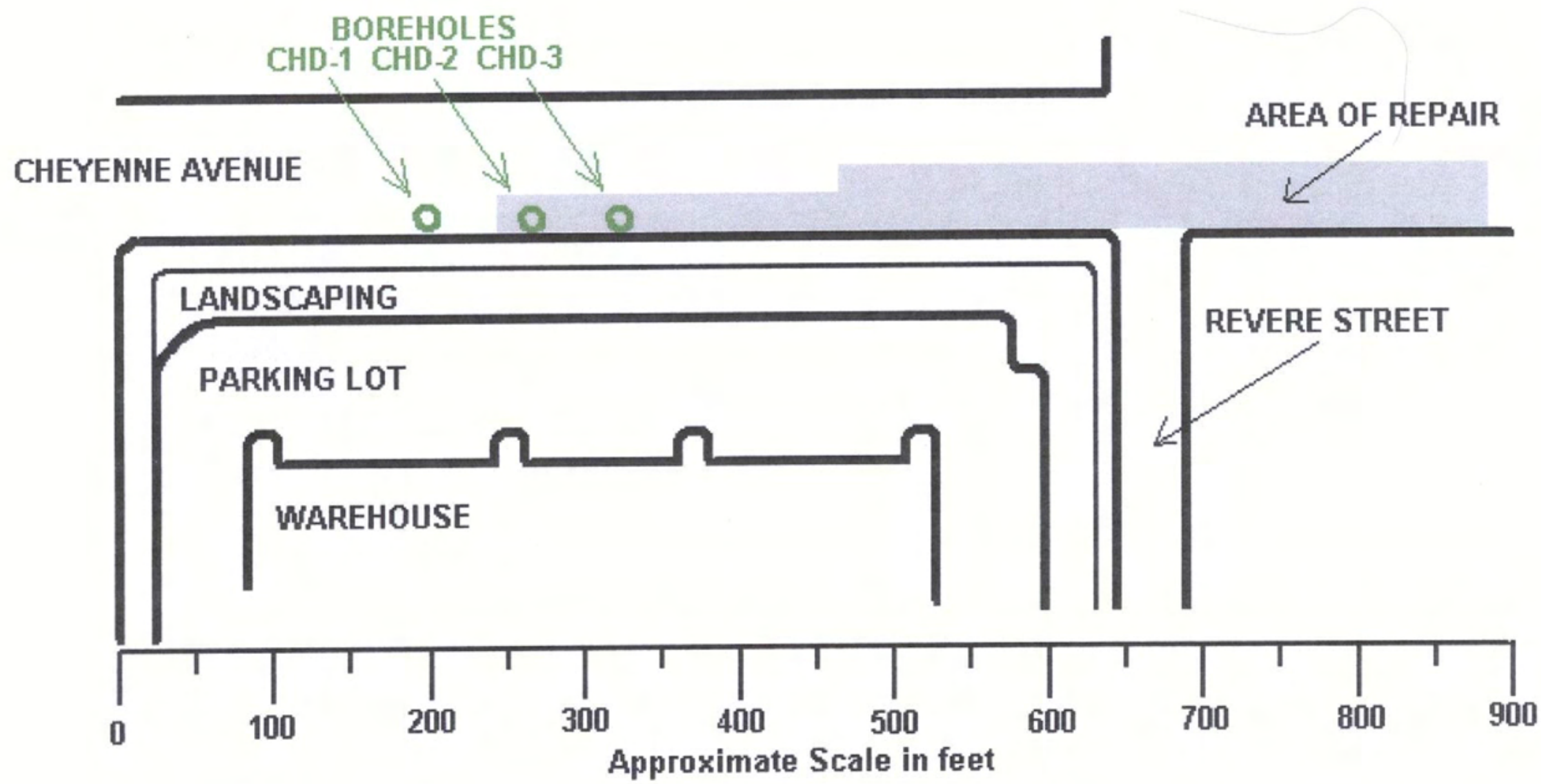
1. Geologic Map of Las Vegas NW Quadrangle; Nevada Bureau of Mines and Geology, Map 3Dg, 1987.
2. Las Vegas NW Folio Tinted Relief Map; Nevada Bureau of Mines and Geology, 1974.
3. Subsidence in Las Vegas Valley, 1980-1991; NBMG Open File Report 93-4, John W. Bell and Jonathan G. Price, 1993, Plate 2, 1991.
4. Subsidence in Las Vegas Valley, 1980-1991; NBMG Open File Report 93-4, John W. Bell and Jonathan G. Price, 1993, Plate 4, 1991.
5. AASHTO Standard Specifications For Highway Bridges, sixteenth edition, 1996; with interims through 2002.
6. Standard Specifications for Road and Bridge Construction, State of Nevada Department of Transportation, 2001.
7. Geotextiles in Transportation Applications, 1996, Amoco Fabrics and Fibers Company

APPENDIX A



AREA OF CONCERN
NORTH LAS VEGAS
CHEYENNE
CAREY
LAKE MEAD
MARTIN L. KING
LAS VEGAS BL. N.
CIVIC CTR.
CIVIC CENTER
574
147
CITY VIEW PARK
PETITTI PARK
DOOLITTLE PARK
BROOKS
TRADE
REVERE
COMMERCE
N 5TH

SITE MAP



Boring Locations

APPENDIX B

KEY TO BORING LOGS

PARTICLE SIZE LIMITS									
CLAY	SILT	SAND			GRAVEL		COBBLES	BOULDERS	
		FINE	MEDIUM	COARSE	FINE	COARSE			
.002 mm	#200	#40	#10	#4	3/4 inch	3 inch		12 inch	

USCS GROUP	TYPICAL SOIL DESCRIPTION
GW	Well graded gravels, gravel-sand mixtures, little or no fines
GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
GM	Silty gravels, poorly graded gravel-sand-silt mixtures
GC	Clayey gravels, poorly graded gravel-sand-clay mixtures
SW	Well graded sands, gravelly sands, little or no fines
SP	Poorly graded sands, gravelly sands, little or no fines
SM	Silty sands, poorly graded sand-silt mixtures
SC	Clayey sands, poorly graded sand-clay mixtures
ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL	Organic silts and organic silt-clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity
CS	Claystone/Siltstone
PT	Peat and other highly organic soils

MOISTURE CONDITION CRITERIA

Description	Criteria
Dry	Absence of moisture, dusty, dry to touch.
Moist	Damp, no visible free water.
Wet	Visible free water,usually below groundwater table.

SOIL CEMENTATION CRITERIA

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Won't break or crumble w/finger pressure

▽ ▼ Groundwater Elevation Symbols

STANDARD PENETRATION CLASSIFICATION*			
GRANULAR SOIL		CLAYEY SOIL	
BLOWS/FT	DENSITY	BLOWS/FT	CONSISTENCY
0 - 4	VERY LOOSE	0 - 1	VERY SOFT
5 - 10	LOOSE	2 - 4	SOFT
11 - 30	MEDIUM DENSE	5 - 8	MEDIUM STIFF
31 - 50	DENSE	9 - 15	STIFF
OVER 50	VERY DENSE	16 - 30	VERY STIFF
		31 - 60	HARD
		OVER 60	VERY HARD

*Standard Penetration Test (N) 140 lb hammer 30 inch free fall on 2 inch O.D. x 1.4 inch I.D. sampler.

Blow counts on Calif. Modified Sampler (N_{CMS}) can be converted to N_{SPT} by:
$(N_{CMS})(0.62) = N_{SPT}$

Blow counts from Automatic or Safety Hammer can be converted to Standard SPT N_{60} by:
$(N_{AUTOMATIC})(1.25) = N_{60}$
$(N_{SAFETY})(1.17) = N_{60}$

TEST ABBREVIATIONS

CD	CONSOLIDATED DRAINED
CH	CHEMICAL (CORROSIVENESS)
CM	COMPACTION
CU	CONSOLIDATED UNDRAINED
D	DISPERSIVE SOILS
DS	DIRECT SHEAR
E	EXPANSIVE SOIL
G	SPECIFIC GRAVITY
H	HYDROMETER
HC	HYDRO-COLLAPSE
K	PERMEABILITY
O	ORGANIC CONTENT
OC	CONSOLIDATIONCPT
PI	PLASTICITY INDEX
RQD	ROCK QUALITY DESIGNATION
RV	R-VALUE
S	SIEVE ANALYSIS
SL	SHRINKAGE LIMIT
U	UNCONFINED COMPRESSION
UU	UNCONSOLIDATED UNDRAINED
UW	UNIT WEIGHT
W	MOISTURE CONTENT

SOIL COLOR DESIGNATIONS ARE FROM THE MUNSELL SOIL COLOR CHART.
EXAMPLE: (7.5 YR 5/3) BROWN

SAMPLER NOTATION

CMS	CALIF. MODIFIED SAMPLER ①
	CONE PENETRATION
CS	CONTINUOUS SAMPLER ②
CSS	CALIFORNIA SPLIT SPOON ①
P	PUSHED (NOT DRIVEN)
PB	PITCHER BARREL
RC	ROCK CORE ③
SH	SHELBY TUBE ④
SPT	STANDARD PENETRATION TEST
TP	TEST PIT

①- I.D.= 2.421 inch
②- I.D.=3.228 inch with tube; 3.50 inch w/o tube
③- NXB I.D.= 1.875 inch
④- I.D.= 2.875 inch

LAST MODIFIED: February 9, 2000

EXPLORATION LOG

NEVADA DEPARTMENT OF TRANSPORTATION — GEOTECHNICAL ENGINEERING

START DATE	12/10/02	STATION	"CA" +6.70
END DATE	12/10/02	OFFSET	S. Edge of Oil
JOB DESCRIPTION	CHEYENNE AVENUE DISTRESS	ENGINEER	Boomhower
LOCATION	Cheyenne Ave. between Trade Dr. and Revere St.	EQUIPMENT	Mobile B-57
BORING	CHD-1	OPERATOR	Altamirano
E.A. #		DRILLING METHOD	6" H.S.A.
GROUND ELEV.	2100.00 (ft)	BACKFILLED	Yes DATE 12/10/2002
HAMMER DROP SYSTEM	Automatic		

GROUNDWATER LEVEL

DATE	DEPTH ft	ELEV. ft

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	Depth	MATERIAL DESCRIPTION	REMARKS
									0.67	**Plantmix Bituminous Surface**	
								GP GM	2.30	**POORLY GRADED GRAVEL with SILT and SAND**(Base)	Bulk 1 @ 1.0 - 1.5 feet.
	3.00 - 4.80	A	SPT	3 2 1	3	17		SP	5.40	**<u>POORLY GRADED SAND with GRAVEL</u>** fine, dry to damp	Most of sample A lost. Bulk 2 @ 3.5 - 5.0 feet.
2095.0	5										
	6.50 - 8.00	B	SPT	6 11 10	21	83		SC	9.00	**<u>CLAYEY SAND</u>** damp to moist, very stiff (5YR 6/4)	Geotextile @ 6.8 feet. Roots @ 7.0 feet.
2090.0	10										
	10.00 - 11.50	C	CMS	21 27 26	53	100		CL ML	11.20	**<u>SANDY SILTY CLAY</u>** cemented, with caliche nodules, dry to damp, very stiff (10YR 8/2 to 5YR 7/2 to 5YR 5/4)	
								SC SM	13.20	**<u>SILTY CLAYEY SAND</u>**	
2085.0	15										
	15.00 - 16.30	D	SH			100		SM	16.30	**<u>SILTY SAND</u>** damp (5YR 6/4)	D push - 50 psi @ 6"; 300 psi @ 12"; 600 psi @ 15".
										B.O.H.	
2080.0	20										
2075.0	25										

EXPLORATION LOG

NEVADA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING

START DATE 12/10/02
END DATE 12/10/02
JOB DESCRIPTION CHEYENNE AVENUE DISTRESS
LOCATION Cheyenne Ave. between Trade Dr. and Revere St.
BORING CHD-2
E.A. #
GROUND ELEV. 2098.10 (ft)
HAMMER DROP SYSTEM Automatic

GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft

STATION "CA" +28.65
OFFSET S. Edge of Oil
ENGINEER Boomhower
EQUIPMENT Mobile B-57
OPERATOR Altamirano
DRILLING METHOD 6" H.S.A.
BACKFILLED Yes DATE 12/10/2002

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	MATERIAL DESCRIPTION	REMARKS
									0.67 **Plantmix Bituminous Surface**	
								GP GM	**POORLY GRADED GRAVEL with SILT and SAND**(Base) 2.30	Bulk 1 @ 1.0 - 2.0 feet.
	3.50							GP	**POORLY GRADED GRAVEL** fine, with silty sand, dry to damp	
2093.1	5.00 (5)	A	CMS	4 3 2	5	0			5.00	A - no recovery.
	6.60	B	CMS	2 2 4	6	100		SP	5.70 **POORLY GRADED SAND with GRAVEL** damp to moist, very stiff (5YR 6/4)	
								CH	**SANDY FAT CLAY** 7.50	
	8.10	C	CMS	5 5 10	15	100		SC	**CLAYEY SAND** damp, (5YR 6/4) 9.30	
	9.00									
2088.1	10 / 11.00	D	SH					SC SM	**SILTY CLAYEY SAND** damp, (5YR 6/4) 11.00	D - push @ 200 psi.
									B.O.H.	
2083.1	15									
2078.1	20									
2073.1	25									

NEVADA DEPARTMENT OF TRANSPORTATION GEOTECHNICAL ENGINEERING

EXPLORATION LOG

START DATE 12/11/02
END DATE 12/11/02
JOB DESCRIPTION CHEYENNE AVENUE DISTRESS
LOCATION Cheyenne Ave. between Trade Dr. and Revere St.
BORING CHD-3
E.A. #
GROUND ELEV. 2096.80 (ft)
HAMMER DROP SYSTEM Automatic

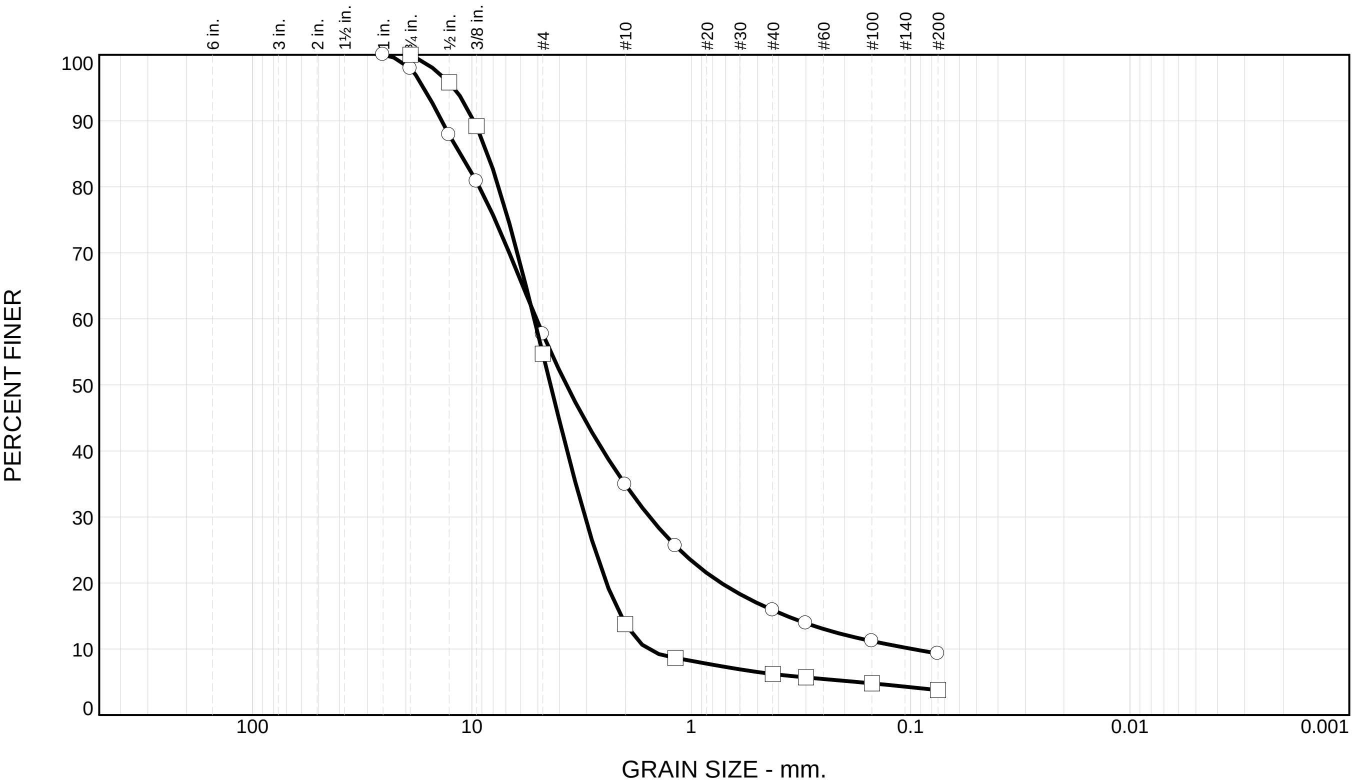
GROUNDWATER LEVEL		
DATE	DEPTH ft	ELEV. ft

STATION "CA" +44.19
OFFSET S. Edge of Oil
ENGINEER Boomhower
EQUIPMENT Mobile B-57
OPERATOR Altamirano
DRILLING METHOD 6" H.S.A.
BACKFILLED Yes DATE 12/11/2002

ELEV. (ft)	DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT 6 inch Increments	BLOW COUNT Last 1 foot	Percent Recov'd	LAB TESTS	USCS Group	Depth	MATERIAL DESCRIPTION	REMARKS
									0.67	**Plantmix Bituminous Surface**	
								GP GM	3.50	**POORLY GRADED GRAVEL with SILT and SAND**(Base)	Bulk 1 @ 1.0 - 2.0 feet.
2091.8	4.80 – 6.30 (5)	A	CMS	7 2 4	6	78		SP	5.80	**POORLY GRADED SAND with GRAVEL** fine, dry to damp	
								ML	7.00	**SANDY SILT** dry, loose to medium dense (5YR 6/4)	Geotextile @ 5.8 feet. Geomembrane @ 6.0 feet.
	7.80 – 9.50	B	SH			94		SM	9.50	**SILTY SAND** dry, loose to medium dense (5YR 6/4)	Geotextile @ 7.8 feet.
2086.8	9.80 – 11.30 (10)	C	SPT	5 5 7	12	100		CL	10.50	**SANDY LEAN CLAY**	
								CH		**FAT CLAY with SAND** with caliche nodules, damp, stiff (5Y 7/2 to 5Y 5/2)	
2081.8	14.20 – 15.70 (15)	D	CMS	7 11 18	29	100				**FAT CLAY** with caliche nodules, damp, stiff (5Y 7/2 to 5Y 5/2), with silty clay lens from 14.5 to 14.8 feet.	
2076.8	19.80 – 21.80 (20)	E	SH			100					
	21.80 – 23.30	F	SPT	5 8 9	17	100			23.30	**FAT CLAY** damp, stiff (5Y 7/2 to 5Y 5/2)	Slickensided, fractured appearance.
										B.O.H.	
2071.8	25										

APPENDIX C

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	42.3	48.4	9.3		SP-SM			
□	0.0	45.3	50.9	3.8		SP			

SIEVE inches size	PERCENT FINER ○	□	
1	100.0		
3/4	97.9	100.0	
1/2	87.9	95.8	
3/8	80.8	89.2	
	GRAIN SIZE		
D_{60}	5.0846	5.1998	
D_{30}	1.5482	3.0512	
D_{10}	0.0982	1.5748	
	COEFFICIENTS		
C_c	4.80	1.14	
C_u	51.78	3.30	

SIEVE number size	PERCENT FINER ○	□	
#4	57.7	54.7	
#10	34.9	13.8	
#16	25.6	8.6	
#40	15.9	6.2	
#50	13.9	5.7	
#100	11.2	4.8	
#200	9.3	3.8	

Material Description

○ Poorly graded sand with silt and gravel

□ Poorly graded sand with gravel

REMARKS:

○

□

○ Source of Sample: CHD1 Depth: 1.0' Sample Number: Bulk1

□ Source of Sample: CHD1 Depth: 3.5' Sample Number: Bulk2

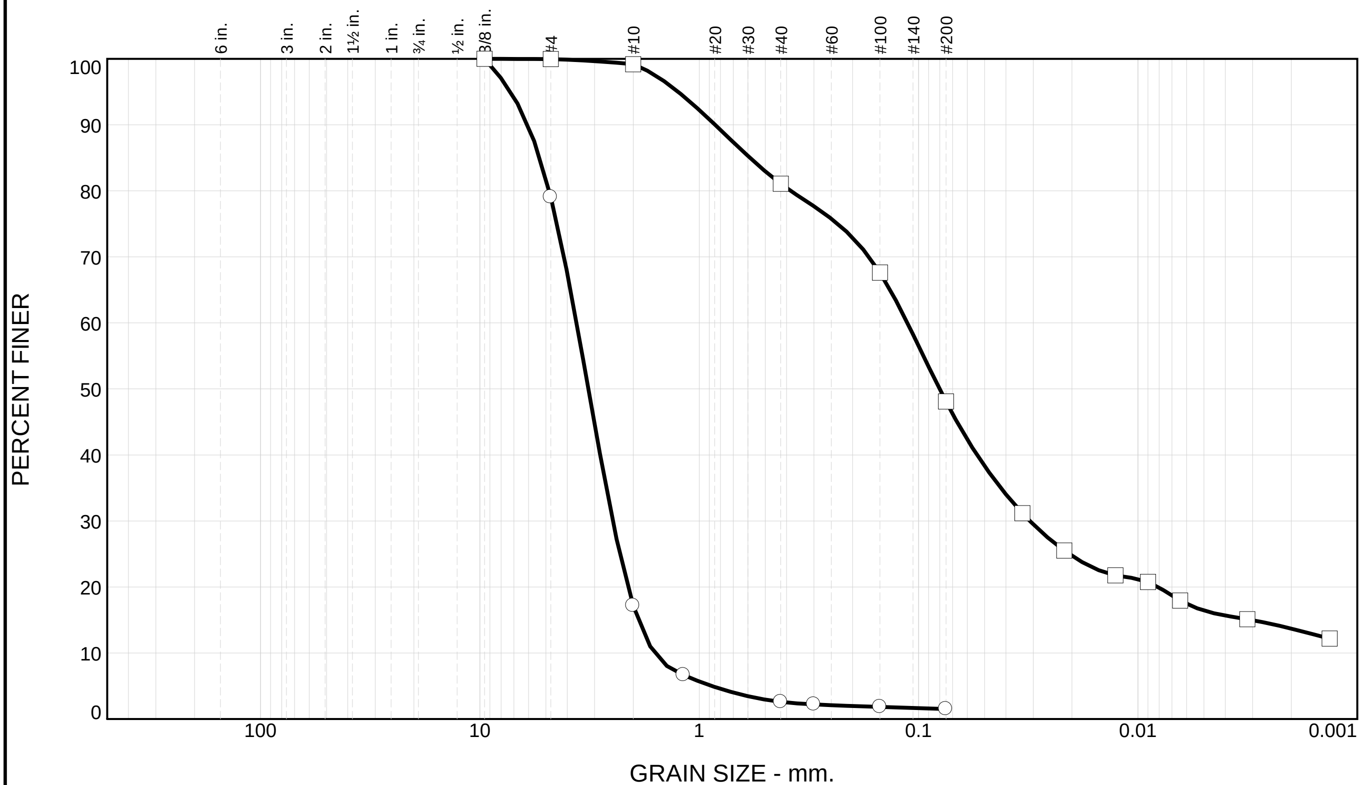
NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower

Project: Cheyenne Ave., Las Vegas

Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	20.9	77.6	1.5		SP			
□	0.0	0.0	51.9	31.7	16.4	SC		19	38

SIEVE inches size	PERCENT FINER ○	□	
3/8	100.0	100.0	
	GRAIN SIZE		
D_{60}	3.6265	0.1124	
D_{30}	2.4793	0.0311	
D_{10}	1.5996		
	COEFFICIENTS		
C_c	1.06		
C_u	2.27		

SIEVE number size	PERCENT FINER ○	□	
#4	79.1	100.0	
#10	17.2	99.2	
#16	6.7		
#40	2.6	81.1	
#50	2.2		
#100	1.8	67.6	
#200	1.5	48.1	

Material Description
○ Poorly graded sand with gravel

□ Clayey sand

REMARKS:
○

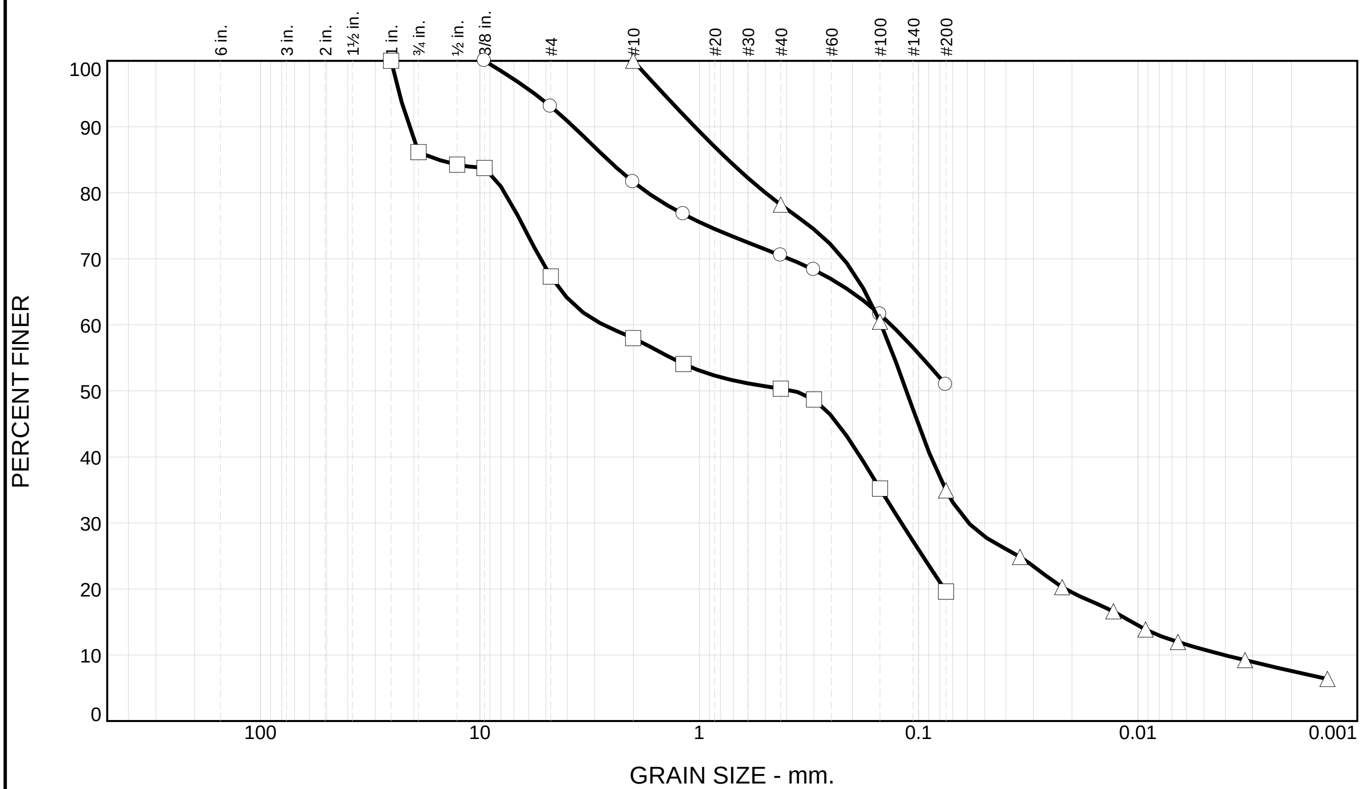
□

○ Source of Sample: CHD1 Depth: 2.5' Sample Number: A
□ Source of Sample: CHD1 Depth: 6.5' Sample Number: B

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	6.9	42.2	50.9		CL-ML			
□	0.0	32.7	47.7	19.6		SC		20	28
△	0.0	0.0	65.1	24.1	10.8	SC-SM		20	24

SIEVE inches size	PERCENT FINER ○	□	△
1		100.0	
3/4		86.2	
1/2		84.3	
3/8	100.0	83.8	
GRAIN SIZE			
D_{60}	0.1333	2.7286	0.1478
D_{30}		0.1197	0.0592
D_{10}			0.0040
COEFFICIENTS			
C_c			5.86
C_u			36.60

SIEVE number size	PERCENT FINER ○	□	△
#4	93.1	67.3	
#10	81.6	58.0	100.0
#16	76.8	54.1	
#40	70.5	50.3	78.2
#50	68.3	48.7	
#100	61.6	35.2	60.5
#200	50.9	19.6	34.9

Material Description

○ Sandy silty clay

□ Clayey sand with gravel

△ Silty, clayey sand

REMARKS:

○

□

△

○ Source of Sample: CHD1 Depth: 10.0' Sample Number: C1

□ Source of Sample: CHD1 Depth: 10.7' Sample Number: C3

△ Source of Sample: CHD1 Depth: 11.2' Sample Number: C4

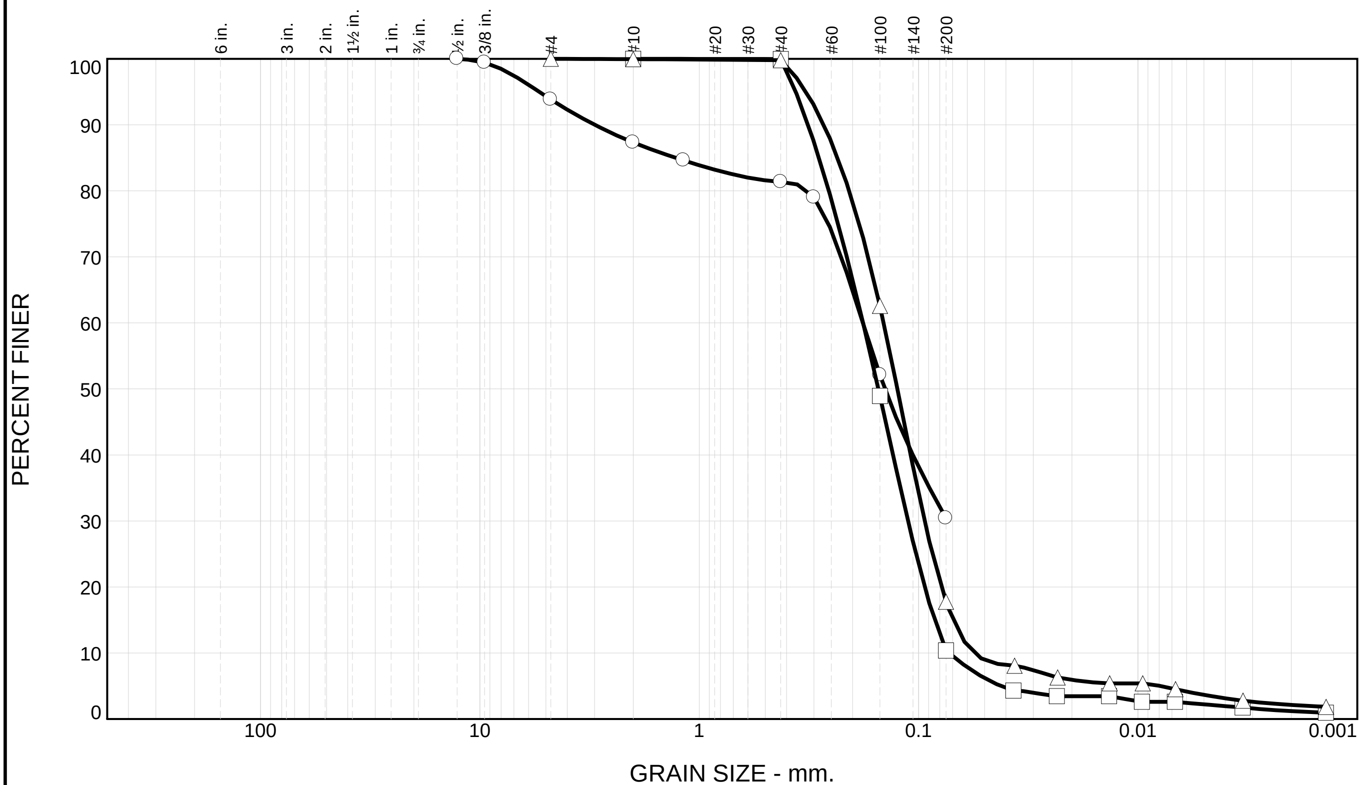
NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower

Project: Cheyenne Ave., Las Vegas

Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	6.2	63.4	30.4		SM		NP	
□	0.0	0.0	89.6	8.2	2.2	SP-SM		NP	
△	0.0	0.0	82.2	14.1	3.7	SM		NP	

SIEVE inches size	PERCENT FINER ○	□	△
1/2	100.0		
3/8	99.4		
GRAIN SIZE			
D_{60}	0.1794	0.1790	0.1442
D_{30}		0.1117	0.0939
D_{10}		0.0727	0.0559
COEFFICIENTS			
C_c		0.96	1.09
C_u		2.46	2.58

SIEVE number size	PERCENT FINER ○	□	△
#4	93.8		100.0
#10	87.3	100.0	100.0
#16	84.6		
#40	81.3	100.0	99.8
#50	79.0		
#100	52.1	48.9	62.6
#200	30.4	10.4	17.8

Material Description
○ Silty sand
□ Poorly graded sand with silt
△ Silty sand

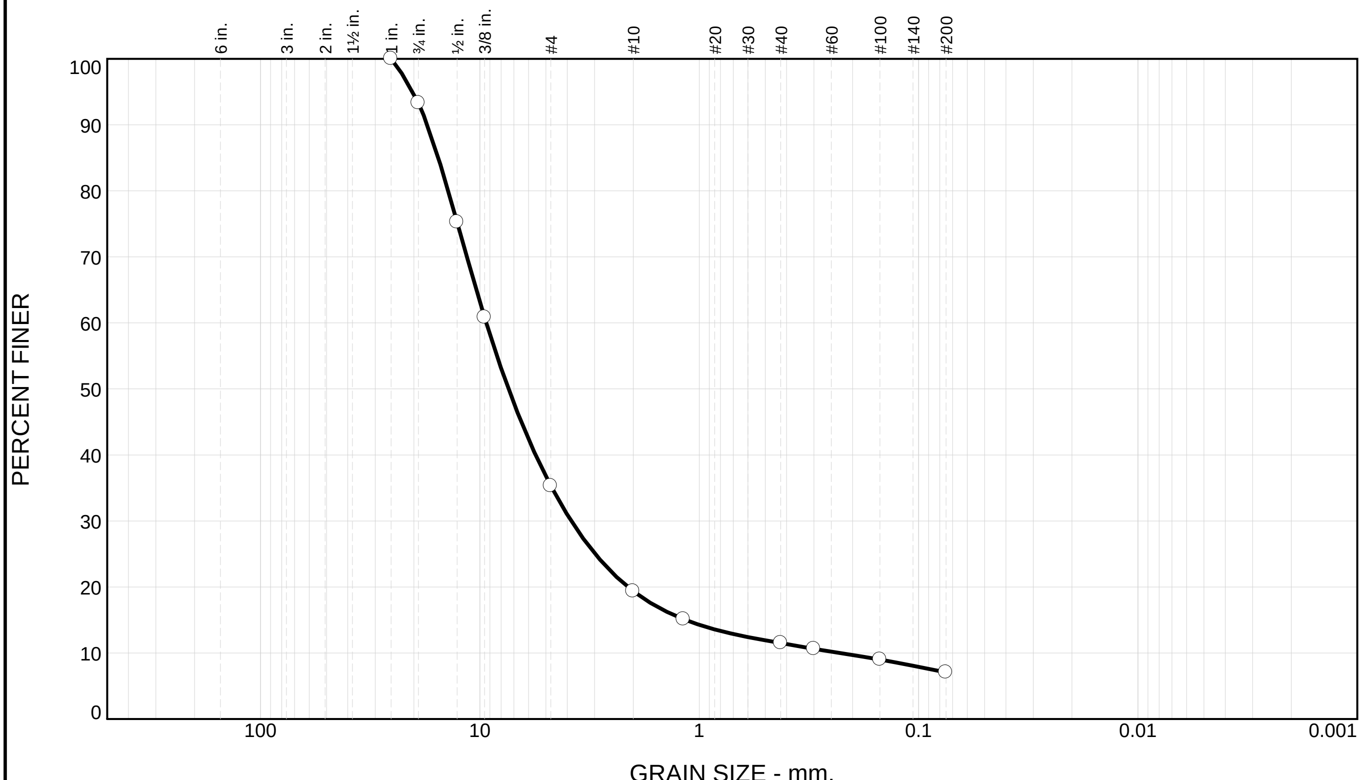
REMARKS:
○
□
△

○ Source of Sample: CHD1 Depth: 15.0' Sample Number: D1
□ Source of Sample: CHD1 Depth: 15.2' Sample Number: D3
△ Source of Sample: CHD1 Depth: 15.6' Sample Number: D10

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	64.7	28.2	7.1		GP-GM			

SIEVE inches size	PERCENT FINER ○		
1	100.0		
3/4	93.3		
1/2	75.3		
3/8	60.8		
	GRAIN SIZE		
D_{60}	9.3593		
D_{30}	3.8353		
D_{10}	0.2291		
	COEFFICIENTS		
C_c	6.86		
C_u	40.86		

SIEVE number size	PERCENT FINER ○		
#4	35.3		
#10	19.4		
#16	15.1		
#40	11.5		
#50	10.6		
#100	9.0		
#200	7.1		

Material Description

○ Poorly graded gravel with silt and sand

REMARKS:

○

○ Source of Sample: CHD2 Depth: 1.0' Sample Number: Bulk1

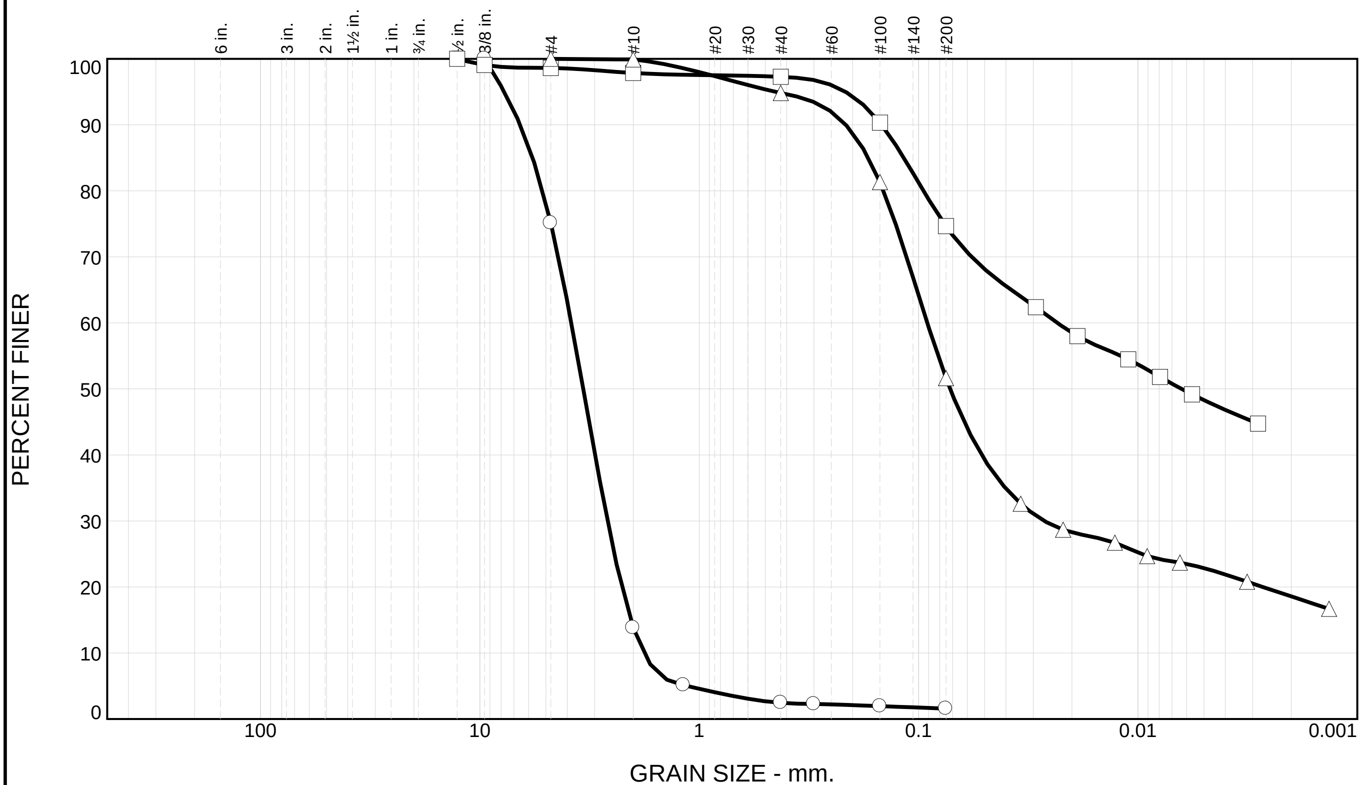
NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower

Project: Cheyenne Ave., Las Vegas

Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	24.9	73.5	1.6		SP			
□	0.0	1.4	23.9	26.4	48.3	CH	A-7-6(52)	28	94
△	0.0	0.0	48.4	28.7	22.9	CL		19	49

SIEVE inches size	PERCENT FINER ○	□	△
1/2		100.0	
3/8	100.0	99.1	
GRAIN SIZE			
D_{60}	3.8329	0.0233	0.0912
D_{30}	2.6208		0.0268
D_{10}	1.7951		
COEFFICIENTS			
C_c	1.00		
C_u	2.14		

SIEVE number size	PERCENT FINER ○	□	△
#4	75.1	98.6	100.0
#10	13.8	97.9	99.9
#16	5.1		
#40	2.5	97.3	94.8
#50	2.3		
#100	2.0	90.3	81.3
#200	1.6	74.7	51.6

Material Description
○ Poorly graded sand with gravel
□ Fat clay with sand
△ Sandy lean clay

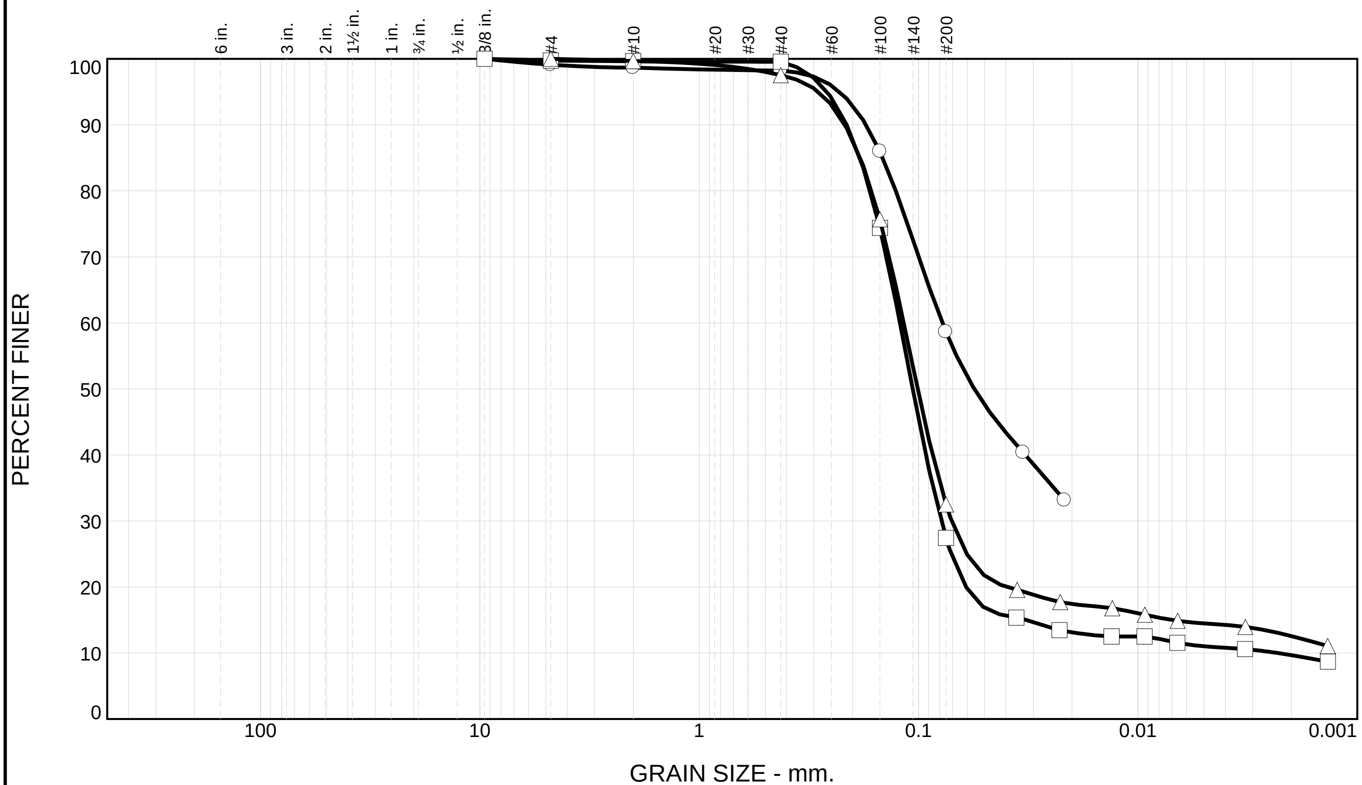
REMARKS:
○
□
△

○ Source of Sample: CHD2 Depth: 5.0' Sample Number: B1
□ Source of Sample: CHD2 Depth: 5.7' Sample Number: B3a
△ Source of Sample: CHD2 Depth: 6.2' Sample Number: B4

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.9	40.5	58.6		CH		19	57
□	0.0	0.3	72.3	16.4	11.0	SM		26	30
△	0.0	0.0	67.5	18.0	14.5	SC		22	32

SIEVE inches size	PERCENT FINER ○	□	△
3/8	100.0	100.0	

GRAIN SIZE	○	□	△
D_{60}	0.0779	0.1215	0.1168
D_{30}		0.0788	0.0707
D_{10}		0.0023	

COEFFICIENTS	○	□	△
C_c		22.26	
C_u		52.86	

SIEVE number size	PERCENT FINER ○	□	△
#4	99.1	99.7	100.0
#10	98.7	99.6	99.7
#40	98.2	99.6	97.5
#100	86.0	74.4	75.7
#200	58.6	27.4	32.5

Material Description
○ Sandy fat clay
□ Silty sand
△ Clayey sand

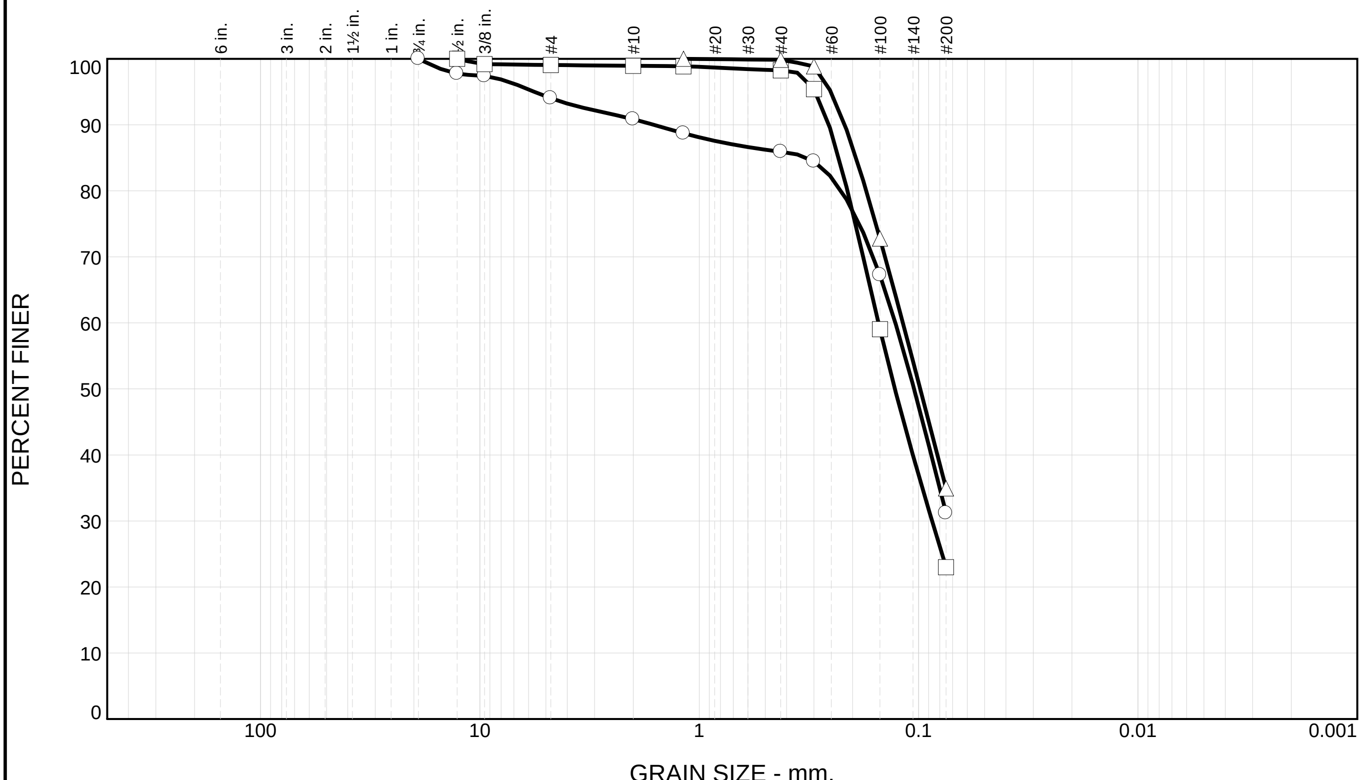
REMARKS:
○
□
△

○ Source of Sample: CHD2 Depth: 7.3' Sample Number: C2a
□ Source of Sample: CHD2 Depth: 7.5' Sample Number: C2c
△ Source of Sample: CHD2 Depth: 7.8' Sample Number: C3

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	6.0	62.8	31.2		SC		23	33
□	0.0	0.9	76.1	23.0		SM		NP	23
△	0.0	0.0	65.1	34.9		SC-SM		21	27

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	PERCENT FINER △
3/4	100.0		
1/2	97.8	100.0	
3/8	97.4	99.2	
	GRAIN SIZE		
D_{60}	0.1275	0.1524	0.1179
D_{30}		0.0868	
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	PERCENT FINER △
#4	94.0	99.1	
#10	90.9	98.9	
#16	88.7	98.9	100.0
#40	85.9	98.3	99.8
#50	84.5	95.4	98.8
#100	67.2	59.1	72.8
#200	31.2	23.0	34.9

Material Description
○ Clayey sand
□ Silty sand
△ Silty, clayey sand

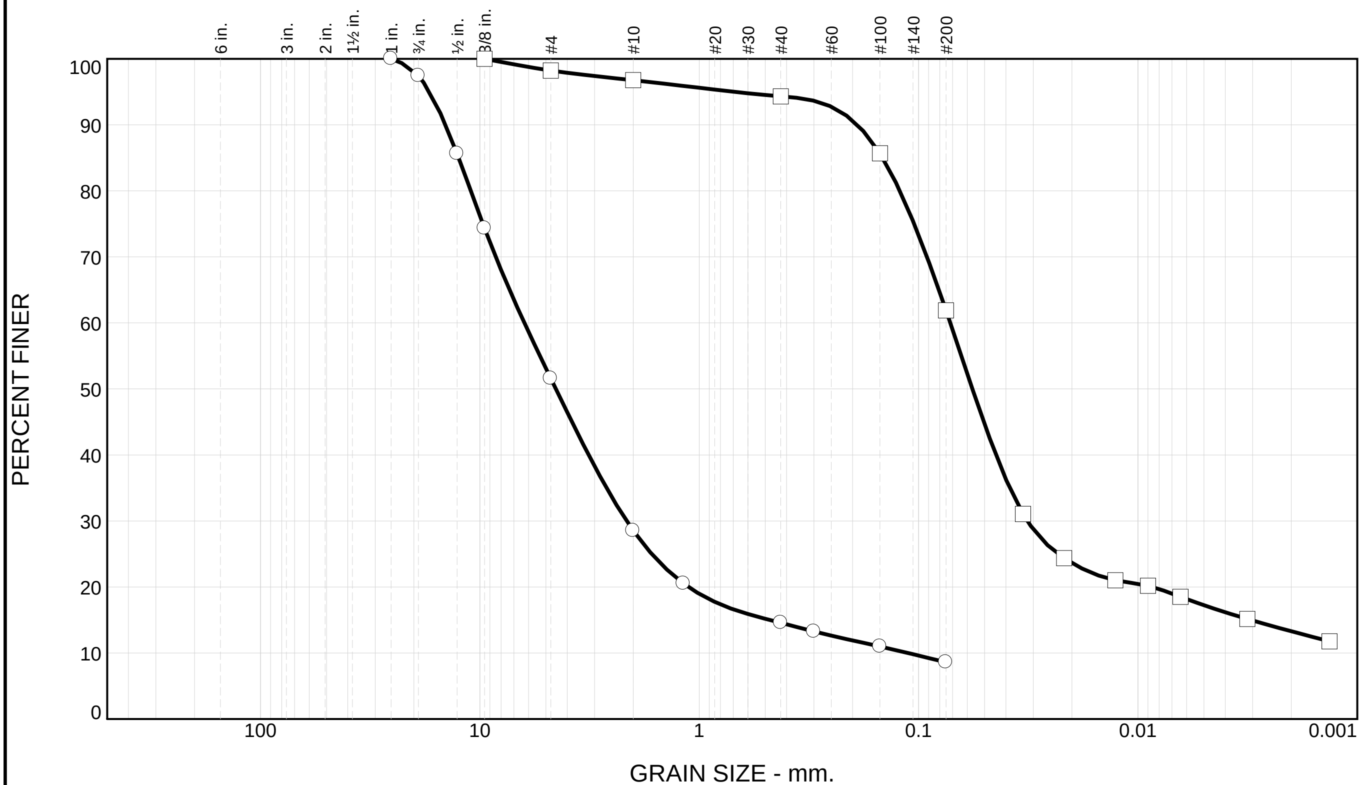
REMARKS:
○
□
△

○ Source of Sample: CHD2 Depth: 9.0' Sample Number: D1
□ Source of Sample: CHD2 Depth: 9.7" Sample Number: D2
△ Source of Sample: CHD2 Depth: 10.5' Sample Number: D3

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	48.4	43.0	8.6		GP-GM			
□	0.0	1.8	36.3	44.7	17.2	CL-ML		19	26

SIEVE inches size	PERCENT FINER ○	□	
1	100.0		
3/4	97.4		
1/2	85.6		
3/8	74.3	100.0	
	GRAIN SIZE		
D_{60}	6.2723	0.0717	
D_{30}	2.1448	0.0319	
D_{10}	0.1119		
	COEFFICIENTS		
C_c	6.56		
C_u	56.07		

SIEVE number size	PERCENT FINER ○	□	
#4	51.6	98.2	
#10	28.5	96.8	
#16	20.5		
#40	14.6	94.3	
#50	13.3		
#100	11.0	85.7	
#200	8.6	61.9	

Material Description

○ Poorly graded gravel with silt and sand

□ Sandy silt

REMARKS:

○

□

○ Source of Sample: CHD3 Depth: 1.0' Sample Number: Bulk1

□ Source of Sample: CHD3 Depth: 6.0' Sample Number: A3

NEVADA DEPARTMENT OF TRANSPORTATION

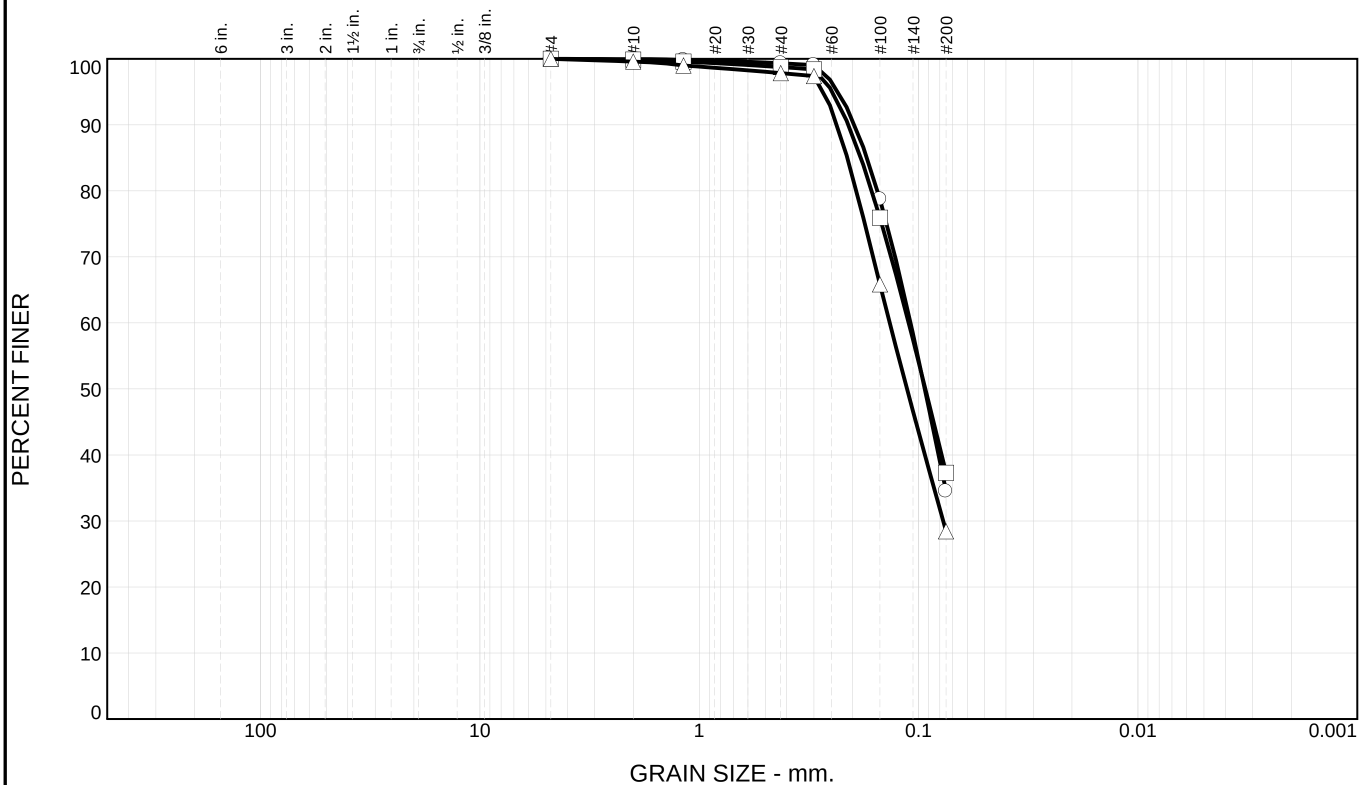
Client: Boomhower

Project: Cheyenne Ave., Las Vegas

Project No.: FL-17-02

Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	65.5	34.5		SM		NP	
□	0.0	0.0	62.7	37.3		SM		NP	
△	0.0	0.0	71.6	28.4		SM		NP	

SIEVE inches size	PERCENT FINER ○	□	△
	GRAIN SIZE		
D_{60}	0.1087	0.1109	0.1354
D_{30}			0.0773
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0	100.0	100.0
#10	100.0	99.9	99.6
#16	99.8	99.6	99.0
#40	99.3	98.7	97.8
#50	99.0	98.4	97.4
#100	78.7	75.9	65.8
#200	34.5	37.3	28.4

Material Description
○ Silty sand
□ Silty sand
△ Silty sand

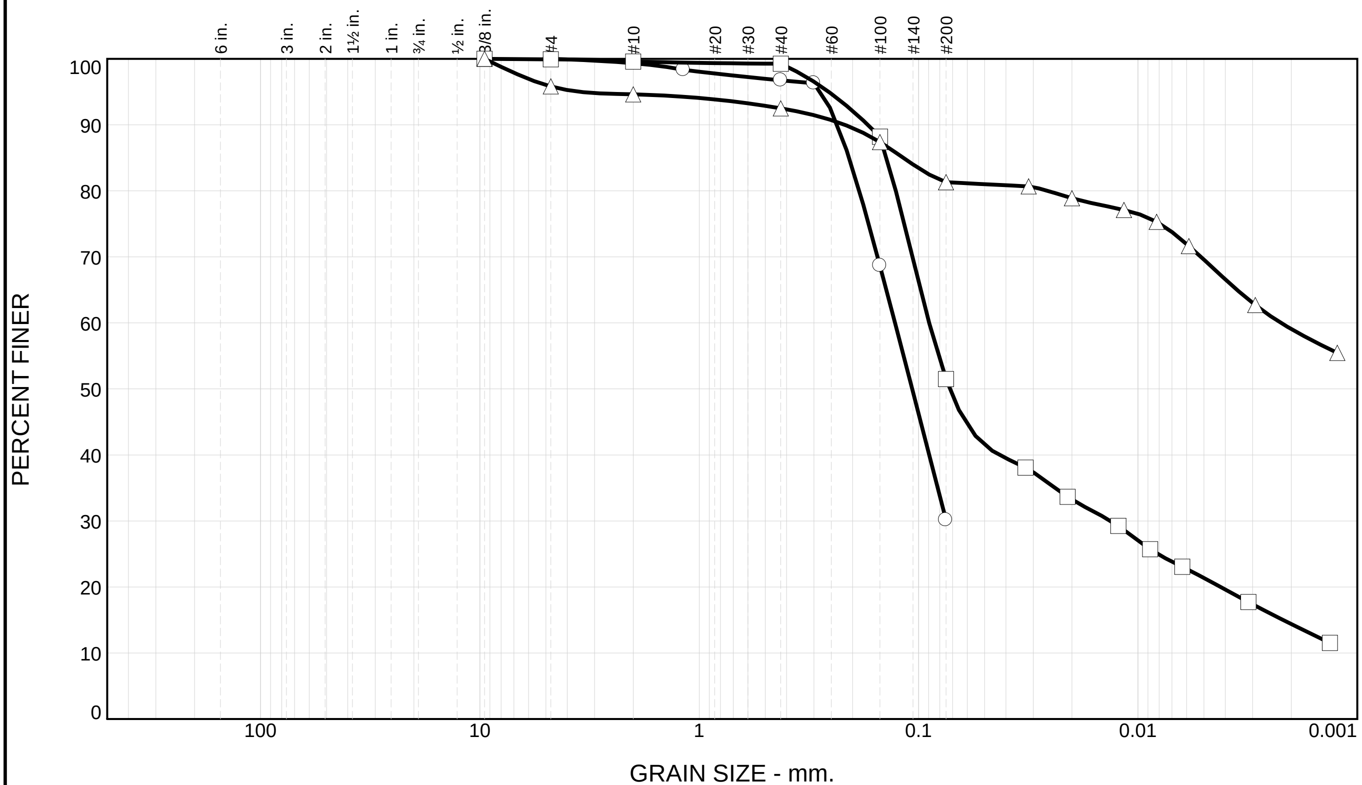
REMARKS:
○
□
△

○ Source of Sample: CHD3 Depth: 8.0' Sample Number: B2
□ Source of Sample: CHD3 Depth: 8.22' Sample Number: B3
△ Source of Sample: CHD3 Depth: 8.63' Sample Number: B4

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	69.9	30.1		SM		NP	23
□	0.0	0.1	48.4	30.1	21.4	CL		19	30
△	0.0	4.2	14.5	11.7	69.6	CH		25	113

SIEVE inches size	PERCENT FINER ○	□	△
3/8		100.0	100.0
GRAIN SIZE			
D_{60}	0.1280	0.0894	0.0022
D_{30}		0.0133	
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#4	100.0	99.9	95.8
#10	99.3	99.6	94.6
#16	98.3		
#40	96.7	99.3	92.5
#50	96.3		
#100	68.7	88.2	87.4
#200	30.1	51.5	81.3

Material Description
○ Silty sand
□ Sandy lean clay
△ Fat clay with sand

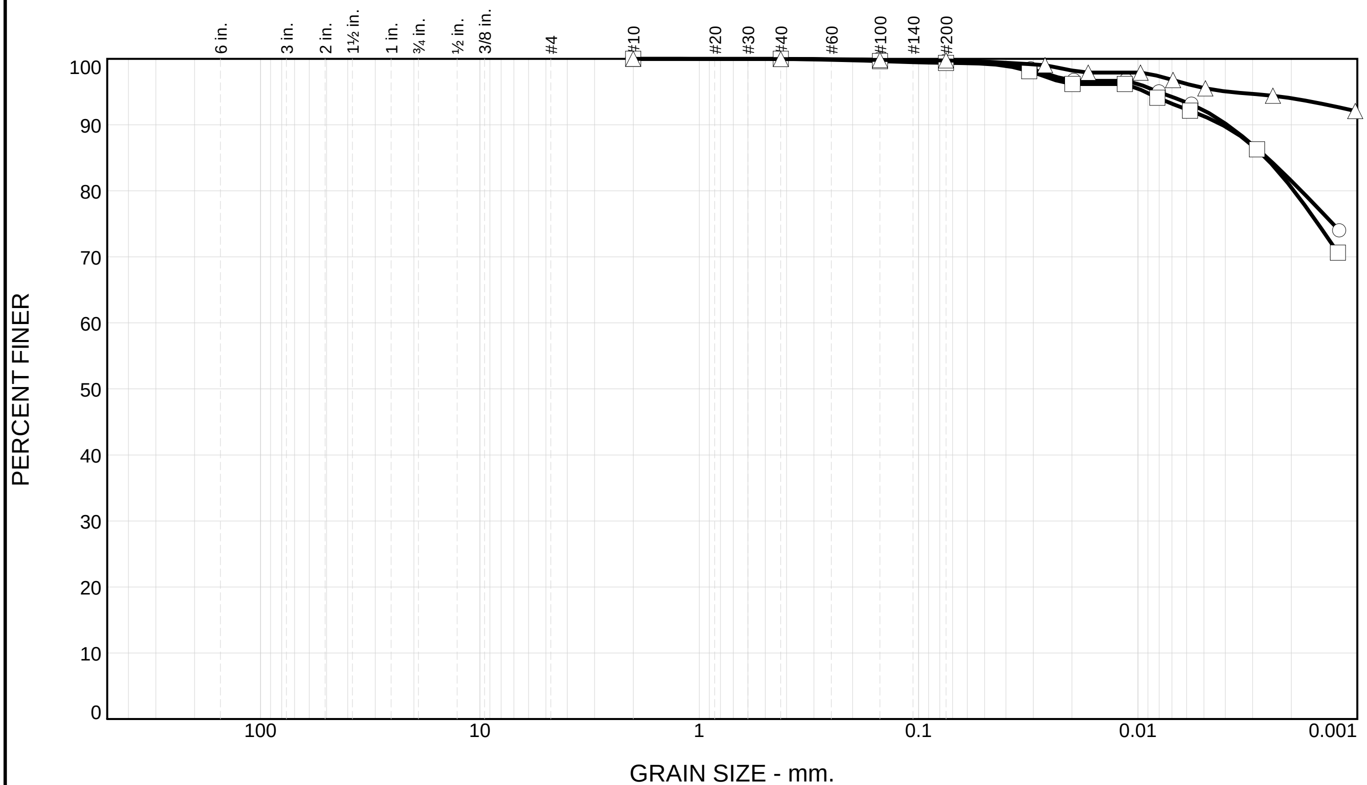
REMARKS:
○
□
△

○ Source of Sample: CHD3 Depth: 8.97' Sample Number: B5
□ Source of Sample: CHD3 Depth: 9.8' Sample Number: C1
△ Source of Sample: CHD3 Depth: 10.5' Sample Number: C2

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	0.5	7.3	92.2	CH		32	144
□	0.0	0.0	0.6	8.1	91.3	CH		32	125
△	0.0	0.0	0.2	4.2	95.6	CH		36	134

SIEVE inches size	PERCENT FINER ○	□	△
GRAIN SIZE			
D_{60}			
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	△
#10	100.0	100.0	100.0
#40	100.0	100.0	100.0
#100	99.9	99.7	99.8
#200	99.5	99.4	99.8

Material Description
○ Fat clay
□ Fat clay
△ Fat clay

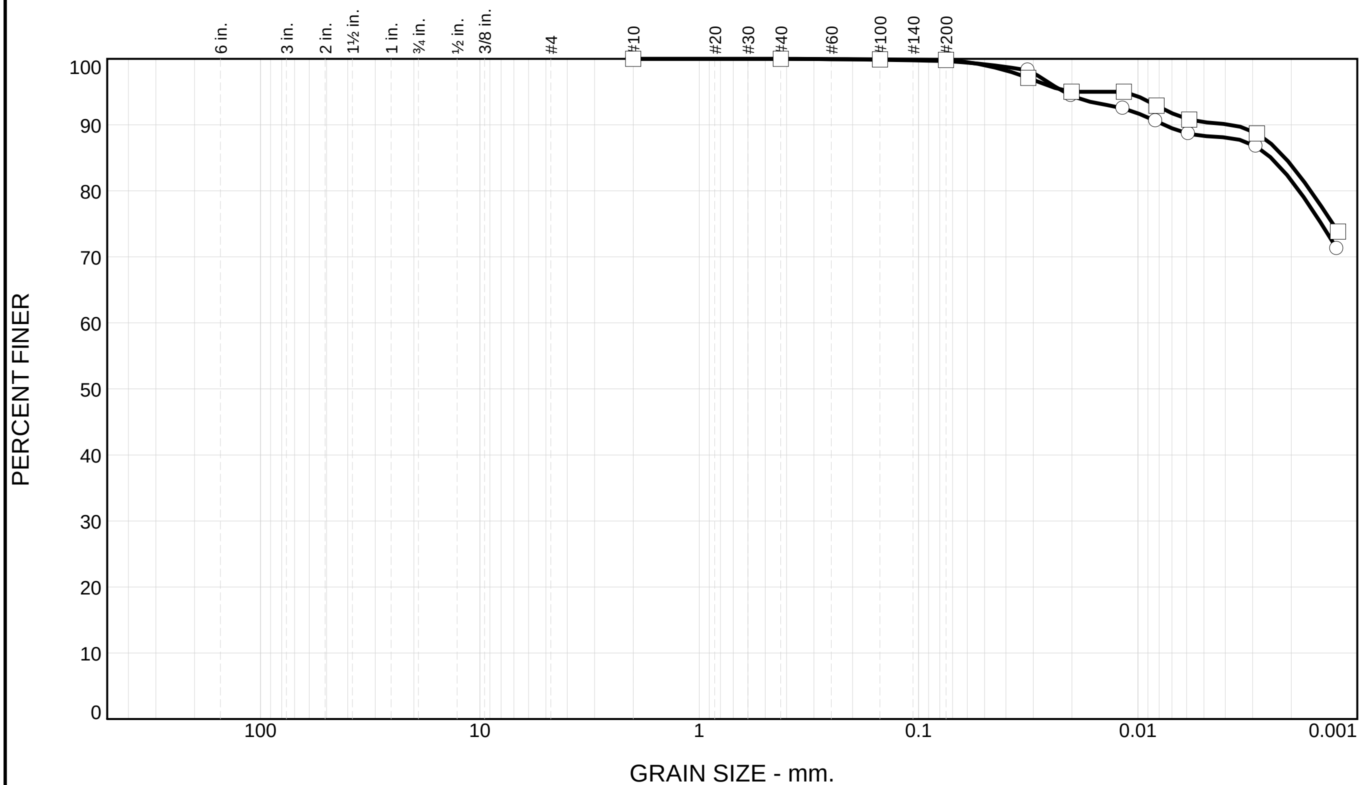
REMARKS:
○
□
△

○ Source of Sample: CHD3 Depth: 14.9' Sample Number: D2a
□ Source of Sample: CHD3 Depth: 15.4' Sample Number: D3
△ Source of Sample: CHD3 Depth: 21.8' Sample Number: F

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

Particle Size Distribution Report



	+3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○	0.0	0.0	0.3	11.4	88.3	CH		27	120
□	0.0	0.0	0.2	9.4	90.4	CH		28	127

SIEVE inches size	PERCENT FINER ○	□	
	GRAIN SIZE		
D_{60}			
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	□	
#10	100.0	100.0	
#40	100.0	100.0	
#100	99.9	99.9	
#200	99.7	99.8	

Material Description
○ Fat clay

□ Fat clay

REMARKS:
○

□

○ Source of Sample: CHD3 Depth: 19.8' Sample Number: E1
□ Source of Sample: CHD3 Depth: 20.8 Sample Number: E10

NEVADA DEPARTMENT OF TRANSPORTATION

Client: Boomhower
Project: Cheyenne Ave., Las Vegas
Project No.: FL-17-02 Figure

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description** Cheyenne Ave. Distress

Boring No. CHD1 **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS per ft.	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak: Φ deg.	Peak: C psi	Residual: Φ deg.	Residual: C psi	OTHERS
Bulk1	1.0 - 1.5			SP-SM			9.3									
A	2.5 - 4.3			SP			1.5									
Bulk2	3.5 - 5.0			SP			3.8									
B	6.5 - 8.0			SC			48.1	38	19	19						
C1	10.0 - 10.2			ML			50.9									
C2	10.2 - 10.7															
C3	10.7 - 11.2			SC	5.8	103.7	19.6	28	20	8						
C4	11.2 - 11.5			SC-SM			34.9	24	20	4						
D	15.0 - 16.3															
D1	1.0"			SM*	8.3		30.4*	18*	NP*	NP*						
D2	2.0"				6.2	87.1										
D3	1.15"			SP-SM*	4.9	91.5	10.4*	19*	NP*	NP*						Hcpot

CMS = California Modified Sampler 2.40" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler
N = Field SPT N = $(N_{css})(0.62)$

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

*** = Average of subsamples**

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description**

Boring No. CHD1 **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS pcf	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak: φ deg.	Peak: C psi	Residual: φ deg.	Residual: C psi	OTHERS
D4	1.1"				3.3											
D5	1.1"				3.2											
D6	1.1"				4.1	90.5										Hcpot
D7	0.5"				6.1											
D8	1.25"				4.3	91.6										Hcpot
D9	1.15"				4.9	92.6										Hcpot
D10	1.1"			SM*	6.0	93.0	17.8*	18*	NP*	NP*						Hcpot
D11	1.1"				7.4	95.1										Hcpot
D12	1.1"				8.4	94.4										Hcpot
D13	1.6"				6.6	94.4										

CMS = California Modified Sampler 2.40" ID
SPT = Standard Penetration 1.38" ID
CS = Continuous Sample 3.23" ID
RC = Rock Core
PB = Pitcher Barrel
CSS = Calif. Split Spoon 2.42" ID
CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
Sh = Shelby Tube 2.87" ID

U = Unconfined Compressive
UU = Unconsolidated Undrained
CD = Consolidated Drained
CU = Consolidated Undrained
DS = Direct Shear
φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

N = Field SPT N = (N_{css})(0.62)

*** = Average of subsamples**

H = Hydrometer
S = Sieve
G = Specific Gravity
PI = Plasticity Index
LL = Liquid Limit
PL = Plastic Limit
NP = Non-Plastic
OC = Consolidation
Ch = Chemical
RV = R - Value
MD = Moisture Density

CM = Compaction
E = Swell/Pressure on Expansive Soils
SL = Shrinkage Limit
UW= Unit Weight
W = Moisture Content
K = Permeability
O = Organic Content
D = Dispersive
RQD = Rock Quality Designation
X = X-Ray Defraction
HCpot = Hydro-Collapse Potential

SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description** Cheyenne Ave. Distress

Boring No. CHD2 **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS ft	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak: φ deg.	Peak: C psi	Residual: φ deg.	Residual: C psi	OTHERS
Bulk1	1.0 - 2.0			GP-GM			7.1									
A	3.5 - 5.0															
B1	5.0 - 5.2			SP			1.6									
B2	5.2 - 5.7															
B3	5.7 - 6.2			CH*			74.7*	94*	28*	66*						
B3a	1.75"				23.3	71.7										Hcpot
B3b	1.1"				48.2	51.2										E
B3c	1.15"				46.0	50.4										E
B3d	1.2"				36.6	60.3										E
B4	6.2 - 6.5			CL			51.6	49	19	30						
C1	6.8 - 7.3															
C2	7.3 - 7.8															

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RC = Rock Core
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CPT = Cone Penetration Test
TP = Test Pit
P = Pushed, not driven
R = Refusal
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U = Unconfined Compressive
UU = Unconsolidated Undrained
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SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description** Cheyenne Ave. Distress

Boring No. CHD2 **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMPLER TYPE	N BLOWS ft	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak φ deg.	Peak C psi	Residual φ deg.	Residual C psi	OTHERS
C2a	1.15"			CH*	23.8	75.4	58.7*	57*	19*	38*						E
C2b	1.1"				20.5	78.8										E
C2c	1.58"			SM*	12.5	83.1	27.4*	30*	26*	4*						
C2d	1.1"				9.0	92.6										Hcpot
C2e	0.75"				8.0											
C3	7.8 - 8.1			SC			32.5	32	22	10						
D	9.0 - 11.0															
D1	8.0"			SC	8.2		31.2	33	23	10						
D2	10.0"			SM	5.5		23.0	23	NP	NP						
D3	5.0"			SC-SM	6.9		34.9	27	21	6						

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SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description** Cheyenne Ave. Distress

Boring No. CHD3 **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS ft	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak φ deg.	Peak C psi	Residual φ deg.	Residual C psi	OTHERS
Bulk1	1.0 - 2.0			GP-GM			8.6									
A1	5.0 - 5.5															
A2	5.5 - 6.0															
A3	6.0 - 6.3			CL-ML			61.9	26	19	7						
B	7.8 - 9.5															
B1	2.25"				5.6											
B2	2.75"			SM	6.1		34.5	19	NP	NP						
B3	5.0"			SM	8.0	104.5	37.3	20	NP	NP						
B4	4.0"			SM	6.4	106.7	28.4	20	NP	NP						
B5	4.1"			SM	7.4	110.0	30.1	23	NP	NP						
C1	9.8 - 10.5			CL			51.5	30	19	11						
C2	10.5 - 11.3			CH			81.3	113	25	88						

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SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description** Cheyenne Ave. Distress

Boring No. CHD3 **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS ft	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak: Φ deg.	Peak: C psi	Residual: Φ deg.	Residual: C psi	OTHERS
D1	14.4 - 14.9															
D2	14.9 - 15.4			CH*			99.5*	144*	32*	112*						
D2a	1.1"				38.3	77.8										E
D2b	1.05"				38.2	79.1										E
D2c	1.1"				37.6	80.5										E
D2d	1.05"				37.5	80.6										E
D2e	1.1"				37.1	81.1										E
D2f	0.25"				36.9											
D3	15.4 - 15.7			CH			99.4	125	32	93						
E	19.8 - 21.8															
E1	1.75"			CH	33.7		99.7	120	27	93						
E2	1.1"				33.5	82.1										E

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Φ = Friction
C = Cohesion
N = No. of blows per ft., sampler

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SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont #

Job Description Cheyenne Ave. Distress

Boring No. CHD3

Elevation (ft)

Station

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS ft	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST: TEST TYPE	Peak: φ deg.	Peak: C psi	Residual: φ deg.	Residual: C psi	OTHERS
E3	1.1"				33.0											
E4	1.5"				33.5	81.4										E
E5	1.5"				34.4	75.3										E
E6	1.2"				36.7	78.0										E
E7	1.1"				37.1	80.5										E
E8	1.1"				36.3	81.2										E
E9	2.0"				36.3	81.6										
E10	1.1"			CH	38.3	78.4	99.8	127		99						E
E11	1.1"				38.4	77.2										E
E12	1.1"				38.8	76.7										E
E13	1.1"				39.1	77.9										E
E14	1.1"				38.9	77.3										E

CMS = California Modified Sampler 2.40" ID	U = Unconfined Compressive	H = Hydrometer	CM = Compaction
SPT = Standard Penetration 1.38" ID	UU = Unconsolidated Undrained	S = Sieve	E = Swell/Pressure on Expansive Soils
CS = Continuous Sample 3.23" ID	CD = Consolidated Drained	G = Specific Gravity	SL = Shrinkage Limit
RC = Rock Core	CU = Consolidated Undrained	PI = Plasticity Index	UW= Unit Weight
PB = Pitcher Barrel	DS = Direct Shear	LL = Liquid Limit	W = Moisture Content
CSS = Calif. Split Spoon 2.42" ID	φ = Friction	PL = Plastic Limit	K = Permeability
CPT = Cone Penetration Test	C = Cohesion	NP = Non-Plastic	O = Organic Content
TP = Test Pit	N = No. of blows per ft., sampler	OC = Consolidation	D = Dispersive
P = Pushed, not driven		Ch = Chemical	RQD = Rock Quality Designation
R = Refusal	N = Field SPT $N = (N_{css})(0.62)$	RV = R - Value	X = X-Ray Defraction
Sh = Shelby Tube 2.87" ID		MD = Moisture Density	HCpot = Hydro-Collapse Potential

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SUMMARY OF RESULTS
N.D.O.T. GEOTECHNICAL SECTION

EA/Cont # **Job Description**

Boring No. **Elevation (ft)** **Station**

SAMPLE NO.	SAMPLE DEPTH (ft)	SAMP-LER TYPE	N BLOWS ft	SOIL GROUP	W%	DRY UW pcf	% PASS #200	LL %	PL %	PI %	STRENGTH TEST					OTHERS
											TEST TYPE	Peak φ deg.	Peak C psi	Residual φ deg.	Residual C psi	
E15	1.1"				39.0	77.7										E
E16	1.1"				39.3	77.8										E
E17	1.1"				39.7	78.0										E
E18	1.03"				39.0	77.5										
F	21.8 - 23.3			CH			99.8	134	36	98						

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APPENDIX D

Minimum Requirements for Geomembrane.

PROPERTY	TEST METHOD	UNITS	REQUIREMENTS
Grab Tensile Strength	ASTM D-4632	Newtons	665
Elongation	ASTM D-4632	percent	40
Seam Strength	ASTM D-4632	Newtons	710
Puncture Strength	ASTM D-4833	Newtons	355
Mullen Burst Strength	ASTM D-3786	kiloPascals	1790
Trapezoidal Tear Strength	ASTM D-4533	Newtons	200
Abrasion Resistance	ASTM D-4886	percent	75
Coefficient of Permeability	ASTM D-4491	cm per second	0
Flow Rate	ASTM D-4491	$m^3/min \cdot m^2$	0
Permittivity	ASTM D-4491	$second^{-1}$	0
Thickness	ASTM D-1777	mm	1.27
Weight	ASTM D-3776	$grams/m^2$	305